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EFFECT OF SOME HOLSTEIN FOALS BIRTH BODY MEASUREMENTS ON LATER DEVELOPMENT

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Abstract

The aim of the investigations was to determine body measurements effect in some phases of Holstein foals growth and development on their later development and sport integration.

Twenty-five Holstein breed foals were measured from birth to the age of three years in the north-west part of the Republic of Croatia. Data consist of four height body measurements: withers height, back height, small of the back height as well as the tail root. Foals measuring was carried out after birth at the age of 1, 2, 3, 4, 5, 6, 12, 18, 24, 30 and 36 months. Lydt stick was used for measuring (withers height was taken by the cattle tape measure). Measures were processed by the statistical program SPSS/PC (Nie et al. 1975). Correlations of the above mentioned traits between some age groups were calculated on the basis of achieved values. The investigation results of withers height growth intensity, back height, small of the back height and tail root height indicate higher intensity in the first postbirth months decreasing with aging. In the first postbirth year increase of all four properties above mentioned ranged from 34.67% to 37.89% compared to postbirth measurements. The above quoted body measurements increased by 41.14%-46.9% at the age of 2 years whereas at the age of three years this increase ranged from 47.05% to 53.44% compared to quoted measurements obtained by postbirth measuring. Values of the above mentioned investigations indicate that foals birth size of withers height, back height, small of the back height as well as tail root height effect positively their later development. Attained correlation coefficient values of the quoted properties are positive and they range between $r = 0.250$ and $r = 0.998^{**}$.

Key words: holstein foals; birth body measurements; development; correlation.

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Introduction

Growth intensity of horse offspring is very significant for horse breeders. Apart from hereditary factors, paragenetic ones also affect body growth and development. Understanding the above mentioned factors influence on growth and development of some horse offspring body dimensions enables successful selection by choosing horses best suitable to established breeding goal.

Horses growing faster at the beginning can be trained earlier whereby their active competition participation is possible. According to Svechina et al. (1974) the fastest three - year racing horses were those growing faster.

Green (1961) claimed that withers height and cannon bone circumference were the most reliable indicators of horse offspring development.

Most former investigations were mainly based on withers height, chest girth and cannon bone circumference. Recent genetic statistical analysis of the holstein and other traits of riding horse breeds were done by Rastija et al. (1999, 2000, 2001), Brockmann et al. (2000), Bösch et al. (2000), Hassenstein et al. (1999a and b). Aimed at achieving the most reliable assessment of offspring development we measured back height, small of the back height and tail root height.

The aim of this paper was to determine height measurements growth harmony of Holstein breed foals in north-west part of the Republic of Croatia.

Material and methods

The investigation data refer to body measurements of 25 Holstein breed foals in north-west part of Croatia. Measurings of withers height, back height, small of the back height and tail root height were done by Lydtin stick after birth, at the age of 1, 2, 3, 4, 5, 6, 12, 18, 24, 30 and 36 months. Collected data of the performed measurings were processed by a statistical program SPSS/PC (Nie et al. 1975). Based on achieved values, correlations of the above mentioned properties among some age groups were computed. Statistical significance of coefficients was tested by "t" test at significance level of 5 and 1%.

Results and discussion

The investigation results in Tables 1, 2, 3 and 4 indicate higher growth intensity of withers height, back height, small of the back height and tail root in the first postbirth months decreasing later.

Table 1. - WITHERS HEIGHT OF DEVELOPING HOLSTEIN BREED FOALS (BY STICK), CM

Tablica 1. - VISINA GREBENA ŽDREBADI HOLŠTAIN PASMINE U RAZVITKU (ŠTAPOM), CM

Age - Dob	Statistical parameters – Statistički parametri					
	$\bar{x}$	s	V	Min.	Max.	%
Birth - Porod	106.67	10.87	10.20	76.00	118.00	100.00
1st month - 1. mjesec	114.83	7.60	6.62	95.00	120.00	107.49
2nd month - 2. mjesec	119.67	6.98	5.83	101.00	132.00	112.19
3rd month- 3. mjesec	124.00	6.23	5.02	108.00	138.00	116.25
4th month- 4. mjesec	128.50	6.16	4.79	114.00	140.00	120.46
5th month- 5. mjesec	131.50	5.75	4.37	118.00	146.00	123.28
6th month- 6. mjesec	134.50	4.09	3.04	121.00	148.00	126.09
1 year - 1. godina	145.00	5.33	3.68	136.00	158.00	135.93
1.5 year - 1.5 godina	152.33	5.71	3.75	141.00	158.00	142.80
2 years - 2. godina	156.67	5.82	3.71	149.00	168.00	146.87
2.5 years - 2.5 godine	159.33	6.15	3.86	151.00	170.00	149.37
3 years - 3. godina	163.67	5.50	3.36	157.00	172.00	153.44

Table 2. - BACK HEIGHT OF DEVELOPING HOLSTEIN BREED FOALS, CM

Tablica 2. - VISINA LEĐA ŽDREBADI HOLŠTAIN PASMINE U RAZVITKU, CM

Age - Dob	Statistical parameters – Statistički parametri					
	$\bar{x}$	s	V	Min.	Max.	%
Birth - Porod	103.83	8.16	7.86	74.00	110.00	100.00
1st month - 1. mjesec	110.00	7.59	6.90	92.00	117.00	105.92
2nd month - 2. mjesec	115.83	6.58	5.68	98.00	127.00	111.56
3rd month- 3. mjesec	121.00	5.59	4.62	105.00	130.00	116.54
4th month- 4. mjesec	125.17	5.27	4.21	111.00	135.00	120.55
5th month- 5. mjesec	129.83	6.27	4.83	115.00	144.00	125.04
6th month- 6. mjesec	133.17	6.79	5.10	119.00	143.00	128.26
1 year - 1. godina	141.50	4.04	2.85	131.00	150.00	136.28
1.5 year- 1.5 godina	145.83	6.40	4.39	135.00	152.00	140.45
2 years - 2. godina	149.67	7.23	5.03	143.00	160.00	144.15
2.5 years - 2.5 godine	152.17	7.19	4.73	141.00	161.00	146.56
3 years - 3. godina	155.00	5.40	3.49	148.00	163.00	149.28

Table 3. - SMALL OF THE BACK HEIGHT OF DEVELOPING HOLSTEIN BREED FOALS, CM
Tablica 3. - VISINA KRIŽA ŽDREBADI HOLŠTAIN PASMINE U RAZVITKU, CM

Age - Dob	Statistical parameters – Statistički parametri					
	$\bar{x}$	s	V	Min.	Max.	%
Birth -Porod	107.33	12.82	11.94	76.00	116.00	100.00
1st month - 1. mjesec	115.50	8.78	7.60	98.00	126.00	104.30
2nd month - 2. mjesec	122.50	8.50	6.94	103.00	133.00	114.30
3rd month- 3. mjesec	127.00	8.81	6.94	110.00	136.00	118.33
4th month- 4. mjesec	132.83	7.88	5.94	113.00	139.00	123.76
5th month- 5. mjesec	136.83	6.18	4.51	117.00	145.00	127.49
6th month- 6. mjesec	139.67	6.95	4.97	121.00	151.00	130.13
1 year - 1. godina	148.00	5.73	3.87	137.00	153.00	137.89
1.5 year- 1.5 godina	153.17	8.03	5.25	139.00	160.00	142.71
2 years - 2. godina	157.67	5.75	3.65	147.00	165.00	146.90
2.5 years - 2.5 godine	160.00	6.51	4.07	149.00	167.00	149.07
3 years - 3. godina	162.00	7.07	4.36	152.00	170.00	150.94

Table 4. - TAIL ROOT HEIGHT OF DEVELOPING HOLSTEIN BREED FOALS
Tablica 4. - VISINA KORIJENA REPA ŽDREBADI HOLŠTAIN PASMINE U RAZVITKU

Age - Dob	Statistical parameters – Statistički parametri					
	$\bar{x}$	s	V	Min.	Max.	%
Birth -Porod	105.00	21.51	20.45	73.00	111.00	100.00
1st month - 1. mjesec	111.60	17.90	16.04	90.00	115.00	106.29
2nd month - 2. mjesec	119.00	15.13	12.72	94.00	127.00	113.33
3rd month- 3. mjesec	123.80	15.04	12.15	103.00	133.00	117.90
4th month- 4. mjesec	128.80	13.70	10.64	106.00	135.00	122.67
5th month- 5. mjesec	134.00	11.22	8.38	110.00	141.00	127.62
6th month- 6. mjesec	138.00	11.51	8.34	122.00	146.00	131.43
1 year - 1. godina	141.40	8.26	5.84	129.00	148.00	134.67
1.5 year- 1.5 godina	143.40	7.09	4.95	132.00	147.00	136.57
2 years - 2. godina	148.20	7.19	4.85	138.00	153.00	141.14
2.5 years - 2.5 godine	149.00	6.20	4.16	139.00	157.00	141.90
3 years - 3. godina	154.40	5.98	3.88	145.00	160.00	147.05

The quoted body measurements growth ranged from 26.09% to 31.43% compared to postbirth size. At age of 1 year this growth increased between

34.67% and 37.89% compared to postbirth size. The second year was characterized by slight growth ranging between 41.14% at tail root height and 46.90% at small of the back height compared to postbirth height. In the third year postbirth growth intensity was even slower ranging between 47.05% at tail root height and 53.44% at withers height. Investigations by Romić (1951) on Lipizzaner offspring development, (1965) on Posavian horse development as well as Croatian draft horse (1975) indicate higher growth intensity in the first postbirth months decreasing with aging. Rastija et al. (1986 and 1995) and Stipić (1980) obtained approximate values in their Lipizzaner foal investigations. Values of the investigations carried out by the above mentioned authors are in accordance with our investigation values.

Attained values on correlations among Holstein breed foals withers height of diverse age structures could be seen in Table 5.

Table 5. - CORRELATION OF DEVELOPING HOLSTEIN BREED FOALS' WITHERS HEIGHT (BY STICK)

Tablica 5. - KORELACIJA VISINE GREBENA ŽDREBADI U RAZVITKU HOLŠTAIN PASMINE (ŠTAPOM)

Age Dob	3 years 3. god.	2.5 years 2.5 god.	2 years 2. god.	1.5 year 1.5 god.	1 year 1. god.	6th month 6. mjes.	5th month 5. mjes.	4th month 4.mjes	3rd mont 3.mjes.	2nd month 2. mjes.	1st month 1.mjes
Birth Porod	0.556	0.423	0.535	0.855*	0.549	0.810	0.927**	0.872*	0.933**	0.873*	0.819*
1st month 1. mjesec	0.462	0.446	0.424	0.890*	0.553	0.705	0.862*	0.819*	0.942**	0.987**	
2nd month 2. mjesec	0.445	0.450	0.470	0.916*	0.559	0.709	0.882*	0.852*	0.976**		
3rd month 3. mjesec	0.531	0.511	0.557	0.944**	0.602	0.770	0.915*	0.907*			
4th month 4. mjesec	0.797	0.802	0.843*	0.983**	0.872*	0.934**	0.968**				
5th month 5. mjesec	0.765	0.684	0.729	0.949**	0.796	0.948**					
6th month 6. mjesec	0.925**	0.803	0.816*	0.873*	0.882*						
1 year 1. godina	0.894*	0.976**	0.961**	0.817*							
1.5 year 1.5 godina	0.710	0.758	0.780								
2 years 2 godine	0.839*	0.959**									
2.5 years 2.5 godine	0.884*										
3 years 3. godine											

* P<0.05
** P<0.01

Presented investigations indicate positive correlation ranging from middle to complete one with correlation coefficients between r = 0.424 and r = 0.987**. It could be said that correlation between closer age groups is more intensive than between remote ones. According to achieved correlation values presented in Table 5 it can be seen that there is a highly significant correlation with numerous closer age groups, a significant correlation with slightly remote whereas a positive (but not significant) correlation was found with the most remote age groups. Saastamoinen (1990) claimed that positive correlation increase occured in withers height. According to investigations carried out by Saastamoinen (1990) withers height correlation was more intensive between closer age groups than between remote ones which is in accordance with our investigations. Mc Canne et al (1988) stated that correlation increase between foal measurements varied between r = 0.34 and r = 0.74 whereas this correlation (based on investigation data by Hintza et al. 1979) ranged between r = 0.38 and r = 0.71 in the first postbirth year.

Table 6. - CORRELATION OF DEVELOPING HOLSTEIN BREED FOALS' BACK HEIGHT
Tablica 6. - KORELACIJA VISINE LEĐA U RAZVITKU ŽDREBADI HOLŠTAIN PASMINE

Age Dob	3 years 3. god.	2.5 years 2.5 god.	2 years 2. god.	1.5 year 1.5 god.	1 year 1. god.	6th month 6. mjes.	5th month 5. mjes.	4th month 4.mjes	3rd mont 3.mjes.	2nd month 2. mjes.	1st month 1.mjes
Birth Porod	0.250	0.345	0.719	0.631	0.568	0.603	0.816*	0.838*	0.869*	0.915*	0.946**
1st month 1. mjesec	0.380	0.516	0.795	0.753	0.731	0.655	0.899*	0.955**	0.934**	0.976**	
2nd month 2. mjesec	0.461	0.520	0.797	0.787	0.786	0.752	0.929**	0.975**	0.984**		
3rd month 3. mjesec	0.576	0.557	0.823*	0.850*	0.843*	0.854*	0.964**	0.972**			
4th month 4. mjesec	0.597	0.674	0.869*	0.879*	0.888*	0.776	0.957**				
5th month 5. mjesec	0.696	0.656	0.879*	0.940**	0.896*	0.906*					
6th month 6. mjesec	0.774	0.527	0.733	0.879*	0.820*						
1 year 1. godina	0.889*	0.892*	0.928**	0.971**							
1.5 year 1.5 godina	0.885*	0.848*	0.941**								
2 years 2 godine	0.806	0.887*									
2.5 years 2.5 godine	0.869*										
3 years 3. godine											

* P<0.05
** P<0.01

Correlation of Holstein breed foals back height measured in various age structures was positive and ranged from low to complete with correlation coefficients between r = 0.250 and r = 0.984**. From Table 6 it could be seen that there was a more intensive correlation between closer than between remote age structures.

Highly significant and significant values were determined at closest age structure whereas positive correlation was somewhat lower at remote age structure.

Correlation of back height is, according to its values, in accordance with correlation coefficient values by withers height

Correlation among Holstein foals' small of the back height of diverse age groups is presented in Table 7.

Table 7. - CORRELATION OF DEVELOPING HOLSTEIN BREED FOALS' SMALL OF THE BACK HEIGHT

Tablica 7. - KORELACIJA VISINE KRIŽA ŽDREBADI HOLŠTAIN PASMINE U RAZVITKU

Age Dob	3 years 3. god.	2.5 years 2.5 god.	2 years 2. god.	1.5 year 1.5 god.	1 year 1. god.	6th month 6. mjes.	5th month 5. mjes.	4th month 4.mjes	3rd mont 3.mjes.	2nd month 2. mjes.	1st month 1.mjes
Birth Porod	0.538	0.726	0.802	0.817*	0.744	0.583	0.827*	0.949**	0.919*	0.936**	0.903*
1st month 1. mjesec	0.325	0.563	0.701	0.753	0.517	0.590	0.839*	0.911*	0.964**	0.939**	
2nd month 2. mjesec	0.469	0.661	0.720	0.833*	0.665	0.660	0.904*	0.974**	0.983**		
3rd month 3. mjesec	0.485	0.673	0.750	0.856*	0.662	0.742	0.944**	0.976**			
4th month 4. mjesec	0.642	0.802	0.845*	0.929**	0.802	0.747	0.944**				
5th month 5. mjesec	0.632	0.736	0.753	0.899*	0.757	0.916*					
6th month 6. mjesec	0.655	0.654	0.622	0.786	0.704						
1 year 1. godina	0.958**	0.971**	0.905*	0.917*							
1.5 year 1.5 godina	0.855*	0.948**	0.945**								
2 years 2 godine	0.861*	0.967**									
2.5 years 2.5 godine	0.956**										
3 years 3. godine											

* P<0.05

** P<0.01

The above mentioned values indicate positive effect of small of the back height at diverse age measuring. Correlations ranged from low to complete with correlation coefficients from r = 0.325 to r = 0.983**. The lowest correlation was determined between measurements obtained by measuring at the age of 1 month and 3 years whereas the highest correlation coefficient was determined between two month and three month old foals. Significant and highly significant values were determined at numerous age groups, especially closer ones.

Table 8 shows correlation coefficient values among diverse age groups of tail root height.

Table 8. - CORRELATION OF DEVELOPING HOLSTEIN BREED FOALS' TAIL ROOT HEIGHT
Tablica 8. - KORELACIJA VISINE KORIJENA REPA HOLŠTAIN ŽDREBADI U RAZVITKU

Age Dob	3 years 3. god.	2.5 years 2.5 god.	2 years 2. god.	1.5 year 1.5 god.	1 year 1. god.	6th month 6. mjes.	5th month 5. mjes.	4th month 4.mjes	3rd mont 3.mjes.	2nd month 2. mjes.	1st month 1.mjes
Birth Porod	0.485	0.790	0.759	0.937*	0.905*	0.840	0.943*	0.977**	0.989**	0.993**	0.992**
1st month 1. mjesec	0.399	0.727	0.671	0.917*	0.911*	0.851	0.958*	0.984**	0.993**	0.998**	
2nd month 2. mjesec	0.411	0.730	0.685	0.925*	0.916*	0.825	0.946*	0.985**	0.985**		
3rd month 3. mjesec	0.432	0.761	0.692	0.915*	0.900*	0.892*	0.970**	0.974**			
4th month 4. mjesec	0.498	0.779	0.663	0.966*	0.970**	0.877	0.975**				
5th month 5. mjesec	0.495	0.782	0.604	0.939*	0.954*	0.958*					
6th month 6. mjesec	0.559	0.805	0.565	0.870	0.878						
1 year 1. godina	0.598	0.804	0.604	0.978**							
1.5 year 1.5 godina	0.702	0.898*	0.758								
2 years 2 godine	0.776	0.891*									
2.5 years 2.5 godine	0.909*										
3 years 3. godine											

* P<0.05
** P<0.01

Attained values indicate positive correlation whose values ranged from low to complete with correlation coefficients between r = 0.399 and r = 0.998**. The weakest correlation occured between one month and three year old foals with correlation coefficient being r = 0.399 whereas the highest correlation was between one month and two month old foals with correlation coefficient r = 0.998**.

Conclusion

On the basis of the performed investigation on birth size effect on later development of Holstein breed foals the following conclusions could be drawn:

Growth intensity of processed body measurements is the highest in the first postbirth months decreasing with aging.

Correlation of withers height between foals age structures was positive and ranged from medium to complete one.

Correlation coefficients of back height of diverse age Holstein breed foals ranged from r = 0.250 to r = 0.984**.

Small of the back height of Holstein foals at birth had positive influence on later development.

Correlation between Holstein breed foals tail root height of different age ranged from middle to complete one.

It was determined that correlation was higher between closer than between remote age structures in all investigated indicators.

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UTJECAJ NEKIH TJELESNIH MJERA PRI ROĐENJU NA KASNIJI RAZVITAK HOLŠTAJN ŽDREBADI

Sažetak

Cilj obavljenih istraživanja bio je utvrditi utjecaj tjelesnih mjera u određenim fazama rasta i razvitka holštain ždrebadi na njihov kasniji razvitak i uključivanje u sport.

Istraživanjima je obrađeno 25 ždrebadi holštain pasmine od poroda do navršene tri godine u sjeverozapadnom području Republike Hrvatske. Podaci se sastoje od četiri visineske tjelesne mjere i to: visina grebena, visina leđa, visina križa i visina korijena repa. Mjerenja ždrebadi su obavljena nakon poroda, te u dobi od 1, 2, 3, 4, 5, 6, 12, 18, 24, 30 i 36 mjeseci. Za mjerenje se koristio Lydtinov štap (a visinu grebena smo izrazili i sa stočnom vrpcom). Dobivene vrijednosti obrađene su statističkim programom SPSS/PC (Nie i sur. 1975.). Na temelju dobivenih vrijednosti izračunata je i korelacijska povezanost navedenih svojstava između pojedinih dobnih skupina. Rezultati istraživanja intenziteta rasta visine grebena, visine leđa, visine križa i visine korijena repa

ukazuju na jači intenzitet u prvim mjesecima iza poroda, koji starenjem opada. U prvoj godini iza poroda za sva četiri navedena svojstva povećanje se kretalo od 34,67% do 37,89% u odnosu na mjere nakon poroda. U dobi od dvije godine navedene tjelesne mjere su se povećale za 41,14% do do 46,9%, a na kraju treće godine života, porast se kretao od 47,05 do 53,44% u odnosu na navedene visine dobivene mjerenjem nakon poroda. Vrijednosti navedenih istraživanja pokazuju da porodna veličina visine grebena, visine leđa, visine križa i visine korijena repa ždrebadi ima pozitivan utjecaj na njihov kasniji razvitak. Dobivene vrijednosti korelacijskih koeficijenata za navedena svojstva su pozitivne, a kretale su se od r = 0,250 do r = 0,998**.

Ključne riječi: holštain ždrebad, porodne tjelesne mjere, razvitak, korelacija

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