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Length of Pregnancy as a Factor Determining Physiological Lowering of Body Mass of Newborns

Długość ciąży jako czynnik determinujący fizjologiczne obniżenie masy ciała noworodka

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Abstract

Material and Methods. In the paper the group of 759 newborns was analysed. The material was divided into three groups depending on the length of pregnancy: first group – pregnancy shorter then 265 days, second group – pregnancy between 269 and 294 days, third group – pregnancy over 295 days. In the groups the following parameters of newborns were taken into account: birth body length, birth body mass, the day of achieving the minimum body mass, maximum lowering of body mass. In order to make the analysis more objective, two additional normalised parameters were introduced: relative maximum of lowering the body mass and relative day of achieving the minimum body mass. Statistical analysis for all parameters was performed using STATISTICA 5.5 programme. The main results were obtained using the variance analysis.

Results. On the basis of the obtained results the following conclusions have been made. The newborns from the short pregnancy, in average, achieved minimum body mass on the 4th day after delivery whereas the newborns from the normal and long pregnancy, one day earlier. The analysis of the corresponding relative parameter makes this conclusion even stronger. The maximum lowering of body mass, taken in absolute values, does not show the statistically significant differences for the newborns from the pregnancies of different length. The analysis of the corresponding relative parameter shows that the relative lowering of body mass is greater for the newborns from the short pregnancy then for those born in time or later (**Adv Clin Exp Med. 2004, 13, 6, 949–953**).

Key words: newborns, length of pregnancy.

Streszczenie

Materiał i metody. Badano 759 noworodków obu płci. Noworodki zostały podzielone na trzy grupy ze względu na długość ciąży: 1) ciąża krótka – do 265 dni, 2) ciąża normalna – 266–294 dni, 3) ciąża długa – ponad 295 dni. W tak pogrupowanym materiale oceniano dla każdego noworodka: urodzeniową długość ciała, urodzeniową masę ciała oraz masę ciała w kolejnych dniach po porodzie. W celu zobiektywizowania analizy i uniezależnienia od wieku noworodków oraz ich urodzeniowej masy ciała wprowadzono dwa wskaźniki względne: 1) wskaźnik A = (dzień osiągnięcia minimalnej masy ciała/wiek noworodka) * 100; 2) wskaźnik B = (wartość maksymalnego obniżenia masy ciała/masa ciała urodzeniowa) * 100. Obliczenia wykonano w programie STATISTICA 5.5. Dla wszystkich analizowanych wskaźników przeprowadzono analizę wariancji.

Wyniki. Na podstawie uzyskanych wyników badań można stwierdzić, że noworodki z krótkiej ciąży przeciętnie w 4. dniu po urodzeniu osiągają minimalną masę ciała, podczas gdy noworodki z ciąży o prawidłowym czasie i z ciąży długiej czynią to o dzień wcześniej. Analiza wartości wskaźnika A, który eliminuje wpływ wieku noworodka, jeszcze bardziej dokumentuje to spostrzeżenie. Maksymalne obniżenie masy ciała, liczone w wartościach bezwzględnych, nie wykazuje istotnych różnic między noworodkami o zróżnicowanym czasie trwania ciąży i waha się między 198 g a 206 g. Dopiero wyeliminowanie czynnika urodzeniowej masy ciała (wskaźnik B) uwidocznia występujące tu różnice: noworodki z krótkiej ciąży wykazują istotnie mniejsze obniżenie masy ciała w stosunku do noworodków z ciąży trwających dłużej niż 265 dni (**Adv Clin Exp Med. 2004, 13, 6, 949–953**).

Słowa kluczowe: noworodki, długość ciąży.

Birth body mass is a subject of studies of many authors. These studies are focused on the analysis of factors influencing on newborns birth body mass [1, 2]. Other authors investigate the retardation of intrauteral growing up [3, 4]. Many works are dedicated to estimation of interpopulation variability of birth body mass [5, 6]. A very wide analysis of the problem of body mass of the newborns in the demographic aspect was performed in [7–10].

The aim of the present work is the investigation of the influence of the length of pregnancy, measured by the catamenial age of the newborns, on the time of appearance and the value of physiological lowering of body mass.

Material and Methods

The study material consists of 759 the newborns of both sexes born in Madurowicz Municipal Hospital in Wroclaw. Birth body length and birth body mass as well as the body mass in the days following birth, were measured for every examined subject. In order to make the analysis independent from absolute values of age of birth and birth body mass, two additional normalised parameters were introduced:

1. A parameter: (the day of achieving the minimum body mass/age of birth)*100,

2. B parameter: (the value of the maximum lowering of body mass/birth body mass)*100.

The material was divided into three groups in the following way:

– group 1 (GR 1): length of pregnancy < 265 days (number of newborns – 68),

– group 2 (GR 2): length of pregnancy 265–295 days (number of newborns – 618),

– group 3 (GR 3): length of pregnancy > 295 days (number of newborns – 73).

In the material divided this way the following parameters of the newborns were taken into account: A parameter (%), B parameter (%), BH – birth body length (mm), BM – birth body mass (g), DMINM – the day of achieving the minimum body mass, MAX – maximum lowering of body mass (g).

All calculations were performed using the Polish version of STATISTICA 5.5 programme. At first the assumption of normality of general population from which the analysed parameters were taken was checked. For every parameter the Kolmogorov-Smirnov and χ^2 tests [11, 12] were performed. In all cases the origin from the population with normal distribution was confirmed with significance level $p < 0.05$. Additionally, the symmetry of distributions of the groups was checked and the analysis of correlation and variance was performed [12–14] in order to prove the existence of differentiating group factors.

Analysis of Material

The linear correlation in particular groups was examined. It was possible to observe that correlation coefficients differ between groups, and for such parameters as DMINM, A and B parameters change the sign, what corresponds to the change of the character of dependence from inversely proportional to straight proportional. It means that attachment to particular group has influence on the kind of dependence between parameters.

In order to study the influence of the group factor on the examined parameters more precisely, the analysis of variance was performed. A single classification and the constant model was used in the following form:

$$x_{ij} = \mu + a_i + e_{ij},$$

where: x_{ij} – value of j-th parameter in i-th group,

μ – influence of factors that are common for all elements of population,

a_i – influence of factors that are common for i-th group,

e_{ij} – random factor influence on j-th element in i-th group.

The aim of the analysis was the determination of the influence of constant effects a_i (i = 1, 2, 3) in particular groups. It was assumed that the population had normal distribution, the samples were taken independently, and the variance in each group was the same and equal σ^2. Under such assumptions the random variable x_{ij} has normal distribution with mean value $\mu_i = \mu + a_i$ and variance σ^2. It is impossible to measure the values of μ_i and a_i directly. However, it is known that if the whole sample is homogeneous, i.e. if in the analysed case $\mu_1 = \mu_2 = \mu_3$ and $a_1 = a_2 = a_3 = 0$, the value of the among group variance s_a and the value of the within group variance s_e should be almost equal [14]. Obviously, it corresponds to the lack of occurrence of the group factors. If s_e and s_a differ statistically significantly then there exist significant group factors. In the Table 1 below, the results of variance analysis for the studied parameters are given.

The columns of the Table correspond to the following quantities: 1 – sum of squares among groups (among group variation), 2 – number of degrees of freedom for among group variation, 3 – among group variance s_a, 4 – sum of squares within groups (within group variation), 5 – number of degrees of freedom for within group variation, 6 – within group variance s_e, 7 – values of F test (s_a/s_e), 8 – values of significance levels.

Table 1. Variance analysis of studied parameters

Tabela 1. Analiza wariancji dla omawianych wskaźników

	1	2	3	4	5	6	7	8
BH	725.2	2	362.6	7765.5	756	10.3	35.30001	.000000
BM	30 443 900	2	15 222 000	227 625 000	756	301 091.4	50.55597	.000000
DMINM	52.0	2	26.0	1518.6	756	2.0	12.94193	.000003
MAX	19 540.3	2	9770.2	5 816 006.	756	7693.1	1.26999	.281434
A	116.3	2	58.2	4382.0	756	5.8	10.03294	.000050
B	17.7	2	8.8	200.8	756	.3	33.32268	.000000

Performed analysis showed the existence of strong group factors with the significance level p much less then 0.05 for all parameters except for the maximum decrease of body mass (MAX).

The existence of group factors is not sufficient to determine for which groups there exist statistically significant differences between mean values. In order to discover these differences post-hoc tests were performed [14]. The results of Scheffe test (the values of the significance levels p) are given in the Tables 2–7. The differences are assumed to be statistically significant for $p < 0.05$.

Taking into account the statistical analysis one can say that the statistically significant differences between mean values of studied parameters exist between group 1 and groups 2 and 3 for all the parameters except for MAX parameter. Significant differences between groups 2 and 3 exist only for BM and BH parameters.

Very useful for the analysis of the parameters behaving are graphs of the mean values [12]. These graphs allow to analyze the trend of changes of the mean values with the change of the group. The mean value graphs of studied parameters are shown in the Figures 1 to 6.

Discussion

The physiological loss of body mass of newborns is partially related to the content of water in organism. The studies in [15] on the newborns, born on time (mean time of pregnancy 39.9 weeks) showed the progressive fall of weight in the course of first three days of life (5.67%) and considerably slower decrease of total water content (1.72%). As a consequence, the loss of solid components of organism is greater than the loss of water. On the basis of the presented results, without analysing the mechanism of the phenomenon, one can ascertain that on the average, the newborns from short pregnancies (shorter than 265 days) achieve minimum body mass in the 4th day after the birth, while for the newborns from normal and longer pregnancy, the fall of body mass takes place about 1 day earlier (Fig. 1). The analysis of the value of

Table 2. Test Scheffe – parameter DMINM

Tabela 2. Test Scheffe – wskaźnik DMIN

	GR 1	GR 2	GR 3
GR 1		.000003	.002265
GR 2	.000003		.891167
GR 3	.002265	.891167	

Table 3. Test Scheffe – parameter A

Tabela 3. Test Scheffe – wskaźnik A

	GR 1	GR 2	GR 3
GR 1		.000000	.000000
GR 2	.000000		.614704
GR 3	.000000	.614704	

Table 4. Test Scheffe – parameter MAX

Tabela 4. Test Scheffe – wskaźnik MAX

	GR 1	GR 2	GR 3
GR 1		.876571	.348639
GR 2	.876571		.350852
GR 3	.348639	.350852	

Table 5. Test Scheffe – parameter B

Tabela 5. Test Scheffe – wskaźnik B

	GR 1	GR 2	GR 3
GR 1		.000051	.014184
GR 2	.000051		.816616
GR 3	.014184	.816616	

Table 6. Test Scheffe – parameter BM

Tabela 6. Test Scheffe – wskaźnik BM

	GR 1	GR 2	GR 3
GR 1		.000000	.000000
GR 2	.000000		.005314
GR 3	.000000	.005314	

Table 7. Test Scheffe – parameter BH

Tabela 7. Test Scheffe – wskaźnik BH

	GR 1	GR 2	GR 3
GR 1		.000000	.000000
GR 2	.000000		.104987
GR 3	.000000	.104987	

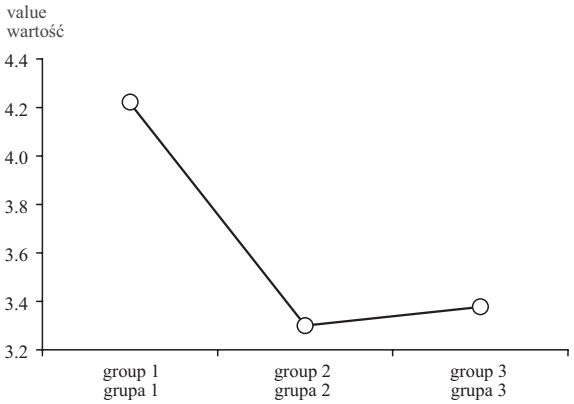

Fig. 1. Parameter DMIN

Ryc. 1. Wskaźnik DMIN

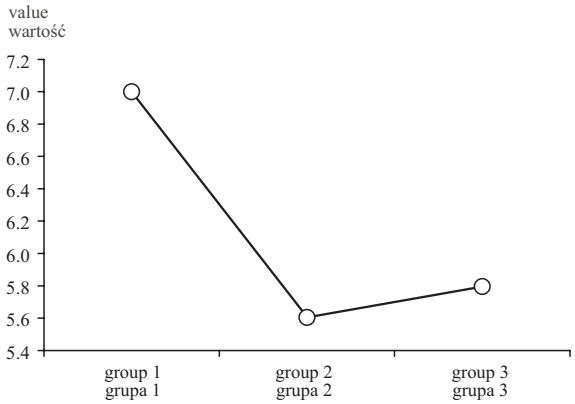

Fig. 4. Parameter B

Ryc. 4. Wskaźnik B

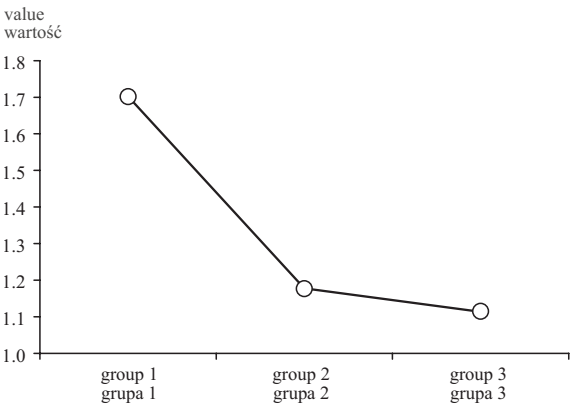

Fig. 2. Parameter A

Ryc. 2. Wskaźnik A

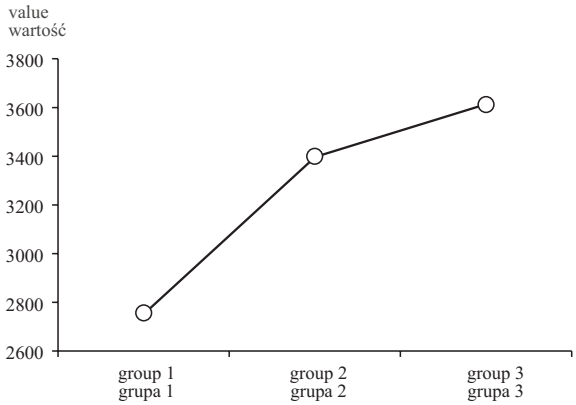

Fig. 5. Parameter BM

Ryc. 5. Wskaźnik BM

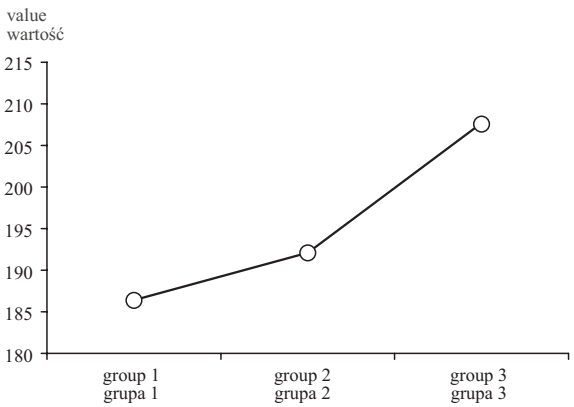

Fig. 3. Parameter MAX

Ryc. 3. Wskaźnik MAX

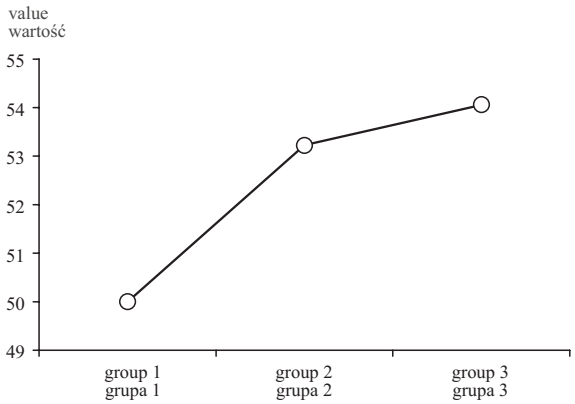

Fig. 6. Parameter BH

Ryc. 6. Wskaźnik BH

A parameter, which eliminates the influence of the absolute values of the age of newborns, made this statement even more reliable (Fig. 2).

The maximum lowering of body mass, measured in absolute values does not show the significant differences between the newborns of different duration of pregnancy and ranges between 198 g and 206 g (Fig. 3). This is because the body mass of newborns borne later is usually much bigger then of the newborns borne earlier and their absolute values of body mass changes are much bigger then for those borne earlier. The analysis of

the relative value of birth body mass (parameter B, Fig. 4) makes the relationship clear: The newborns from short pregnancies exhibit significantly greater relative lowering of body mass in comparison with the newborns from pregnancy lasting longer than 265 days. It is worth to emphasize that introduction of standardized parameters A and B, allows deeper interpretation of dynamics of changes of newborns body mass. Both, birth body mass and body length; show the dependence on the length of pregnancy. As one can expect, longer duration of pregnancy is associated with the increase of both values. Figures 5 and 6 illustrate this very known relationship between the birth body length (parameter BH), the birth body mass (parameter BM) and duration of pregnancy.

Relatively greater degree of physiological loss of mass of the newborns born earlier, in comparison with those born on time, can be related with the liver immaturity and can be the result of the impairment of the adaptation mechanisms in the first days of life.

Sizes of the examined groups, their distributions and statistical parameters, make the obtained results reliable. It is also worth to notice that in almost all cases it was possible to perform statistical inference on the significance level much smaller than 0.05.

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