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HUNGARIAN REFERENCE DATA REGARDING MATERNAL WEIGHT GAIN DURING PREGNANCY

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Abstract: *In the framework of the "Health and demographic survey of pregnant women and infants" a follow-up investigation of 8818 pregnant women and their infants was carried out in Hungary.*

The authors have worked up the change of body mass of the pregnant women, who gave birth to appropriate birth weight for gestational age live-born babies of 2500–4500 gram birth weight and 38–43 completed gestational weeks. The change of body mass of pregnant women (mothers) was measured at the first visit at prenatal care, the 20th, 27th, 34th week of pregnancy and at birth. Mean- and percentile values of the change of body mass are to be presented partly for the all eligible women, partly for the different body weight and height groups. Mothers are categorized into three groups according to prepregnancy weight and height, respectively. In the first group there is the lower 25 per cent of women, the middle group includes the next 50 per cent, and the third group is constituted by the upper 25 per cent.

Maternal weight gain is relevant regarding birth weight of babies which is revealed by the regression analysis carried out for birth weight as a dependent variable with duration of pregnancy, number of previous pregnancies and previous live births, mother's age, educational attainment, prepregnancy weight and height as independent variables. The relation between maternal weight gain and birth weight of babies, however, depends on mother's statue before pregnancy.

Key words: *Maternal weight; Maternal height; Maternal weight gain during pregnancy; Maternal weight gain – newborn weight; Prepregnancy body weight, body height and Kaup – index; Maternal prepregnancy weight–height groups.*

Introduction

Maternal weight gain is important regarding the appropriate development of foetus, the mother's health as well as her aesthetical self-evaluation (Taffel 1980, Vedra 1977, Bodnár – Bodnárné 1985). Simplifying, we can say, the appropriate weight gain during pregnancy is one of the preliminary conditions of the appropriate development of newborn. Immoderate weight gain endangers mother's health overcharging the core and joints. "The experienced obstetrician is convinced of the complications, both major and minor, caused by excessive weight gain in pregnancy. Although restriction of the gain in weight to 20 pounds" (around 9 kgs) "may be difficult in many cases . . . " (Abrams & Laros, 1986).

The aim of this article is to develop reference values for weight gain during pregnancy for in-term singleton newborn's of birth weight 2500–4500 grams and whose birth weight is appropriate for gestational age. That is, whose birth weight is between the 10th and 90th percentile values according to the Hungarian reference data (Joubert 1983). Furthermore, another goal is to present the relation among mother's prepregnancy weight and height; maternal weight gain and newborn's birth weight. Since maternal weight gain and newborn's birth weight depends also on mother's pregravid weight and height (Abrams & Laros 1986, Szabó & Rex-Kiss 1984, Taffel 1980, Stoll et al. 1986), it is advisable to give the reference values for women with different prepregnancy weight and height.

These reference values can help physicians, obstetricians, district nurses (while such aid has not been prepared on Hungarian data) to judge the weight gain of pregnant

women under their prenatal care. On the basis of such an aid they can recognize at-risk pregnancies more quickly and easier, and this can give an opportunity to apply the appropriate therapy.

If pregnant woman gets this chart, she would be able to control if her weight gain is appropriate according to the reference values. In such a way she would have an opportunity to influence it consciously during pregnancy.

Materials and Methods

The data come from the "Health and demographic survey of pregnant women and infants", which has been carried out on a 2% national representative sample of 8818 pregnant women in the cooperation of the Population Statistics Department of the Hungarian Central Statistical Office, the Demographic Research Institute of the CSO and the National Institute of Infants' and Children's Health (Joubert – Gárdos 1991).

Pregnant women from November 1979 through November 1982 were interviewed several times during pregnancy: at the first visit at prenatal care, on the 20th, 27th, 34th week of pregnancy and when the pregnancy was terminated. In the case of spontaneous abortions and prematures some of them might be left out. In this way we could get information on weight gain during pregnancy simultaneously with the interviews.

In this study data referring to 6918 pregnancies have been analysed, which ended in in-term singleton live birth of 2500–4500 grams and prepregnancy weight of mother was available. It can be supposed these conditions can assure us to have a homogeneous sample which does not contain pregnancies of irregular course. Weight gain was calculated by subtracting the stated prepregnancy weight from the measured weight at the given points of time during pregnancy.

To reveal importance of maternal weight gain a regression analysis was calculated for the birth weight as dependent variable with eight independent variables.

Maternal weight gain was supposed to be different according to the mother's prepregnancy weight and height taking them into account simultaneously. Thus, nine categories were created for these two parameters considering them together, combining the three groups for both measurements: less then the 25th percentile; between the 25th and 75th percentiles; above 75th percentile.

The Kaup-index: weight (g) / height^2 (cm^2) (Martin – Saller 1957) classification used is based on the values proposed by Garrow (1981).

Results

The *Table 1* provides descriptive details on the entire sample worked up here, and the *Table 2* and *Table 3* show the distribution of women according to pregravid weight and height, as well as the Kaup-index.

Importance of the maternal weight gain in the birth weight of newborn is demonstrated in two considerations here. Taking into account the pregnant women who have given birth to in-term babies of normal birth weight, from the point of the 10 kgs weight gain at the end of pregnancy, birth weight is almost linearly increasing with lifting maternal weight gain. At 10 kgs weight gain the average birth weight is 3261 g, while at 27 kgs newborn are weighing 3497 g as an average (*Fig. 1*).

The connection mentioned above does not inform us about the importance of weight gain among other variables affecting birth weight. The eight variables chosen as de-

Table 1. **Characteristics of the main variables in the study**

Variable	Mean		SD	No. of cases
Pregravid weight	57.8		9.4	6918
Weight gain at 20th week	5.2	(9%)*	3.5	6703
Weight gain at 27th week	8.6	(15%)	3.9	6767
Weight gain at 34th week	11.6	(20%)	4.4	6721
Weight gain at the end	12.8	(22%)	4.9	6598
Mother's height	162.2		6.0	6899
Kaup-index	21.9		3.3	6899
Birth weight	3300.4		412.5	6918

*Weight gain in percentage of prepregnancy weight

Table 2. **Distribution (per cent) of women according to pregravid weight and height**

Pregravid weight (kg)	Height (cm)							
	– 149	150–154	155–159	160–164	165–169	170–174	– 175	All
– 49	60.3	42.8	26.1	12.5	5.9	2.3	2.4	15.8
50 – 59	35.9	40.3	50.4	55.5	46.4	31.5	22.4	47.7
60 – 69	2.6	12.1	17.5	23.2	32.2	42.9	37.1	25.1
70 – 79	1.3	4.1	4.7	6.4	10.7	16.0	27.6	8.2
80 –	0.0	0.7	1.4	2.4	4.8	7.3	10.6	3.2
All	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
No. of cases	78	563	1545	2328	1520	695	170	6899

Table 3. **Distribution of women according to value of pregravid Kaup-index**

Kaup-index		Per cent
– 1.8	(underweight)	6.5
1.81 – 2.2	("ideal" weight)	52.3
2.21 – 2.8	(overweight)	35.5
2.81 –	(very overweight)	5.7
All		100.0
No. of cases		6899

pendent variables for the regression analysis of birth weight can be grouped into three categories: (1) biological, genetic and health status of mother (duration of pregnancy, mother's age, number of previous pregnancies and number of previous live births); (2) social background (number of school years completed); (3) anthropometric variables (prepregnancy body weight, body height, weight gain). The latter group is proved to be very relevant in birth weight of newborn, since the most significant variable of the eight ones is the prepregnancy weight, and maternal weight gain is on the third place, while, mother's body height is on the 5th (*Table 4*).

Table 4. **Regresion analysis for birth weight**

Variables	B	ß	F
Pregravid body weight	10.95	0.25	370.86*
Gestational age	66.09	0.20	320.83*
Maternal weight gain	15.06	0.18	242.45*
Educational attainment	10.44	0.07	36.54*
Body height	4.67	0.07	28.51*
Age of mother	3.90	0.04	11.79*
No. of previous pregnancies	8.80	0.04	4.84*
No. of previous live births	−1.95	−0.01	0.45
Constant	−1110.50		

*significant at level of $p < 0.05$

It can be seen that birth weight is significantly affected by mother's anthropometric parameters. Closed connection have been stated, however, also between weight gain on the one hand, and mother's prepregnancy weight and height and weight-for-height index, on the other (Abrams & Laros 1986, Raffel 1980). Comparing the nine groups produced taking into consideration prepregnancy weight and height together, it can be stated that the tallest women with the lowest body weight get on the most at any stage of pregnancy, while, weight gain of the heaviest, but lower pregnant women is the lowest (*Fig. 2*).

This connection is not only because of the different weight-for-height index. In the same Kaup-index category the heavier or taller the woman the more weight she gets on (*Table 5*).

Table 5. **Average maternal weight gain by Kaup-index and pregravid weight**

Kaup-index		Pregravid weight – 51	52 – 62	63 –	All
		kgs			
– 1.8	(underweight)	4.0	15.2		14.1
1.81 – 2.2	(ideal weight)	13.0	13.6	14.4	13.4
2.21 – 2.8	(overweight)	12.2	12.4	12.0	12.2
2.81 –	(very overweight)			9.4	9.4
All		13.2	13.2	11.5	12.8

As it was seen above pregravid weight and height have an effect on weight gain, moreover, weight gain influences birth weight. This latter influence, however, is not the same in the different groups of women according to prepregnancy anthropometric characteristics. As the *Fig. 3* shows, weight gain during pregnancy have no significant effect on birth weight for the tall and heavy women; moderate effect can be detected for medium tall and heavy women, as well as, tall and light women. Increase of maternal weight gain rises the newborn's weight the most significantly for short or medium high and low weight women. Drawing the trends it can be seen, that in the latter groups 20 kgs weight gain results about 500 gram increase in birth weight, while, for the tall and heavy women only about 100 grams.

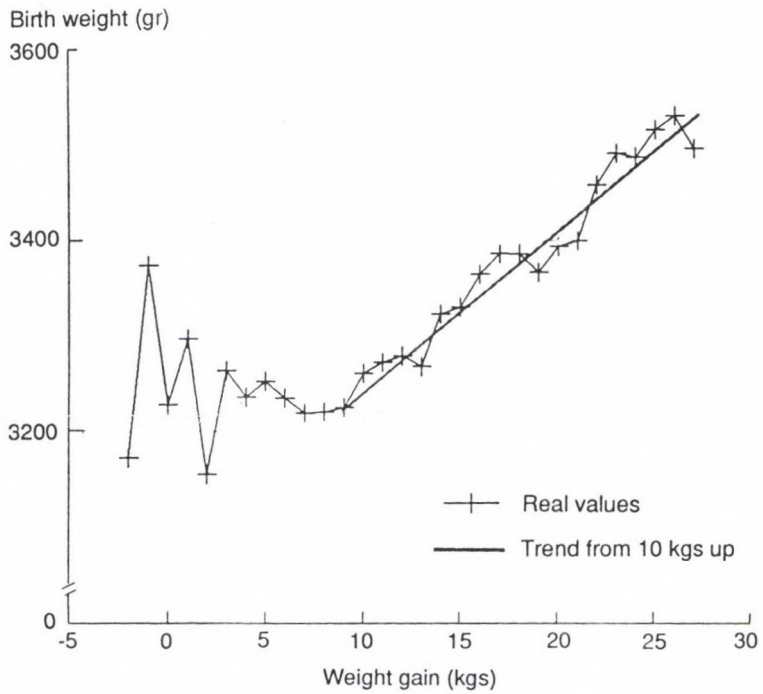

Fig. 1: Average birth weight by maternal weight gain

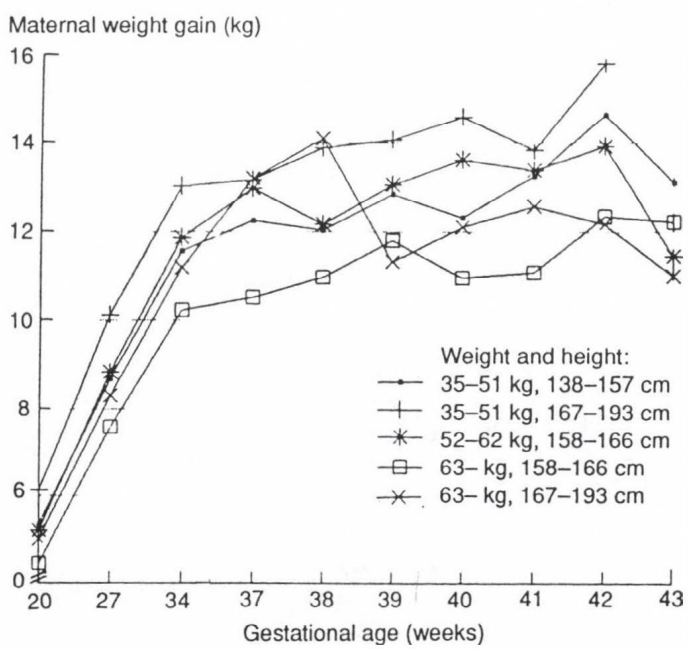

Fig. 2: Maternal weight gain by gestational age and mother's body height and prepregnancy weight

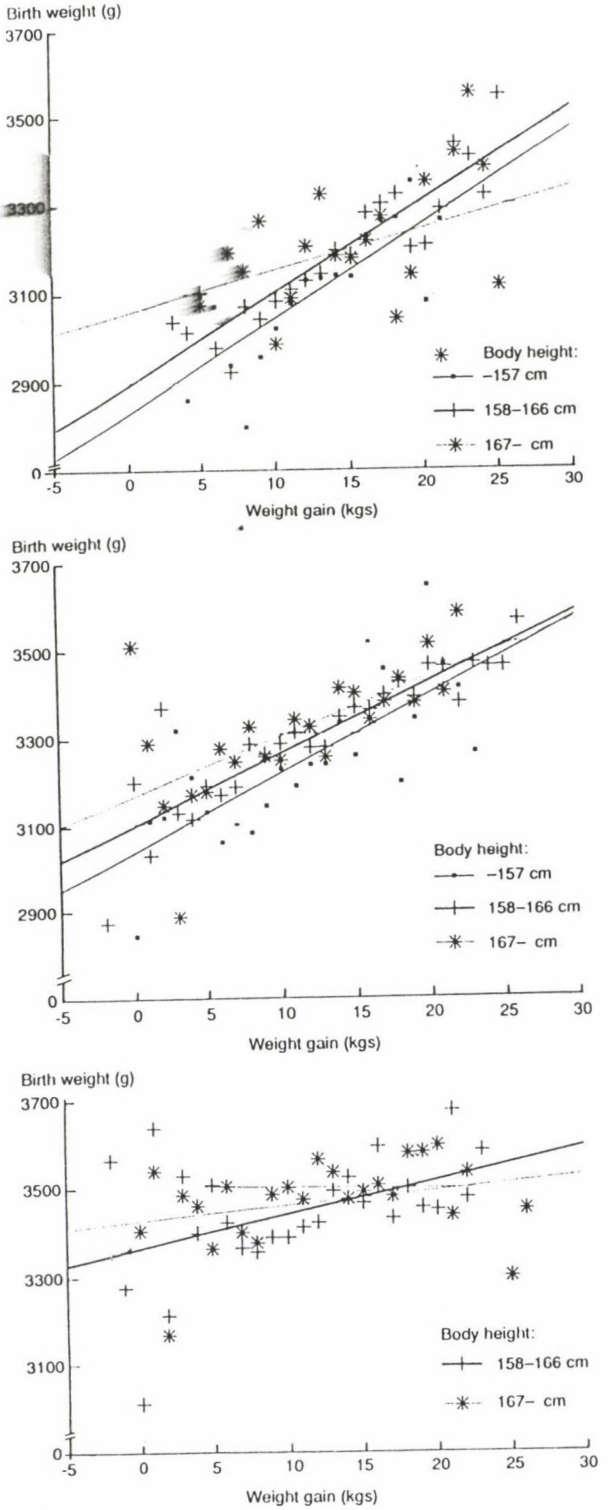

Fig. 3: Average birth weight by height and maternal weight gain: a) pregravid weight: –51 kg; b) pregravid weight: 52–62 kg; c) pregravid weight: 63– kg

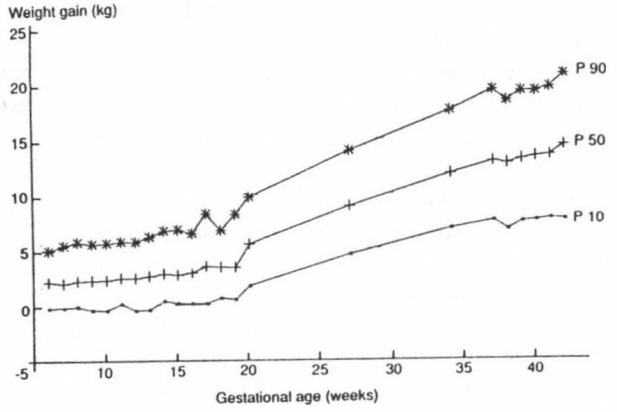

Fig. 4: Percentile curves of maternal weight gain considering in-term AGA newborn of 2500–4500 grams

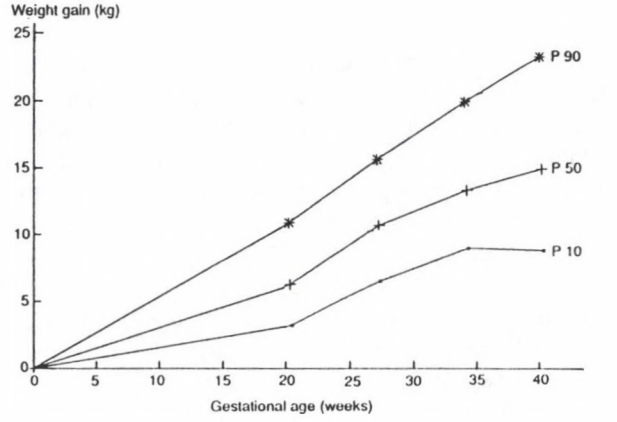

Fig. 5: Percentile curves of maternal weight gain considering in-term newborn of 2500–4500 grams (pregravid weight: less than 52 kgs; height: 167 cms or more)

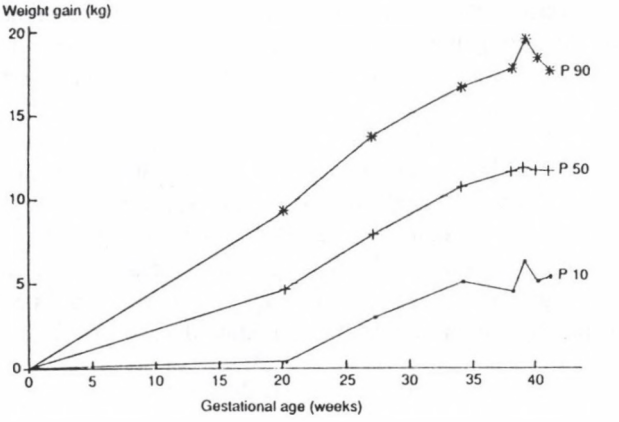

Fig. 6: Percentile curves of maternal weight gain considering in-term newborn of 2500–4500 grams (pregravid weight: more than 62 kgs; height: 158–166 cms)

The results mentioned above give the reason to produce reference percentile curves for several prepregnancy weight and height categories.

To give a basis to compare the several prepregnancy weight–height groups with a generally healthy course of maternal weight gain, following the percentile curves for all women who have given birth to in-term, normal weight newborn (Gárdos & Joubert 1989/90) the same chart has been created for those women whose newborn were appropriate for gestational age (*Fig. 4*). From the 6th week duration of pregnancy to the 19th week the data were obtained at the first prenatal care, similarly, for the 37th–42th weeks, where the data refer to the time of termination of pregnancy. In this way these values come from cross-sectional like samples, while, the data of 20th, 27th and 34th weeks concern a longitudinal sample. Only to demonstrate the differences between the groups, two set of percentile curves are shown here (*Fig. 4*, *Fig. 5*, and *Fig. 6*). Since in the two extreme groups the number of cases was not enough to compute percentile values for all the separate gestational weeks either at the time of the first attention at prenatal care, or at the end of pregnancy, we were confined to the longitudinal data.

Discussion

Birth weight of newborn is a very important factor considering the chance to survive and develop in an appropriate way (Demographic year-book of Hungarian Central Statistical Office 1990, Molnár 1990b). Birth weight is affected, first of all, by gestational age, but there are a lot of several factors which have been proved to be determining in this aspect (Gárdos & Joubert, 1990, Molnár 1990a, Joubert 1975, 1991). According to Thomson (1973) following gestational age maternal size is the most important individual factor effecting birth weight. Even in matured pregnancies there is a considerable correlation between these two measurements. This connection is real, and it is only partly caused by variables in the background affecting the both in the same direction. This is shown by the partial correlation coefficient (0.1883; $p < 0.0001$) between newborn's weight and maternal weight gain controlling for mother's age, educational attainment, height, pregregnancy weight as well as geestational age. Our finding that there is a significant linear relationship between maternal weight gain and birth weight confirm earlier studies.

Several other studies have had also the finding that while weight gain and birth weight were generally associated, heavier women delivered average to large size infants even with low maternal weight gain or weight loss (Frentzen et al. 1988, Abrams & Laros 1986).

For the first sight it is surprising, that the mean weight gain in this sample does not exceed the data reported by some foreign authors (Abrams & Laros 1986, Taffel 1980) 13 to 15 kgs, although, it is well known about Hungary, that nourishment is generally very unhealthy there. We feel this reflect the general overweight of Hungarian women preceding pregnancy. That might be the reason why they don't get on more weight during pregnancy. To test this supposition we would need the basic data they used for the publication, however, this condition does not fulfil.

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