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CLINICAL STUDY

Anthropometry, nutrition status and thymic size of Gypsy newborns from Southwestern Slovakia

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Abstract: Gypsy population represents a specific minority in Slovakia that differs from the majority population by its origin and genetic markers, as well as by generally lower social and economic status and lower hygienic standards of living. The aim of the present work is the analysis of anthropometric dimensions and indexes, as well as of thymus size, in the group of Gypsy and non-Gypsy newborns from the Southern Slovakia. Our group of 212 physiological newborns consisted of 33 Gypsy and 179 non-Gypsy newborns. All newborns were underwent anthropometric examination and their thymus size was assessed by ultrasonography and calculated as so-called "Thymic Index". Gypsy newborns show statistically significant lower anthropometric dimensions (birth weight and birth body length, head and chest circumference) when compared to non-Gypsy newborns, however, they do not differ in the values of nutritional status indicators (arm circumference, Quételet index and Rohrer index). They do not differ even in the thymus size that can be regarded as a „barometer" of the nutrition and of some negative stimuli. In spite of generally deficient nutrition and lower health status of the Gypsy minority in Slovakia, we did not find any significant differences in the indicators of nutritional status or in thymus size *(Tab. 2, Ref. 34)*. Full Text (Free, PDF) *www.bmj.sk.*
Key words: anthropometry, nutrition status, size of thymus, Gypsy and non-Gypsy newborns.

Gypsy (Gypsies) represent the second largest minority in Slovakia. The census of 2001 revealed that approximately 1.7 % of the inhabitants of Slovakia claimed themselves to belong to Gypsy nationality. However, their actual number is estimated to be several fold higher and the number of Gypsy is on the rise due to high natality of Gypsy population (1). Gypsy as ethnic group belong to europoid population. The country of their origin was probably the central part of western India. Gypsy left India in the 11th century and migrated westwards. The main period of their migration to western and northern Europe was in 15th century (2). Gypsy represent a very special minority, therefore solving the so-called "Gypsy problem" requires a complex approach. Matters related to Gypsy minority in the Central Europe are reflected also in medical journals. Up to 70 % of all published papers in the Medline database have the country of origin either in Slovakia, Czech Republic or Spain. The majority of published papers refer to lower health status of Gypsy population compared to the respective majority population (3).

Gypsy subpopulation has a specific lifestyle that differs from the non-Gypsy population. In some region of Slovakia, Gypsy people often live in segregated settlements without electricity or water delivery. Regarding the health status, the situation in Gypsy population is much worse compared to the non-Gypsy population. The investigation of Szabova et al (4) revealed a significantly higher caloric intake caused by intake of fat and carbohydrates, significant increase of obesity, low physical activity, higher incidence of nicotinism and alcoholism in the Gypsy population. Krajcovicova-Kudlackova et al (5) compared the cardiovascular risk in the individuals from Gypsy and non-Gypsy population. The Gypsy group had significantly higher levels of triglycerides, higher atherogenic index, insulin and insulin resistance, while the level of HDL-cholesterol was significantly lower in this group. Higher incidence of dyslipidemia, obesity and insulin resistance in Gypsy children is related to their lifestyle (inadequate nutrition, high fat intake, low physical activity and smoking) as well as to the low level of education in this group. In spite of the difference in cardiovascular risk, the distribution of the gene for methylene tetrahydrofolate reductase, the enzyme playing the key role in reducing the level of atherogenic homocysteine, was similar in both Gypsy and non-Gypsy population in Slovakia (6).

A close attention is given to the anthropologic research on the body dimensions of newborns and children in distinct ethnic groups. This research revealed differences in growth and development that

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can be caused by genetic factors or exogenous factors from the environment. Several anthropologic studies investigating phenotypic demonstrations of monogenic and polygenic heredity refer to different gene distribution in Gypsy and non-Gypsy populations (7, 8). Moreover, Ferák et al (9) indicates that Gypsy in Slovakia have the highest incidence of inbreeding in the whole Europe.

Thymus is a lymphoepithelial organ with immune and endocrine functions. It is the major site of the differentiation and proliferation of immune cells. Normal development and functions of thymus are important for development and maintenance of immune functions (10). Thymus in newborns and children is extremely sensitive to intrinsic and extrinsic negative stimuli causing stress-related thymus involution (11). Investigation of the relationship between the size of thymus in newborns and their anthropometric characteristics gains on importance in recent years. The relation between small size of thymus and malnutrition has been mentioned for the first time by Menkel in 1810 introducing thus the term "nutritional thymectomy" (cited by 12). In 1845 Simon declared thymus for the barometer of nutrition (cited by 13). Malnutrition has generally major influence on the size of all lymphatic organs (13, 14). According to the hypothesis of Godfrey et al (15) malnourishment of the fetus in late phases of gestation causes disproportional body growth and anomalies in the development of thymus. Newborns with large head circumference have rapid intrauterine growth. This may cause malnutrition and disproportional growth of the trunk and limbs with respect to head. This is reflected also in defective development and functions of thymus causing increased serum levels of IgE antibodies. McDade et al (16) detected a relationship between prenatal malnourishment and reduced immune response after vaccination against typhus in Filipino adolescents. The close relationship between thymus size and nutrition was confirmed also by Collinson et al (17). Thymus size in newborns in Gambia (Africa) was reduced in children born in the period from July to December – the period of draught and famine in this country.

The aim of this work was to analyze physical parameters and indexes as well as thymus size in the group of Gypsy and non-Gypsy newborns from the region of Southern Slovakia. We suppose that due to lower socio-economic situation and lower hygienic standards, newborns in the Gypsy population should have different nutritional status and smaller size of thymus.

Patients and methods

Examined group consisted of 212 newborns born in years 2005 and 2006 at the Department of Gynecology and Obstetrics in the General Hospital in Komárno, Slovak Republic. The group consisted of 33 Gypsy and 179 non-Gypsy newborns. All newborns were delivered between the weeks 38 and 42 after gestation. Newborns with premature birth or newborns with symptoms of congenital infection, chromosomal aberration or malformation were not included in the group. All newborns passed the anthropometric examination during the first five days after the delivery. The size of their thymus was estimated during the routine ultrasound examination of kidney.

Examined anthropometric parameters included birth weight, birth length, chest circumference, mid-arm circumference (circumference at the site of highest development of *musculus biceps brachii* measured perpendicularly to the longitudinal arm axis with a tape measure) and frontooccipital circumference of the head (horizontal circumference of the neurocranium measured by a tape measure with accuracy of 1 mm).

Following nutritional status indexes were calculated from examined anthropometric parameters:

– Quételet index – index indicating the ratio of the body weight in grams to the second power of body height in centimeters (known as Body Mass Index),
– Rohrer index – indicates the ratio of centuple of body weight in grams to the third power of the body height in centimeters (known also as Body Massiveness Index),
– Index of the ratio of arm circumference to the head circumference – where arm circumference is the anthropometric parameter significantly affected by changes in the nutritional status and head circumference is a measure with the least dependence on nutritional status.

Thymus size was estimated according to Hasselbalch et al (18) as so-called "Thymic Index". This index was determined as the multiple of the transversal width of the cranial part of thymus and of the sagittal area of the major thymus lobe. Their results obtained *post mortem* in 12 children confirmed that "Thymic Index" shows high correlation with actual volume and weight of the thymus. Thymic index was used for determination of thymus size in children *in vivo* also by Benn et al (19), Iscan et al (20), Jeppessen et al (21), Jeppessen et al (22), Park et al (23) and Zeyrek et al (24). The suitability of the use of "Thymic Index" in Slovakia has been referred for the first time by Varga et al (25). According to their conclusions, USG method is very prompt; the result is available immediately and does not burden the patient with detrimental radiation, as in the case of native X-ray imaging. Ultrasonography examination is safe, effective and appropriate for simple determination of thymus size that may be very variable in children.

Mann-Whitney non-parametric test was used for the comparison of differences between the anthropometric indicators as well as between the thymus size in Gypsy and non-Gypsy newborns. The level of significance $P<0.05$ was considered as statistically significant. Software Statistical Package for the Social Sciences (SPSS) for Windows version 13.0 was used for all statistical calculations

Results

The results of anthropometric examinations are shown in Table 1. The values of body dimensions in Gypsy newborns are significantly lower. They have lower birth weight, birth lenght, head circumference and chest circumference. However, there is no difference in the mid-arm circumference that can be considered as alternative indicator of the nutritional status. With respect to three tested indicators – nutritional status indexes, there is no statistically significant difference in nutritional status between Gypsy and non-Gypsy

Tab. 1. Body dimensions and indexes of evaluated Gypsy and non-Gypsy newborns using the Mann-Whitney non-parametric test.

	Gypsy newborns (n=33)		Non-Gypsy newborns (n=179)	
	Mean	SD	Mean	SD
Birth weight (g) (p=0.001)*	3154.55	467.94	3424.86	421.85
Birth lenght (cm) (p=0.002)*	48.73	2.32	50.02	1.96
Head circumference (cm) (p<0.001)*	33.74	1.16	34.54	1.15
Chest circumference (cm) (p=0.028)*	33.21	1.76	33.86	1.63
Mid-arm circumference (cm) (p=0.916) NS	11.83	0.91	11.80	1.01
Quételet's index (p=0.051) NS	1.32	0.11	1.37	0.11
Rohrer's index (p=0.961) NS	2.72	0.23	2.73	0.22
Mid-arm/head circumference ratio (p=0.128) NS	0.35	0.03	0.34	0.03

* – significant, NS – non-significant, p – level of significance

Tab. 2. The size of newborns thymus as "Thymic index" assessed by sonography using the method of Mann-Whitney non-parametric test to compare the differences between Gypsy and non-Gypsy newborns.

	Gypsy newborns (n=33)		Non-Gypsy newborns (n=179)	
	Mean	SD	Mean	SD
Thymic index (p=0.072) NS	8.35	1.86	9.21	2.54

NS – non-significant, p – level of significance

newborns. Nutritional status indicators such as arm circumference and Rohrer index are almost identical in both newborn groups.

Since we have found statistically significant difference in body dimensions between Gypsy and non-Gypsy newborns, we compared also the thymus size in both groups (Tab. 2). We found no statistically significant difference in thymus size in these groups. This suggests that in spite of significant differences in physical characteristics, Gypsy and non-Gypsy newborns have the same nutritional status and thymus size.

Discussion

Gypsy represent a specific subpopulation in Slovakia. The results of our anthropometric examinations confirm that Gypsy newborns reach significantly lower values of all commonly examined body dimensions. This is in agreement with results of other studies performed in Gypsy newborns from Southern and Eastern Slovakia (1, 2). In spite of lower socio-economic status and lower hygienic standards in Gypsy population, the indicators of nutritional status and thymus size did not differ significantly from the values in non-Gypsy newborns. This indicates that lower values of body dimensions and body weight are not related to the deficient nutrition of newborns. Differences in physical constitution in Gypsy newborns are genetically determined. In India as the country of their origin, the values of the thickness of subcutaneous skin folds in newborns are similar to the values in the United States despite of significantly lower average birth weight in India (26). Considering the generally lower average birth weight of Gypsy newborns in Slovakia Bernasovský et al (27) suggested a specific limit for low birth weight (2250 grams) to be used in Gypsy newborns. According to these authors, 8.5 % of full term Gypsy newborns have low birth weight according to the WHO criteria (under 2500 g). Reducing this limit to 2250 g, would result in just 2.03 % Gypsy newborns with low birth weight. This percentile corresponds to the percentile of non-Gypsy newborns with the birth weight below 2500 g. However, this suggested limit is not used in practice due to unclear etiology of this difference in birth weight.

It is surprising that there is no statistically significant difference in thymus size between Gypsy and non-Gypsy newborns. Considering the deficiencies in the nutrition (e.g. Gypsy take just 44 % from the recommended daily dose of vitamin C), suboptimal hygienic standards, high unemployment rate, low level of education, higher incidence of transmissible diseases, high rate of smoking and consumption of alcoholic beverages (3, 4, 5, 28, 29, 30) we would expect significantly lower values of Thymic Index in Gypsy. Interestingly, Park et al (23) reported even higher average values of Thymic Index in Gypsy newborns from East Slovakia; however, they were not able to provide any explanation for this difference.

So far it has not been extensively studied how individual factors exert their effect on lower values of physical parameters in Gypsy newborns. In addition to ethnic differences in body proportions, high incidence of smoking in Gypsy mothers may play a role here. Varga et al (1) reported that 15.31 % of Gypsy mothers smoke during pregnancy. According to Pavúk (31), almost 60 % of Gypsy females are smoking and only a half of them quit smoking during the pregnancy. Nicotinism was reported by more than 18 % of Gypsy mothers in our group. Smoking during the pregnancy causes increased rate of perinatal complications including premature delivery, intrauterine growth retardation, as well as low birth weight of newborns or the syndrome of sudden infant death (32). Newborns delivered by mothers smoking during the pregnancy have birth weight reduced on average by 165 g (33) and have lower thymus size (24, 34).

Conclusion

Gypsy population differs from the majority population in Slovakia not just by its origin, but also by its lifestyle and by its different lifestyle and health or social status. Gypsy newborns are born with the average birth weight by almost 300 grams lower,

with birth body length by 1 cm shorter and they have also smaller circumference of head and chest. In spite of this, their anthropometric indicators on nutritional status and thymus size are identical to the majority of population. We suppose that there is a genetic predisposition for lower values of body parameters that is expressed already during the intrauterine development.

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