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Anthropometric differences of Roma and Non-roma newborns in Virovitica-Podravina County

Jadranko Šegregur*

The aim of this work is to assess anthropometric parameters of the Roma newborns in Virovitica-Podravina County and compare them with the values for the non-Roma group. This retrospective investigation includes 204 Roma and 408 non-Roma newborns, born at the maternity ward of the Virovitica General Hospital in the period from 1991 to 2010. Various parameters, such as birth weight and length, head perimeter, as well as the ponderal index and percentile values of birth weight, were assessed. Roma newborns have, on average, 321.7 g smaller weight, 1.3 cm smaller length and 0.7 cm smaller head perimeter at birth, compared to non-Roma newborns. The ponderal index was found to be 0.06 less for Roma newborns, with higher frequency of hypothrophic newborns, according to the percentile values of the birth weight. The differences in anthropometric parameter values of Roma and non-Roma newborns may be due to the ethnic identity, but also due to the impact of the surroundings and the lifestyle of the population itself. Assessed data could provide a better understanding to, and political direction for the improvement of the reproductive, as well as the overall health of the Roma population.

Key words: INFANT, NEWBORN

INTRODUCTION

Roma are of the northern Indian origin and the largest transnational ethnic minority in the central and eastern Europe (1). They inhabited Croatia more than six centuries ago (2) and represent a national minority. The size of the population is not exactly known. According to the population census from 2011, 9463 individuals, i.e. 0.4% of the overall Croatian population, declared themselves to be of Roma nationality, whereas according to other estimations, there are 60000 - 150000 Roma in Croatia. The difficulty in determining the number of local Roma population is present in the Virovitica-Podravina County due to the assimilation pressure and ethno-mimicry. According to the population census from 2011, 14 individuals (0.02 % of the overall population) declared themselves as Roma in the Virovitica-Podravina County. The data of the Center for Social Work are disproportionate, since the estimated number of Roma in the area of Podravina is 1500 (3, 4).

Historically, Roma have been politically, economically and culturally marginalized and stigmatized, with employment mostly in the area of seasonal agricultural activities, as well as collection and trade of the secondary processed goods. Roma population situated in Virovitica-Podravina Coutny, however, successfully integrated and assimilated into the rest of the population. Since inhabiting this area, they spoke Croatian and their economic status is also better, compared to the rest of Roma in Croatia. As a result, this part of Roma population lost their national identity (5).

Roma currently are still a less known and less frequently researched population. Recently, a larger number of publications on Roma in scientific literature originated from Slovakia, Czech Republic, Hungary, Romania and Spain, however research on this topic in Croatia is rare and in regard to perinatal events, to our knowledge, has not yet been published (6).

Anthropometric assessment in the field of pediatrics usually encompasses birth weight, birth length, ratio of birth

* General Hospital Virovitica, Gajeva 21, Virovitica

Correspondence to:
Jadranko Šegregur, MD, PhD., General Hospital Virovitica, Gajeva 21, 33000 Virovitica, e-mail: jsegregur@gmail.com

weight and length, percentile values of the birth weight, ponderal index, the head perimeter, the weight of the placenta, ratio of the body weight and weight of the placenta as well as the thickness of the skin fold. These values are used to estimate neonatal growth and most of the values depend on the gestational age and are linked to perinatal mortality and morbidity (7).

Fetal growth is a complex process, involving interplay of the mother, placenta and fetus itself. Birth weight is a result of the hereditary genetic potential and acquired growth boost (8). Birth weight, on average, reaches values 2500 - 3999 g. Newborns with a low birth weight, as well as the macrosomic newborns (due to their specific neonatal morbidity, mortality and tendency to cardiovascular and metabolic diseases later in life), have a significantly larger risk of death in neonatal and infant stage. Furthermore, these children are more frequently hospitalized in the first year of life, with potentially permanent consequences on the metabolism and hormonal regulation into the adult life, thus indicating an large issue for the public health (9).

The assessment of the fatty tissue quantity is not possible only based on the body weight. For newborns and infants, the ponderal index (PI) is used, rather than the body mass index (BMI), since PI is based on their body ratios vs. age and, furthermore, it is independent of the gender, parity, ethnical identity or socioeconomic status of the parents. Values below 2.32 and above 2.85 indicate a disproportional growth. PI is a multidimensional complex anthropometric indicator of asymmetric fetal growth and predictor for the higher-risk newborns with growth retardation and is considered to be a better indicator than the percentile tables of the fetal growth (10).

Values of the birth weight strongly depend on gender of the new born, as well as the ethnicity, cultural characteristics, body height and weight, as well as parity of the mother. While estimating the body weight it is thus important to take all such physiological parameters into account. The standard percentile curves are used only if they include data on the heterogeneity of the included sample (11).

The aim of this study is to report anthropometric characteristics of the Roma newborns in the Virovitica-Podravina County, as well as to compare the values of the anthropometric parameters of the Roma and non-Roma newborns.

SUBJECTS AND METHODS

The retrospective study was conducted on the maternity ward of the General Hospital Virovitica in the period of January 1991 to December 2010. The research was not continued in the last ten years due to a lower number of births of Roma women, which is likely caused by the migration out of the Virovitica-Podravina County. Data on the newborns was acquired from the medical history of pregnant women, stored at the archive of the Maternity Ward of the General Hospital Virovitica, as well as from the medical history of the newborns hospitalized after birth at the Neonatal ward, stored in the archives of the Department of Pediatrics of the General Hospital Virovitica.

Throughout the twenty-year period in the General Hospital Virovitica, 19318 births were reported, of which 204 originated from Roma women, representing 1.06% of the total number of births. The total number of births throughout the years steadily decreased, from 1277 to 767, whereas the number and frequency of the births of the Roma population showed variability, with the lowest frequency in 1996 (0.39% of the overall number of births) and highest in 2002 (1.95%) and 2008 (1.84%). The sample for this research consists of data from 612 newborns (204 Roma and 408 non-Roma) of the singleton pregnancies and gestational age of 28 to 43 weeks. Non-Roma newborns were selected as a control group, in the ration of 1 to 2 to Roma pregnancies, so that for each identified Roma newborn, a non-Roma newborn immediately prior and after the Roma birth was selected.

In order to define and identify the researched group of Roma women as accurately as possible, the usual habitation addresses in the streets of Pitomača, Kloštar Podravski and Kladare, where this population of Roma primarily lives, as well as the surnames specific to them, noted in registries (registry of births - 1893, wedding registry - 1923, death registry - 1912) stored at the registry office in Pitomača (12), were used.

Gestational age of the newborns was determined Naegele's rule, i.e. via assessment according to the first day of mother's last menstruation, and confirmed or corrected on the basis of the ultrasound biometry during the pregnancy. The value was further estimated according to Farrov's childbirth method by a pediatrics (13). Premature birth was considered to be a birth before the 37th week (36^{+6} and less), while a birth on time was considered to be from 37 weeks to at least 42nd week (37^{+0} until 41^{+6} weeks included). Post term delivery was defined as after 42 or more weeks (42^{+0} or more).

Birth weight of the newborns was noted in grams (g), rounded to the closest 50-gram value, and was measured immediately after birth on a tilt weighing scale or by using an electric weighing scale with a formational bed. Birth length in centimeters (cm) was measured in the formational bed and rounded to the closest centimeter value, whereas the head perimeter (cm) was measured during the first sev-

eral days of life using a linen ribbon meter. Limits of <2500 and ≥4000 g were chosen to separate the low, normal and large birth weight.

PI (ponderal index) was calculated as a ratio of the birth weight and cubed birth length, multiplied by 100 (PI = PT/PD^3×100, in g/cm^3). The values of the PI less than 2.32 and larger than 2.85 indicate a disproportionate growth of the newborns (14). The newborns were furthermore categorized according to percentile values into three groups: hypotrophic (<10th percentile), eutrophic (10-90th percentile) and hypertrophic newborns (>90th percentile). In order to provide an accurate grouping, the assessment took gestational age into account, and also corrected percentiles for the weights of the progressing week, according to the fertility of the mother and the gender of the infant, as reported in Zagreb (15).

The data for this research was compiled in accordance with fundamental bioethical standards, which ensured the privacy and secrecy of information for individuals (medical non-disclosure), and is in accordance with the Nürnberg code, revised Helsinki declaration and other relevant documents (16).

For qualitative variables, data is presented in absolute numbers and frequencies, whereas quantitative ones are represented using mean values and standard deviation. In the comparisson of the qualitative variables, χ^2-test (for categories of the gestational age, birth weight, length and head perimeter, PI, and percentile values) and bifactorial correlation method of variance analysis (for the change of the birth weight and PI according to 5-year categories) were used, whereas for the quantitative variables, t-test was used (variable frequency). Statistical significance was set to $p<0.05$. IBM's SPSS Statistics 19 package for Windows was used for the statistical analysis.

RESULTS

The data on the gestational age, gender and anthropometric characteristics of the Roma newborns (n=204) and non-Roma newborns (n=408) are shown in Table 1.

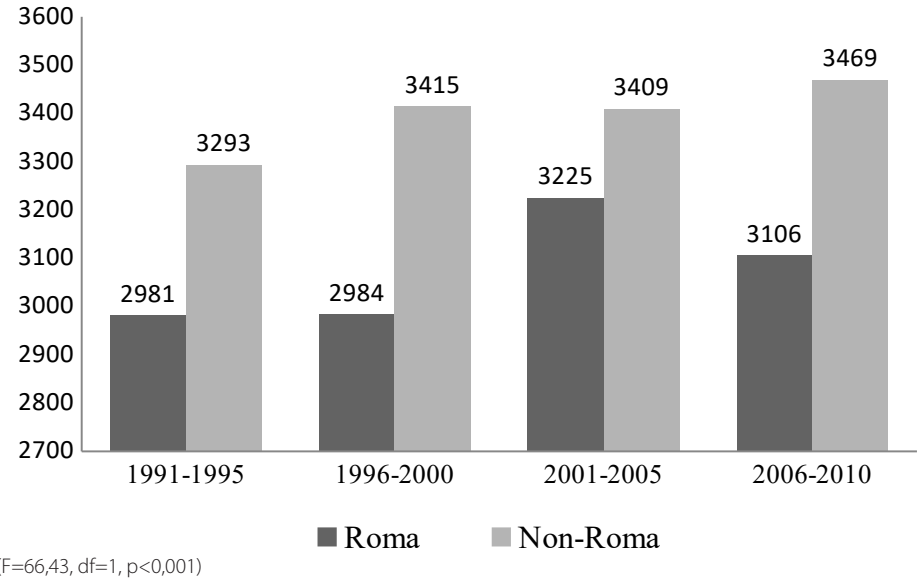
TABLE 1. Dieffrences of the gestational age, gender and anthropometric characteristics of the Roma and non-Roma newborns (t-test, χ^2 test)

	Roma newborns (n=204)	Non-Roma newborns (n=408)	p
Gestational age (weeks)	38.88±1.73	39.52±1.21	< 0.001
28-34^{+6}	2.5%	0.2%	0.001
35-36^{+6}	6.9%	20.0%	
37-41^{+6}	90.7%	97.3%	
≥42	0.0	0.5%	
Gender			
Male	52.0%	47.5%	0.305
Female	48.0%	52.5%	
Birth weight (g)	3069.7±485.3	3391.4±454.4	< 0.001
<2500	10.3%	2.5%	< 0.001
2500 - 3999	87.2%	87.9%	
≥4000	2.5%	9.6%	
Birth length (cm)	49.1±1.9	50.4±1.48	< 0.001
<48	18.1%	3.2%	< 0.001
48 - 52	80.4	89.9%	
>52	1.5%	6.9%	
Ponderal index	2.583±0.255	2.645±0.223	0.002
<2.32	10.3%	5.9%	0.018
2,32 - 2.85	78.4%	75.7%	
>2.85	11.3%	18.4%	
Percentiles for the birth weight			
<10	17.2%	5.6%	< 0.001
10 - 90	79.9%	80.1%	
>90	2.9%	14.2%	
Head perimeter (cm)	34.0±1.6	34.7±1.3	< 0.001
Percentiles for the head perimeter			
<10	6.1%	2.6%	0.292
10 - 90	82.7%	84.1%	
>90	11.2%	13.3%	

The average gestational age of the newborns was 38^{+6} weeks for Roma, and 39^{+4} for non-Roma. The difference of five days earlier birth for the Roma newborns is statistically significant. Moreover, the frequency of premature births for Roma newborns is significantly greater as well, both for early premature birth (28-34^{+6} week), as well as the late premature birth (35-36^{+6} week). Post term birth happened only for two non-Roma women.

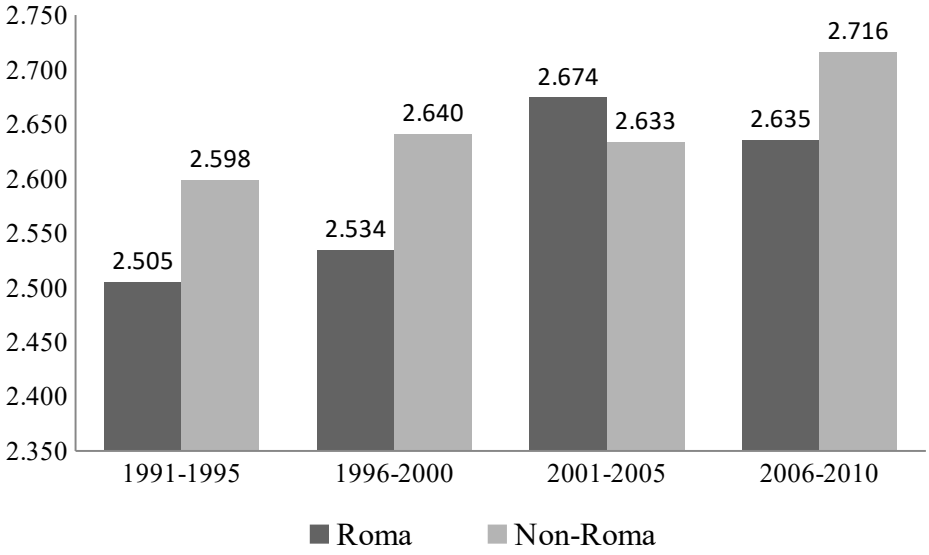
The frequency of male and female newborns comparing the Roma and non-Roma did not differ. The size of the newborns, according to birth weight, length and head perimeter, indicates that the Roma newborns are, on average, significantly smaller (Table 1.). Roma newborns had on average 321 g smaller birth weight and 1.3 cm shorter birth length, as well as 0.7 cm smaller head perimeter after birth. The frequency of Roma and non-Roma newborns according to the categories of birth weight and length show significant differences.

The newborns with lower birth weight are more frequent, whereas the macrosomal are less frequent in the Roma population. A similar trend was observed for the birth length as well.



(F=66,43, df=1, p<0,001)

FIGURE 1. Average birth weight of Roma and non-Roma newborns (g) according to birth periods (ANOVA)



(F=9,88, df=1, p=0,002).

FIGURE 2. Average ponderal index (PI) values for Roma and non-Roma newborns according to birth periods (ANOVA)

PI of Roma newborns was 0.06 less than for non-Roma ($p < 0.05$). The difference in the categories of PI for Roma and non-Roma newborns were significant as well. Disproportionate growth of the newborns in the category of a low PI (<2.32) is more frequent for Roma newborns, whereas in the category of an elevated PI (>2.85), the disproportionate growth is less frequent for the Roma, compared to the non-Roma. Roma and non-Roma newborns differ significantly when comparing percentile values of the birth weight. Roma newborns are more frequently categorized to the group of hypotrophic newborns (<10th birth weight percentile), whereas the non-Roma are more frequently categorized as hypertrophic newborns (>90th birth weight percentile).

The differences in the categories of the head perimeter percentile values are not significant.

The differences in the birth weight and PI in compared groups were assessed using a bifactorial method of variation analysis; with a given group and 5-year interval as variables. Roma newborns have a significantly lower birth weight and PI, compared to non-Roma newborns.

Figure 1 depicts average birth weight of Roma and non-Roma newborns, for each five-year interval. Weight of the newborns significantly rises throughout the years in both groups. Average values of the birth weight of Roma newborns show a tendency of a linear increase over the 5-year

TABLE 2. Correlation between the gestational age, birth weight, birth length and PI of Roma and non-Roma newborns (Person)

	Roma newborns			Non-Roma newborns		
	Ges-age	Weight	Lenght	Ges-age	Weight	Lenght
Weight	0,571			0,334		
Lenght	0,506	0,779		0,348	0,767	
PI	0,376	0,704	0,174	0,205	0,782	0,253

p = 0.05
p = 0.01

Ges-age - Gestational age (weeks), Weight - Birth weight (g), Lenght - Birth length (cm), PI - Ponderal index

periods; with the overall increase difference of 243.6 g (period of 1991-1995 to period of 2001-2005). There is a deviation from this trend in the last 5-year period, with an overall decrease of the newborn body weight. The differences in the birth weight increase of non-Roma newborns during longer periods are somewhat smaller (175.1 g), while the increase itself is linear. In all 5-year periods, the average birth weight of Roma newborns was lower than of the non-Roma, with the largest difference in the period 1996-2000 (430.9 g), and the smallest in 2001-2005 (184.1 g).

Average PI values for Roma and non-Roma newborns according to five-year periods are shown in Figure 2. Average values of PI for Roma and non-Roma newborns show a tendency to increase linearly throughout the 5-year periods, with a deviation in the final period for the Roma newborns, similarly to the findings for the birth weight. While observing the differences in PI values of Roma and non-Roma newborns based on the time periods, a comparable increase in PI for both groups; as well as on average lower values of PI in Roma newborns were observed. Furthermore, an inversion in the time interval of 2001-2005 can be observed, where the average PI of Roma newborns was higher than the average PI of non-Roma.

A significant (positive) correlation was identified between the gestational age, birth weight and length, as well as PI for Roma and non-Roma newborns (Table 2.).

The frequency of the PI categories, according to percentile values of birth weight, are shown in Figure 3., for the Roma and non-Roma newborns separately. These two parameters are interlinked. The categories of hypotrophic and eutrophic newborns of the same PI are similar in both groups, Roma and non-Roma, whereas the hypertrophic Roma, compared to non-Roma, are four times less frequent in the group of disproportionately large growth.

DISCUSSION

Anthropometry in the field of pediatrics includes a routinely measurement of the body weight and length, as well as the head perimeter of children. The size of the newborn during birth is the result of individual and reciprocal impact of hereditary and various environmental factors, and represents one of the basic anthropometric characteristics for the observed population. A continuous focus on these children's anthropometric parameters is important to estimate the somatic growth and development. Furthermore, factors originating from the mother, as well as the fetus gender, ethnic, cultural and geographic variables have a significant impact on the fetal growth.

Epidemiological studies have shown that genetic factors play an important role in defining the birth weight of the newborns and have a significant impact on their variability (17). Genetic research is able to evaluate genetic differentiation of Roma population in Europe. From available research about the Roma and respective majority European population, comparing them with the north-Indian population, *Kalaydieva et al.* analyzed the data on classical polymorphism and thus confirmed the Indian origin of the European Roma. A high level of Roma genetic differentiation was found when compared to the differentiation of the native European population (18). Furthermore, lower values for anthropometric parameters in Roma children is in accordance with the values of the same parameters in the population of south India (19). *Muthayya et al.* investigated the anthropometric characteristics of the newborns on the area of south India and identified average birth weight of 2810 g and average birth length of 49.7 cm (20). In India, the body mass of the mothers is a strong predictor for the body weight of the offspring. The disorder of the fetal nutrition is connected to a larger quantity of the fatty tissue in the adulthood. The birth weight and length positively correlate with being skinny during adulthood for both sexes. Nevertheless, the birth weight and length positively correlate with the thickness of the fatty tissue mass and the thickness of the sum of skin folds for women only. Furthermore, the effect of malnourishment was found to encompass at least three generations, which is indicated by the link between the height of the grandmothers and the weight of the granddaughters (21).

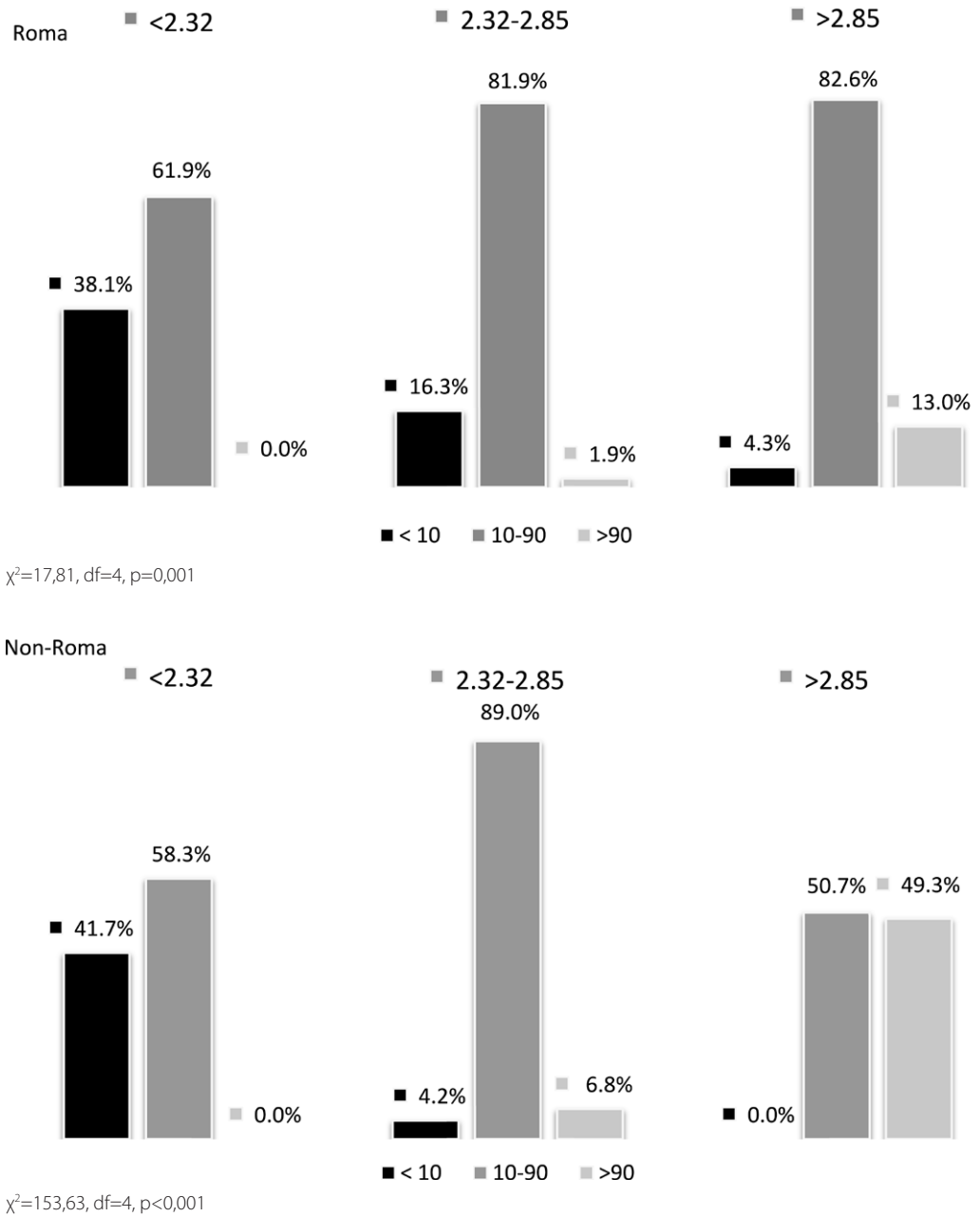


FIGURE 3. The frequency of the PI categories, according to percentile values of birth weight of Roma and non-Roma newborns (χ^2 test)

A Hungarian study identifying risk factors for increased frequency of low birth weight and premature births of Roma newborns, reports the causes in not only ethnic affiliation, but also in demographic, socioeconomic and cultural factors, as well as the style of life. Roma ethnic affiliation can be seen as a predictor of the bad socioeconomic characteristics and behavior, which is linked to a bad perinatal outcome. Ensuring a healthy way of life, limiting tobacco consumption and ensuring the healthy body weight of the pregnant women may improve the pregnancy outcome (22).

The reports on the birth outcome of the Roma population, compared to the majority, non-Roma population of Czech Republic indicate a one week shorter duration of pregnancies, an overall lower birth weight and length, as well as a more frequent incidence of low birth weight in Roma newborns (24).

Bulgarian authors confirm overall lower birth weights of Roma newborns, compared to the majority, non-Roma newborns (25). Similarly, a paper on anthropometric and nutritional status of Roma newborns in Slovakia reports significantly lower birth weight, lower birth length and head perimeter, as well as a lower PI, compared to newborns of Slovakian majority population. Lower values of anthropometric parameters and weight of the newborns do not cor-

related with the deficit in nutrition, while genetic predisposition for smaller anthropometric parameters can be observed during intrauterine development (26, 27). Lower birth weight of the Roma newborns is connected to a younger birth age of the mothers, them being lone parent, having a higher number of pregnancies, as well as to the lower education, perinatal outcome and more frequent nicotine, alcohol and drug consumption during pregnancy, connecting to a lower socioeconomic status in Roma villages (28). Roma pregnant women in Virovitica-Podravina County are significantly younger as well, and give birth five times more frequently as underaged individuals, compared to non-Roma (6).

Anthropometric research indicates a phenotypic manifestation of monogenic and polygenic heredity and differences in genetic construct of Roma and non-Roma population. *Varga et al.* found differences in values of dimensions and index cephalicus, when comparing Roma and non-Roma newborns. Roma newborns were found to have a significantly lower head perimeter, lower length, a more narrow head base, as well as a more narrow face, whereas their values of transversal and sagittal measurements of the head were greater and they had a brachycephalic head shape (29). The conclusions about the different morphology of the head between these ethnic groups may hint towards the genetic impact on the morphological development of the head during prenatal period; which may in turn be used as a diagnostic tool in perinatology and neonatology.

Socioeconomic status had a significant impact on anthropometric parameters of the newborns of the Međimurje County, with a more numerous and characteristic Roma population. Roma newborns were, due to a number of reasons, including genetic predisposition, on average smaller compared to other newborns (30).

Ethnic differences in the growth have been observed in several countries, with further similarities of the secular trend of growth connected to genetic potency for growth. Population of the industrialized countries and the population of the highest socioeconomic groups in developing countries show a similar secular trend for European, Latin-American and Indo-Mediterranean populations, and a less similar trend for Asian population. The secular trend of body growth has not stopped for many populations, including the wealthy ones (31). *Schack-Nielsen et al.* consider the increase of birth weight, length and PI of the newborns in last 30 years to be a consequence of increased body weight and more frequent obesity of the mothers (32). Israeli authors connect such increase to a better antenatal care and the improved public health (33). The change of the anthropometric parameters at birth of healthy newborns in a period of 20 years has been reported by Chinese authors as well. A significant average increase of body weight, length, PI and head diameter of the newborns was reported, as well as a notable increase in the percentage of newborns with macrosomia (34).

The fetal growth charts provided by the World Health Organization (WHO) aim at international usage, and thus do not follow the local growth scale. There are large differences in the values of growth depending on the location and observed population, compared to the default estimations, which allow for a risk of wrongful growth classification (35). Growth charts ought to be updated, or, alternatively, national references for gestational age and gender considering birth weight, length and head diameter specific for the specific population should be developed in order to be used in clinical praxis (36).

Comparing design of the birth weight percentile curves for the Croatian newborns, there are differences between an older study from Zagreb and other, newer studies, which hints to the fact that it is necessary to set universal rules and methodology on a national level in order to form national standard of healthy fetal growth (37, 38). Comparing new Indian body weight, length and head diameter growth curves for newborns with other Indian and international curves, authors find smaller values of percentile birth weight and discuss the need to update the curves in order to avoid wrongful classification of the newborns into categories of low or increased birth weight (39). Due to a small growth of Roma newborns, as well as due to a frequent categorization of the newborns into groups of lower birth weight, Serbian authors suggest to generate population focused, birth specific growth curves for the birth weight and length for the considered population (40).

The lower limits for the birth weight, formulated in such a way, would decrease the frequency of our Roma newborns in the group of small newborns. A more adapted percentile curves would, moreover, decrease the frequency of hypotrophic, especially proportionally hypotrophic newborns.

The study is not representative of the complete population of Roma in Croatia, since it did not include Roma populations in other parts of Republic of Croatia. Nevertheless, the results of this study should be considered in a critical way, as other Roma groups present in Croatia differ in their socioeconomic status, parity and genetics (as tribes) and were not taken into account for this investigation. Further research is needed to understand perinatal outcome more accurately, e.g. by exploring not only the genetic background, but also the interaction of it with the environmental factors. Furthermore, during the result interpretation, it is necessary to consider the fact that the data on newborn's fathers was absent, similarly to data about parental environ-

ment, parental education, economic and material conditions, diet and habits for the explored Roma population. This would further support explanations of the ethnic differences and the impact of more complex perinatal factors related to the anthropometric characteristics of the Roma population.

CONCLUSION

This research found lower average values of anthropometric parameters for the Roma newborns, compared to a non-Roma group. Similar average values and differences in birth weight, length, head perimeter and PI of Roma newborns, compared to non-Roma for a specific population have been reported by other researches as well, which confirms Roma common origin.

The differences between the ethnic groups, in regard to the fetal growth, can be caused by a misclassification of constitutionally small or large newborns, when considering abnormal growth for a specific gestational age. There is some controversy regarding the decision to selecting the most appropriate growth curves for neonatal growth estimation. Next to other parameters, it is necessary to adapt the standards to geographic areas and racial or national affiliation, and, moreover, generate comparisons between different countries in this regard.

During the design of new neonatal growth curves for the clinical practice, it is necessary to use strict criteria for the selection of a sample, due to the changes in not only sample size, parity and age of the mothers, but also due to the changes in socioeconomic and environmental factors, as well as according to the needs of the obstetric and neonatal care. Such new neonatal curves would represent the standard on a national level, with the aim of a more accurate estimation of the neonatal growth. It would be necessary to update them every 5 to 10 years, in order to harmonize with the secular trend of the population growth.

The data collected in this paper can contribute to a better understanding and development of policies aimed at improving the reproductive and overall health of the Roma population and reduce disparities and inequalities in the health of Roma and the majoritarian population in Croatia.

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SAŽETAK

Antropometrijske razlike romske i neromske novorođenčadi u Virovitičko-podravskoj županiji

Jadranko Šegregur

Cilj je ovog rada prikazati antropometrijske vrijednosti romske novorođenčadi u Virovitičko-podravskoj županiji i usporediti ih s većinskom neromskom skupinom. Retrospektivno istraživanje obuhvatilo je 204 romske i 408 neromske novorođenčadi, rođene u rodilištu Opće bolnice Virovitica u razdoblju od 1991. do 2010. godine. Analizirani su podaci o porođajnim težinama, duljinama i opsegu glave novorođenčadi te ponderalnom indeksu i centilnim vrijednostima porođajne težine. Romska novorođenčad po porođaju ima prosječno 321,7 g manju težinu, 1,3 cm manju duljinu i 0,7 cm manji opseg glave u odnosu na neromsku novorođenčad. Značajne su razlike u ponderalnom indeksu koji je za 0,06 manji kod romske novorođenčadi, kao i u centilnim vrijednostima porođajne težine s većom učestalosti kategorije hipotrofične novorođenčadi. Razlike antropometrijskih vrijednostima romske i neromske novorođenčadi mogu se objasniti utjecajem etničke pripadnosti, ali i utjecajem okoline i životnog stila populacije. Prikupljeni podaci mogu pridonijeti boljem razumijevanju i razvoju politike usmjerene poboljšanju reproduktivnog i cjelokupnog zdravlja romske populacije.

Ključne riječi: NOVOROĐENČAD