VILNIUS UNIVERSITY

Jonas Drąsutis

# CHANGES IN BREAST MORPHOLOGICAL PARAMETERS, BODY SIZE AND SHAPE, BLOOD SERUM PROLACTIN AND LIPIDS DURING PREGNANCY, MULTIPLE RELATIONSHIPS OF THESE INDICATORS AND MORPHOLOGICAL MARKERS FOR HEALTH RISK

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VILNIAUS UNIVERSITETAS

Jonas Drąsutis

# KRŪTŲ MORFOLOGINIŲ PARAMETRŲ, KŪNO DYDŽIO BEI FORMOS IR KRAUJO SERUMO PROLAKTINO BEI LIPIDŲ KITIMAI PER NĖŠTUMĄ, DAUGIALYPĖS ŠIŲ RODIKLIŲ SĄSAJOS IR SVEIKATOS RIZIKOS MORFOLOGINIAI ŽYMENYS

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## ABBREVATIONS

BMI – body mass index
WHI – waist hip index
LDL Ch – low density lipoprotein cholesterol
HDL Ch – high-density lipoprotein cholestrol
TG – Triglycerides
VLDL Ch – very low density lipoprotein cholesterol
DNA – deoxyribonucleic acid
TD – transverse diameter
VD – vertical diameter
H – height of the breast
CT – computed tomography scan
MRI – magnetic resonance imaging

## 1. INTRODUCTION

The recent decades in Lithuania have demonstrated dramatic changes in the conception of economic, social and moral values. The demographic situation in Lithuania has reached a critical level, which poses a deep concern for the medical community. Therefore, today's pregnant woman receives exceptional medical attention because the pregnant woman's health, physical and emotional state impacts her future health, especially at critical stages of age (*Drąsutienė et al., 2016; Medical data of Birth Register from 2000 through 2016*). Pregnancy is a young woman's physiological condition, however, over this period, a woman suffers from huge changes taking place in terms of her anthropometric parameters, visceral topography, passive body weight gain and topography, breast size and various metabolic chain changes (*Drąsutienė et al., 2007*). All these processes affect lactation after childbirth and also the health of the newborn, while the health of future generations depends on the health and physical condition of each fetus and newborn. All the research carried out into the assessment of the relationship between maternal health, physical condition and metabolism during pregnancy may be related to a positive development in the country's demographic indicators (*Basys et al., 2016; Drąsutienė et al. 2016; Kirchengast, 2007; Pölzlberger et al., 2017*). Based on the scientific evidence, pregnant women can be provided maximum assistance so that the outcome of each pregnancy is the birth of a healthy child.

A woman's breasts, an important external sexual feature, have received much scholarly attention on behalf of medical specialists, human biologists, anthropologists, artists, psychologists, sociologists and other specialists of other fields. Breasts have always been regarded as a symbol of a woman's fertility and beauty. Beauty standards are associated with fashion and cultural factors of each epoch. Unfortunately, sometimes the condition of breasts becomes a cause of a severe oncological disease, their size is associated with a risk to suffer from diabetes, metabolic syndrome and other diseases (*Sprague et al., 2015; Rosenberg et al., 2014; Michels et al., 2012; Volochovič, 2010*). Large breasts can cause health problems such as pain in the neck or in the

upper region of the back. Large breasts are associated with an increased risk of breast cancer (*Talghini, 2013*). Particularly large breasts at a young age (up to 20) are associated in later life with the increased risk of obesity and diabetes mellitus type II (*Kulshreshtha, 2017*).

During pregnancy the breast parameters increase. What factors trigger these changes in the breast volume? Do these changes occur under the impact of significant fluctuations observed in hormones, lipids, carbohydrates or in other metabolic chain stages during pregnancy? There is a lack of studies that have examined in detail the volume of breast development during pregnancy in terms of other changes that occur in the body's anthropometric parameters. So far, no detailed analysis has been carried out into the changes of the shape of female breasts during pregnancy (*Francaite-Daugeliene et al., 2016; Wood et al., 2008*). Therefore, breast tissue changes during pregnancy may be a permanent object for scientific research. A question naturally arises, which morphological changes in the breast size and shape are observed during pregnancy and how these changes are interrelated with the other body parameters, and, possibly, with some risk for health. The parameters and their changes in the physical condition of pregnant women are not only impacted by each country's exceptional life specifics and women's social status, but are also associated with the indicators of female health.

The breast size in terms of anthropological studies is unique and the results obtained from scholarly research vary even within the same population of women of different ethnic groups (*Stratz, 1922; Ellison-Loschmann et al., 2013*). A variety of breast morphology and size is determined by hereditary and external environmental factors. However, the search for the relationship of the size and shape of breasts with other female anthropometric indicators is relevant today, as there is still a lack of scientific evidence-based data on a specific population enabling scholars to make summarized conclusions. Human biology is a complex field of science, because its object – an individual – is exposed not only to biological, but also to socio-economic factors. It is recognized that different countries use different methodologies in measuring the breast size, thus it is sometimes difficult to compare the obtained results.

A continuous current upgrade in the woman's beauty and health industry worldwide poses new challenges for the plastic and reconstructive surgery specialists and requires joint efforts and complex work involving obstetricians and gynecologists, plastic and reconstructive surgeons, endocrinologists, family practitioners, dermatologists, fundamental medicine and other medical specialists. The reconstructive surgery is performed on bodily structure defects (congenital defects, post-trauma or post-surgery defects), while the aesthetic operations are carried out seeking to improve the shape of the body. The frequency of the human body's aesthetic surgery significantly increases each year. It is associated with openly expressed images on the perceived ideal body shape. An increasingly growing number of studies deal with the impact of an appropriate body figure on the individual's emotional state and the target to achieve the desired body shape (*Inanir et al 2015, Meireles et al 2017*). Only research findings on women residing in a particular country and belonging to different age categories, especially the standard of anthropometric indicators of pregnant women, can be assessed as a standard to identify pathological changes.

The breast beauty perception is very individual. The aesthetic surgery on breasts is performed in order to enlarge or reduce the breasts, to restore their shape that has been changed after pregnancy and childbirth, to correct the asymmetry of the size or shape after weight changes a woman has undergone. The most commonly performed aesthetic breast surgery is breast augmentation surgery. Not only the external beauty is important, but also the internal status and the psychological comfort of women (*Crerand and Magee, 2013*). The estimated statistical data show that 97 per cent of women, who have undergone plastic surgery, would opt for it again. Even 98 per cent of patients recognize that the operation results have met their expectations (*Heden et al., 2009; Mello et al., 2010*). The volume of plastic and reconstructive surgery in the United States has increased by even 203 per cent over the period from 2012 through 2013. Approximately 35-40 percent of women after mastectomy select plastic reconstructive procedures (*Albornoz et al., 2013*). This operation

is the daily work of plastic surgeons. Over the period from 2000 to 2015, the number of breast lift operations increased significantly – even by 89 percent (*American Society of Plastic Surgeons, 2016*).

The scientific literature has indicated that the presence of implants has a negative effect on lactation, while after breast reduction surgery, no lactation disorders were observed (*Hill et al., 2004; Cruz and Korchin, 2007*). There are abundant literature sources available that describe breast reconstructive and plastic surgery research, however, they do not disclose a diversity of breast size observed in a specific population and its relationship with other parameters and anthropometric indicators of the female body. Despite the abundance of the ongoing research, there is a lack of studies evaluating the change in the breast shape from the woman's age perspective, especially during pregnancy, and linking these changes with health indicators of a specific population. It is a medical approach to the woman's breast physiology and pathology. However, even the textile industry which produces women's bras is interested in research that assesses the female breast size in the population (*Brown, 2016*).

It is not accidental that for decades anthropologists of Vilnius University, have been involved in the research of health issues of various groups of the Lithuanian population, including pregnant women. The scholars examine the parameters and the changes of their physical condition as well as the links to the health condition. The present study carried out into the anthropometric, body composition and breast volume changes of pregnant women is the continuation of research work conducted by the anthropologists of Vilnius University. Longitudinal studies of anthropometric indicators, also body image issues of the Lithuanian pregnant women and their comprehensive evaluation alongside with the metabolic changes during pregnancy supplement the international scientific research, are important and continuously relevant, given that some of the factors in this study are valued in terms of epochal dynamics (*Drąsutienė et al., 2007; Volochovič et al., 2010; Kasilovskienė et al., 2005*).

## AIM OF THE DISSERTATION

To evaluate the changes observed in the breast morphological parameters, in other body size and shape indicators, in some metabolic indicators (prolactin, lipids) during pregnancy and to identify the multiple relationships between the mentioned indicators and morphological markers for the health risk.

## OBJECTIVES OF THE DISSERTATION

1. To identify the differences between the breast parameters and other anthropometric indicators observed in pregnant and young nulliparous women:
   1.1. To compare the indicators of the breast size and shape in these women.
   1.2. To compare the general indicators of the body size (height, weight, BMI, body circumferences).
   1.3. To compare the size of the subcutaneous fat tissue (passive body mass) and its topography (skinfolds).
2. To identify the changes observed during pregnancy in breast parameters and other anthropometric indicators of primiparous and multiparous women:
   2.1. To compare the indicators of breast size and shape in these women for the first and third trimesters of pregnancy.
   2.2. To compare the changes in general indicators of body size (height, weight, BMI, body circumferences) in these groups of women during pregnancy.
   2.3. To compare the indicators of the development of subcutaneous fat tissue (passive mass quantity) and its topography (skinfolds) at the first and third trimesters of pregnancy.
   2.4. To compare the changes the indicators of body size and the development of subcutaneous fat tissue and its topography in modern women during pregnancy with the findings of the study carried out in 1986.

3. To identify the changes in breast parameters and other anthropometric indicators during pregnancy in relation to the breast size:
   3.1. To compare the breast size and shape indicators for the first and third trimesters of pregnancy.
   3.2. To compare the general indicators of body size (height, weight, BMI, body circumferences) for the first and third trimesters of pregnancy.
   3.3. To compare the development of subcutaneous fat tissue (passive mass quantity) and topography indicators (skinfolds) for the first and third trimesters of pregnancy.
4. To identify the changes in the breast parameters and other anthropometric indicatorsduring pregnancy in relation to the body size:
   4.1. To compare the breast size and shape indicators for the first and third trimesters of pregnancy.
   4.2. To compare general indicators of body size (height, weight, BMI, bodycircumferences) for the first and third trimesters of pregnancy.
   4.3. To compare the development of subcutaneous tissue (passive mass quantity) and topography indicators (skinfolds) for the first and third trimesters of pregnancy.
5. To identify some peculiarities of the metabolism indicators (prolactin, lipids) in pregnant women for the first and third trimesters of pregnancy and their multiple relationships with the breast parameters and body size indicators:
   5.1. The dynamics of maternal serum prolactin and lipid metabolism parameters in primiparous and multiparous women during pregnancy.
   5.2. Comparison of the changes in the analysed indicators of maternal serum concentrations in women with small, medium and large breasts during pregnancy.
   5.3. Comparison of the changes of serum prolactin, total cholesterol, high-density cholesterol, low-density cholesterol and triglyceride concentration levels in lean, normal body build and obese women during pregnancy.
6. To identify the pregnant women's self-esteem and attitudes towards their body image during pregnancy.

## RELEVANCE AND SCIENTIFIC NOVELTY OF THE RESEARCH

The scholarly literature presents a wide range of studies that examine the relationship of parameters of women during pregnancy and after childbirth with the fetal physical condition and links it with the child's development and health in the future. However, the literature sources on the relationship of breast, anthropometric and other body size indicators and their changes during pregnancy, especially from the point of view of epochal dynamics, are scarce. Thus, the contribution of Vilnius University anthropologists and clinicians to the examination of anatomical and physiological changes that occur during pregnancy, an important period in a woman's life, is relevant not only for today's research but also for the future studies. The data of the accessible scientific literature show that a complex research of this kind has not yet been carried out to date. The data obtained from this study are relevant in terms of the sustainability of a long-term research carried out by the scientists of Vilnius University and a contribution to the international scientific research findings on the relationships of female anthropometric and metabolic indicators, while our data obtained examining the changes in breasts parameters during pregnancy may facilitate identifying female health risk groups already during pregnancy.

Thus, a woman's health risk for her later age stage can be forecasted even from the first trimester of pregnancy which facilitates taking appropriate and timely preventive measures aimed at the perspective of positive trends in the health of future generations. Variations in the size of breast changes during pregnancy and after childbirth is a relevant scientific problem which so far has not received sufficient scholarly attention. Today's young people are too concerned about their body image and "perfection" ambitions. The female breast size and shape is an integral part of the body image. The current scientific data on the breast size and shape can have a long-standing effect not only on the future aesthetic, plastic and reconstructive surgery, but also for treating women from related diseases.

## MATERIALS AND METHODS

The research was carried out at Vilnius Maternity Hospital, also at the Department of Obstetrics and Gynecology, Clinic of Vilnius University from 2013 through 2015. The pregnant women were examined and their general anthropometric and biochemical blood serum indicators such as levels of prolactin, total cholesterol, high, low density lipoprotein cholesterol and triglycerides were obtained. For the first time, pregnant women were tested in the first trimester of pregnancy - up to 13 weeks of gestational age (M=10.5 weeks), for the second time - at the end of pregnancy (M=35.1 weeks).

The study used standard anthropometric methods. The following body size anthropometric indicators were measured: height, body weight, body mass index. The circumferences of the body (cm) in pregnant women were measured in standing position (the distance between the feet 20-30 cm): the neck, the shoulders, the upper arm, the forearm, the wrist, the chest (above, at the breast level, and below the breasts), the waist, the hip, the thigh and the calf. The upper arm circumference was measured in the middle of the upper arm, the waist circumference – in the middle between the lower rib cage and the pelvic crests. The hip circumference was determined by measuring the maximum indicator at the widest site of gluteal region. The absolute and relative quantity of adipose tissue in kilograms and its relative quantity by percentage were determined according to specific formulas after measuring the skinfolds and the subcutaneous fat layer. The fat skinfolds were measured by special Holtain caliper (Siber Hegner, Switzerland), accuracy of 0.1 mm (10 g/cm$^2$).

The subcutaneous fat skinfolds (mm) were measured: submental, pectorial I, pectorial II, axillary, abdominal, suprailiac, subscapular, bicipital, tricipital, forearm, thigh, knee, calf.

The body density (BD) was calculated using the Wilmore J. H. and R. A. Behnke formulas: (*Wilmore, Behnke, 1970*). The relative quantity of adipose tissue by percentage (AT%) was calculated according to W. E. Siri formula: (*Siri, 1961*).

In terms of the adipose tissue hypertrophy, the pregnant women were examined in early and late pregnancy and were divided into three groups: **lean** (fat tissue per cent was less than 25 percentile), of **normal body build** (adipose tissue per cent ranged from 25 to 75 percentile) and **obese** (fat percent was higher than 75 percentile).

Each series of the research had specific aims. The parameters of breasts were investigated in detail. The following measurements were taken: transverse (TD) and vertical (VD) diameters, breast height, i.e. protrusion from the chest (H), the jugular fossa –nipple, nipple – inframammary fold, the distance between the nipples, the distance between the lower breast poles, horizontal and vertical diameters of the areola, the height of the nipple. The breast volume was calculated according to the formula (*Kramer, Drexler, 1981; Kramer et al., 1982*):

$$\text{Breast volume} = \tfrac{1}{2} \times 4\pi/3 \times \tfrac{1}{4} \times TD \times VD \times H,$$

TD – transverse diameter of the breast, VD – vertical diameter of the breast, H – height (protrusion) of the breast.

According to the breast volume ($cm^3$), pregnant women were divided into three groups in early pregnancy and late pregnancy.

The first, **small breasts** group comprised pregnant women with breast volume of less than 25 percentile. The second, **medium-sized breasts** group included pregnant women whose breast volume amounted to between 25–75 percentile. The third, **large breasts** group consisted of pregnant women whose bilateral breast volume amounted to more than 75 percentile.

Analogous calculations of anthropometric, lipid metabolism and blood serum prolactin (mU/l) indicators were also carried out after dividing the subjects into two groups – **primiparous** and **multiparous** women.

The following tests were conducted at the Biochemistry Laboratory: concentration levels of blood serum prolactin (PL, mU/l), total cholesterol (Ch, mmol/l), high density lipoprotein cholesterol (HDL Ch, mmol/l), low density lipoprotein cholesterol (LDL Ch, mmol/l), triglycerides (TG,

mmol/l) were determined. Total cholesterol, triglycerides and HDL Ch were determined by an enzymatic colorimetric method (Architect ci8200, Abbott, the U.S.). LDL Ch was calculated according to the Friedewald formula; a direct enzymatic clearance method was used to determine if TG>4.5 mmol/l (Architect ci8200, Abbott, the U.S.).

The statistical analysis of the data was performed using "MS Excel" and "IBM Statistics 23". The calculation of anthropometric and biochemical indicators mean values, standard deviations, minimum and maximum values was performed. The data at the beginning and the end of pregnancy or the data of different groups were compared using Student's t test, also chi-square and ANOVA analysis. The correlation analysis Pearson correlation coefficients) was performed to examine the relationship between various indicators. Seeking to distinguish the most relevant correlation trends, a cluster analysis of correlation matrices was conducted, the results of which are provided in the form of dendrograms. The selected level of statistical significance – $p<0.05$.

The findings obtained from our study in the years 2013–2015 on pregnant women were compared with the data of an analogous study on pregnant women conducted by the anthropologists and clinicians of Vilnius University in 1986 (N=386). The pregnant women – participants of the study of 1986 – were divided by their constitutional type into asthenic, normosthenic and hypersthene groups. The anthropometric and lipid metabolism parameters of their body size were evaluated according to the concept of the constitutional type,widely used in medical practice.

Consequently, having converted the pregnant body size indicators of 1986 by BMI values, we were able to carry out a comparative analysis of the analogous indicators obtained from the study of 2008 on nulliparous young girls (N=82) and our study of theyears 2013–2015 on pregnant women (N=105). These comparisons allowed to identify the epochal trends in the anthropometric dimensions and metabolic changes observed in the pregnant Lithuanian young female bodies, revealed by indicators of various levels. In addition, for the purpose to compare self-esteem and body image of

pregnant and non-pregnant females – in total, 385 nulliparous 18–20 aged girls were investigated in 2012–2016. The self-esteem and a number of body image issues were evaluated on the basis of the responses obtained from the surveyed women: self-esteem – according to the Rosenberg's self-esteem scale (1965), body image issues – by specific questions related to attitudes towards one's own body size and shape.

## RESULTS

### 1. Characteristics of the pregnant women involved in the research

In total, 105 pregnant women were examined for the first time in the first trimester of pregnancy – up to 13 weeks of gestational age (M=10.5 weeks) and the second time – in the third trimester (M=35.1 weeks). The study involved 52 **primiparous** and 53 **multiparous** pregnant women.

According to the total volume of both breasts, pregnant women were divided into the **small breasts** group (breast volume <1787.2 ml, N=21), the **medium size breasts** group (breast volume 1787.2–2748.4 ml, N=40) and the **large breasts** group (breast volume >2748.4 ml, N=21). The further analysis presents and analyses the parameters of only one, i.e. the right breast (because there were no statistically significant differences between parameters of the left and right breasts).

The **lean** women's group consisted of 27 pregnant women. The relative amount of their body fat tissue at the first measurement (at the beginning of pregnancy) was less than 24.4 percent and at the second measurement (by the end of pregnancy) – 28.54 percent. The **normal body build** group comprised 51 pregnant women with the body fat content ranging from 24.4 to 30.65 percent at the first measurement and from 28.58 to 33.65 percent at the second measurement. In all, 27 pregnant women belonged to the **obese** group. At the first measurement, overweight pregnant women had more than 30.65 per cent and at the second measurement – more than 33.65 per cent of the passive body weight.

## 2. Differences between the breast parameters and anthropometric indicators in pregnant women and young nulliparous women

### *2.1. Comparison of the breast size and shape parameters*

The study compared the breast size and shape indicators of two groups of women: pregnant primiparous and young nulliparous women (Table 1).

TABLE 1. **Breast size and shape indicators in pregnant primiparous and young nulliparous women**

| Dimensions | Primiparous (N=52) | | Young nulliparous (N=82) | | p |
|---|---|---|---|---|---|
| | M | SN | M | SN | |
| Breast base width (cm) | 14.2 | 1.2 | 13.35 | 1.53 | **0.000** |
| Breast base height (cm) | 12.4 | 1.2 | 11.7 | 1.16 | **0.001** |
| Jugular fossa - the nipple (cm) | 21.8 | 2.2 | – | – | – |
| Jugular fossa - 5 cm lateral to the nipple (cm) | 21.0 | 2.3 | – | – | – |
| The nipple – inframammary fold (cm) | 7.6 | 1.2 | – | – | – |
| The nipple – inframammary fold (lifting the breast) (cm) | 9.1 | 1.5 | – | – | – |
| Medial breast pole pinch (cm) | 23.6 | 6.9 | – | – | – |
| Lateral breast pole pinch (cm) | 23.9 | 9.3 | – | – | – |
| Upper breast pole pinch (cm) | 22.8 | 8.3 | – | – | – |
| Distance between the breasts (lower) (cm) | 4.6 | 0.8 | – | – | – |
| Distance between the nipples (cm) | 20.9 | 1.9 | – | – | – |
| Height of the nipple (cm) | 0.6 | 0.2 | – | – | – |
| Vertical dimension of the areola (cm) | 4.8 | 1.2 | 4.45 | 1.27 | 0.11 |
| Horizontal dimension of the areola (cm) | 4.6 | 1.2 | 4.23 | 1.02 | 0.07 |
| Horizontal lateral circumference (cm) | 13.2 | 1.8 | 10.9 | 1.98 | **0.000** |
| Horizontal medial circumference (cm) | 11.7 | 1.7 | 9.20 | 2.01 | **0.000** |
| Vertical upper circumference (cm) | 11.0 | 2.1 | 9.26 | 1.96 | **0.000** |
| Vertical lower circumference (cm) | 8.9 | 2.2 | 7.33 | 2.11 | **0.000** |
| Transverse circumference (cm) | 25.1 | 3.7 | – | – | – |
| Vertical circumference (cm) | 19.5 | 2.8 | – | – | – |
| Breast protrusion (cm) | 12.3 | 1.6 | 7.13 | 1.79 | **0.000** |
| Breast volume ($cm^3$) | 1145.9 | 252.1 | 602.4 | 239.6 | **0.000** |

The first trimester of pregnancy revealed the following differences between the breast parameters of pregnant primiparous women and young nulliparous women: the breast dimensions of young nulliparous women, except for areola, are smaller than those of primiparous women in early pregnancy (Table 1). The breast volume (602.4 $cm^3$) of young nulliparous women was nearly twice smaller than the analogous indicator of pregnant women (1145.9 $cm^3$).

### *2.2. The general body size indicators*

The pregnant women, participants of the study conducted from 2013 through 2015, were similar in height to the young nulliparous girls, as well as the average weight of pregnant women was 63.1 kg before pregnancy (in the first examination – 64.7 kg) while young nulliparous women weighed 61.15 kg. The BMI of the pregnant women in absolute figures was higher than that of young nulliparous girls (Table 2).

TABLE 2. **Body size indicators in pregnant primiparous and young nulliparous women**

| Indicator | Pregnant promiparous | | | Young nulliparous | | | P |
|---|---|---|---|---|---|---|---|
| | N | M | SN | N | M | SN | |
| Height (cm) | 104 | 168.9 | 5.6 | 82 | 168.18 | 6.09 | 0.41 |
| Weight (kg) | 105 | 63.1 | 10.5 | 82 | 61.15 | 9.2 | 0.18 |
| BMI | 104 | 22.2 | 3.6 | 82 | 21.7 | 3.19 | 0.32 |
| Chest circumference at breast level (cm) | 104 | 93.3 | 8.6 | 82 | 85.5 | 5.51 | **<0.001** |
| Waist circumference (cm) | 105 | 80.7 | 9.9 | 82 | 70.7 | 6.22 | **<0.001** |
| Hip circumference (cm) | 105 | 99 | 7.8 | 82 | 95.4 | 6.65 | **<0.001** |
| Waist-hip ratio | 105 | 0.81 | 0.07 | 82 | 0.74 | 0.04 | **<0.001** |
| Thigh circumference (cm) | 104 | 55.3 | 5.6 | 82 | 56.3 | 5.31 | 0.21 |
| Breast volume ($cm^3$) | 81 | 1173.4 | 420.4 | 82 | 602.4 | 239.64 | **<0.001** |

Table 2 shows that the mean breast circumference (93.3 cm) of the examined pregnant women was even 7.8 cm larger than this indicator (85.5 cm) in young girls. The difference was statistically significant, and it is associated with a large difference in the breast volume (602.4 $cm^3$ in young girls and 1173.4 $cm^3$ in pregnant women). The waist (80.7 cm) and the hip circumferences were also significantly increased in pregnant women. The thigh circumference (56.3 cm) was on average higher in young women, but this difference was not statistically significant. Even though the indicators of height and BMI did not differ between women bearing for the first time and nulliparous girls, however, almost all the body circumferences, with the exception of the thigh, are significantly larger.

### *2.3. Indicators of subcutaneous fat tissue development (passive body mass) and its topography (skinfolds)*

**The suprailiac, subscapular and tricipital skinfolds, were significantly** larger in pregnant women (p>0,05) than in young girls was slightly bigger in young nulliparous females (Figure 1).

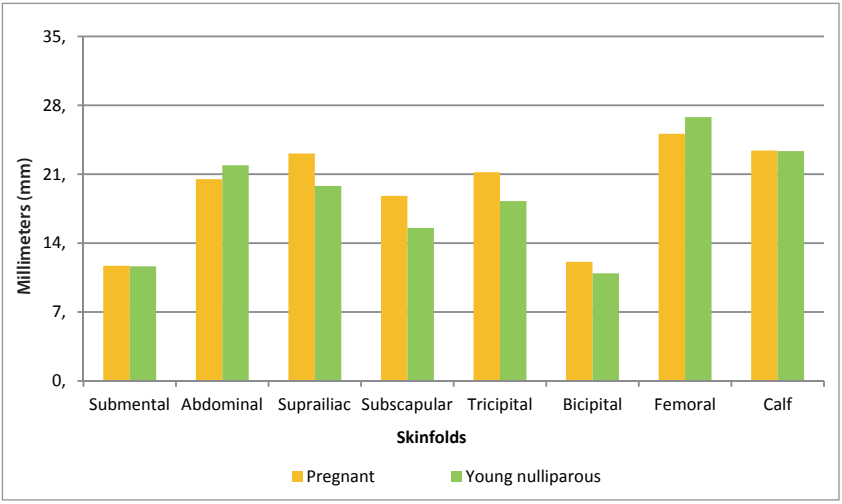


FIG. 1. **Subcutaneous fat skinfolds and passive body mass indicators in pregnant and young nulliparous women (measurements provided in mm)**

## 3. Changes in the breast parameters and in other anthropometric body parameters in primiparous, multiparous and all pregnant women (all the three groups) during pregnancy

### *3.1. Comparison of the breast size and shape indicators for the first and third trimesters of pregnancy*

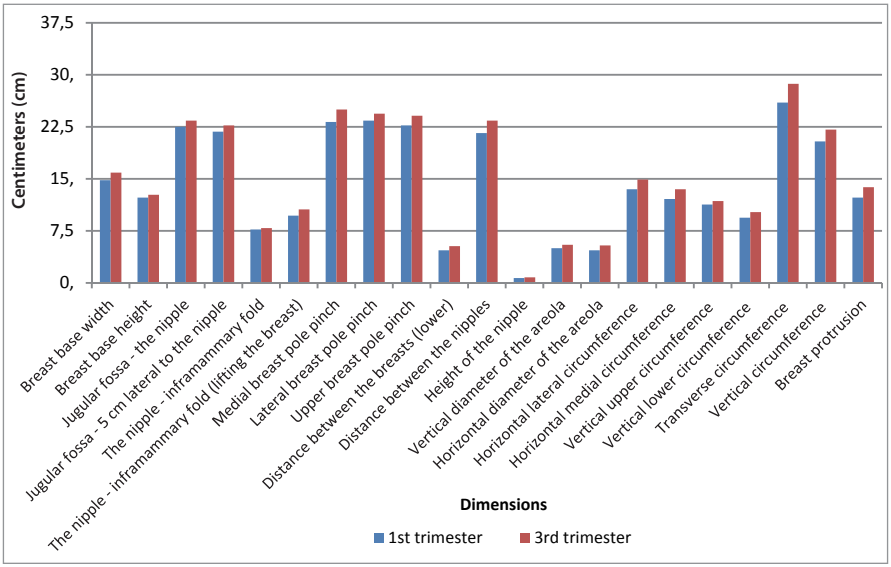


FIG. 2. **Breast size and shape indicators in pregnant women at the beginning and end of pregnancy (measurements provided in cm)**

A statistically significant increase was observed in the breast dimensions and volume of almost all the pregnant subjects during pregnancy. The breast volume increased by third from 1173.4 $cm^3$ at the first trimester of pregnancy up to 1480.8 $cm^3$ during the third trimester. Only three anthropometric indicators – the pinches of the medial, lateral breast poles and the upper breast pole – although increased in absolute numbers, did not reach statistical significance.

### *3.2. Changes in general body size indicators during pregnancy*

Table 3 shows the general indicators of body size – height, weight, BMI – in all pregnant women. The changes in the anthropometric indicators are already observed on the first weeks of pregnancy, although they are not visible yet. The changes in the body size and breast volume during pregnancy are provided in Figure 3.

TABLE 3. **Gestational age and general body size indicators of pregnant women (2013–2015)**

| Indicator | 1st trimester of pregnancy | | | 3rd trimester of pregnancy | | |
|---|---|---|---|---|---|---|
| | N | M | SN | N | M | SN |
| Gestation week | 105 | 10.5 | 2.7 | 86 | 35.1 | 1.8 |
| Weight (kg) | 105 | 64.7 | 10.1 | 86 | 84.1 | 8.5 |
| Height (cm) | 105 | 168.9 | 5.6 | – | – | – |
| BMI (kg/m$^2$) | 105 | 22.19 | 3.64 | – | – | – |

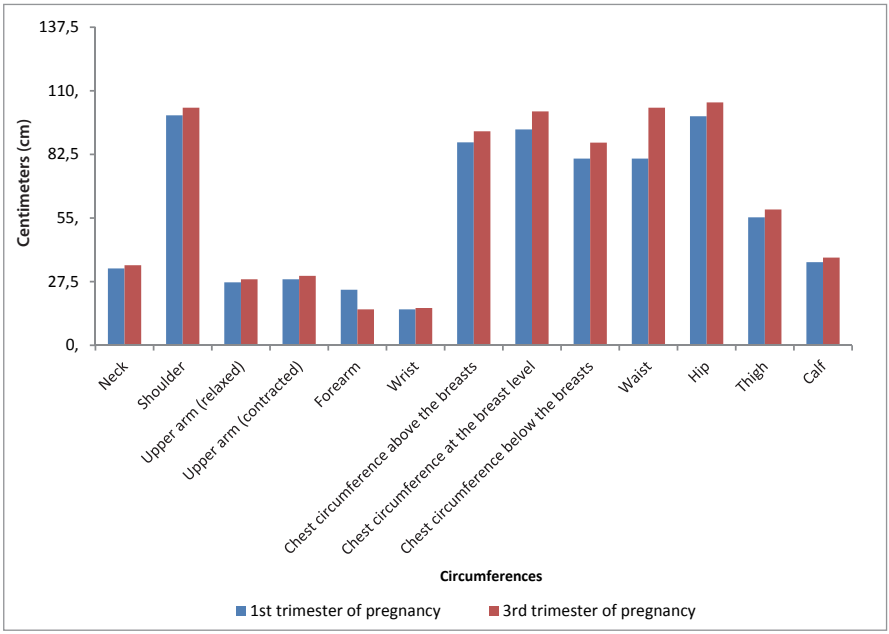


FIG. 3. **Body circumferences (provided in cm) in pregnant women (2013–2015)**

All the body circumferences taken in pregnant women during pregnancy show an increase ($p < 0.01$). Apart from that, the statistically significant difference was observed between anthropometric indicators of primiparous and multiparous women. The measured body circumferences of primiparous women were lower than those in multiparous subjects, especially at the beginning of pregnancy: neck circumference ($p=0.002$), shoulder ($p=0.003$), forearm ($p=0.04$), wrist ($p=0.03$), chest circumference at the breast level ($p=0.04$); chest below the breasts ($p=0.02$), waist ($p=0.0008$), hip ($p=0.017$) and waist to hip index ($p=0.015$). However, in late pregnancy, the mentioned differences in the anthropometric indicators decrease or even disappear completely, except for the neck circumference ($p=0.004$), because the body shape of primiparous females during the pregnancy is changing more evidently and becomes more similar to that of multiparous women.

### *3.3. Subcutaneous fat tissue (passive body mass) development and its topography (skinfolds) at the first and third trimesters of pregnancy*

Despite the differences in the body size during early pregnancy, the fat skinfold indicators of primiparous and multiparous women showed no statistically significant difference, although, taking into account absolute numbers, all the skinfolds indicators in primiparous women were smaller with the exception of the suprailiac skinfold.

At the end of pregnancy, the difference between the skinfolds of primiparous and multiparous women was not statistically significant (the only statistically significant difference was observed between the suprailiac skinfolds), however, the skinfolds in the majority of primiparous pregnant women were slightly larger. Thus, women who bear for the first time, gain slightly more passive body mass than women giving birth repeatedly.

Over the investigation period, the absolute passive body mass in pregnant primiparous women increased by an average of 6.0 kg, and in women with repeated childbirth – 4.1 kg. There was almost no difference in the relative body mass (in per cent) gain between the two groups of women. During the early pregnancy the passive body mass in primiparous women accounted for

27.98%, and at the end of pregnancy – 30.39%, in multiparous women – by 28.58% and 29.97%.

### *3.4. Comparison of the changes in the modern female body size and subcutaneous fat tissue development and its topography during pregnancy with the findings of the study carried out in 1986*

The average age of the pregnant women investigated in 1986 was 25.8 years (Table 4).Thirty years ago pregnant women were significantly (up to 4 cm) shorter in height and had a significantly higher BMI.

TABLE 4. **General body size indicators of pregnant women at early pregnancy in 1986 and in 2013–2015**

| Indicator | Year 1986 | | | Year 2013-15 | | | P |
|---|---|---|---|---|---|---|---|
| | N | M | SN | N | M | SN | |
| Height | 385 | 164.68 | 5.56 | 105 | 168.9 | 5.6 | **0.000** |
| Weight | 386 | 63.08 | 11.05 | 105 | 64.7 | 10.1 | 0.15 |
| BMI | 386 | 23.26 | 3.9 | 105 | 22.19 | 3.64 | **0.009** |

The submental, pectoral I, subscapular, calf subcutaneous fat skinfolds of the women investigated in early pregnancy in 2013–2015 were significantly bigger, compared to the analogous measurements obtained in 1986. However, the abdominal and thigh skinfolds of the pregnant women examined in 2013–2015 were significantly smaller, while the upper arm folds did not show any difference (Figure 4). Hence, the body shape of modern pregnant females became more "cylindrical", i.e. more subcutaneous body fat now is located on females' trunk, and that shows central fat patterning which is a typical marker for many metabolic syndrome related diseases.

In late pregnancy, all the subjects investigated in 2013-2015 showed almost all fat skinfolds to be statistically larger in comparison with the analogous data obtained in 1986. In particular, a statistically significant difference was observed in the diminished femoral skinfold of pregnant women from the years 2013–2015. This distinction confirms the trend in the distribution of subcutaneous fat tissue in modern young women shifting towards the male body build (Figure 5).

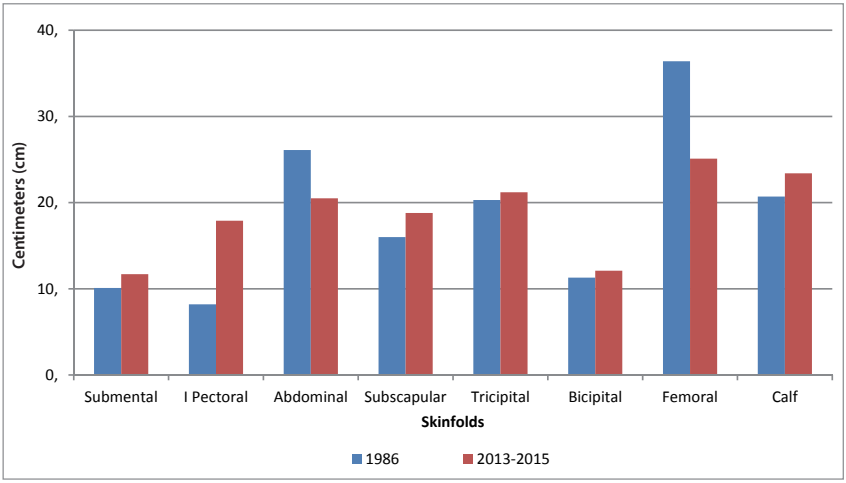


FIG. 4. **Subcutaneous fat tissue topography (skinfolds) in pregnant women in early pregnancy in 1986 and in 2013–2015**

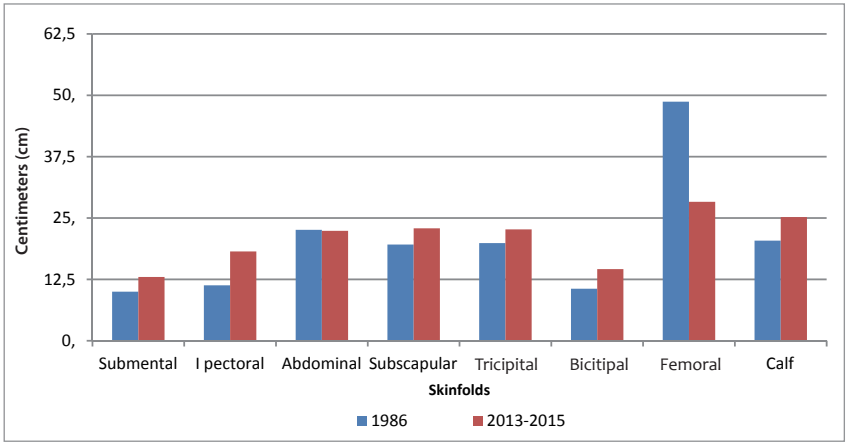


FIG. 5. **Subcutaneous fat tissue topography (skinfolds) in pregnant women in late pregnancy in 1986 and in 2013–2015**

## 4. Changes in breast parameters and other anthropometric indicators of pregnant women in relation to the breast size

### *4.1. Comparison of breast size and shape indicators in the first and third trimesters of pregnancy*

All the breast dimensions increased in the group of women with small breasts during pregnancy (Table 5). The absolute numbers showed an increase in the medial, lateral, upper breast pole pinch, the distance between the breasts, the height of the nipple and vertical lower circumference, however, the change in these dimensions was not statistically significant. The remaining 15 dimensions revealed a statistically significant increase during pregnancy. The breast volume increased by almost 40 per cent mostly due to the increased breast protrusion – more than 17 per cent. Apart from that, a considerable increase was observed in the areola diameters (more than 14 per cent) and in the horizontal medial circumference of the breast (more than 15 per cent).

In the group of women with medium-sized breasts, all the breast parameters accelerated by the end of pregnancy. However, the increase observed in this category was less tangible than the one recorded in the group of women with small breasts. The breast circumferences revealed a statistically significant increase, with the exception of the irrelevant rise of the vertical upper circumference.

The comparison of the breast size indicators of subjects with three breast size categories leads to a conclusion that the breast size alterations were not identical. The most dramatic statistically significant changes were detected in the group of women with small breasts, whereas the smallest fluctuations were observed in women with large breasts.

TABLE 5. **Breast size and shape indicators and their changes in women with small breasts during pregnancy**

| Indicator | 1st trimester | | 3rd trimester | | P | Relative change (%) |
|---|---|---|---|---|---|---|
| | M | SN | M | SN | | |
| Breast base width (cm) | 13.1 | 0.6 | 14.6 | 1.0 | **0.000** | 11.5 |
| Breast base height (cm) | 11.3 | 1.3 | 12.0 | 1.3 | **0.000** | 6.2 |
| Jugular fossa - the nipple (cm) | 20.4 | 1.7 | 21.8 | 1.8 | **0.0012** | 6.9 |
| Jugular fossa - 5 cm lateral to the nipple (cm) | 19.6 | 1.7 | 20.9 | 1.9 | **0.003** | 6.6 |
| The nipple – inframammary (cm) | 7.0 | 1.0 | 7.6 | 1.1 | **0.02** | 8.6 |
| The nipple – inframammary fold (lifting the breast) (cm) | 8.5 | 1.2 | 9.3 | 1.2 | **0.002** | 9.4 |
| Medial breast pole pinch (cm) | 20.6 | 6.5 | 23.3 | 7.5 | 0.45 | 13.1 |
| Lateral breast pole pinch (cm) | 21.0 | 8.1 | 22.4 | 7.8 | 0.93 | 6.7 |
| Upper breast pole pinch (cm) | 20.2 | 8.1 | 22.2 | 7.4 | 0.64 | 9.9 |
| Distance between the breasts (lower pole) (cm) | 4.5 | 0.8 | 5.0 | 1.1 | 0.08 | 11.1 |
| Distance between the nipples (cm) | 19.8 | 1.5 | 21.7 | 1.5 | **0.000** | 9.6 |
| Height of the nipple (cm) | 0.8 | 0.2 | **0.9** | 0.2 | 0.50 | 12.5 |
| Vertical dimension of the areola (cm) | 4.2 | 1.1 | 4.8 | 1.3 | **0.0015** | 14.3 |
| Horizontal dimension of the areola (cm) | 4.2 | 0.9 | 4.8 | 1.0 | **0.000** | 14,3 |
| Horizontal lateral circumference (cm) | 11.5 | 1.4 | 12.6 | 1.5 | **0.009** | 9.6 |
| Horizontal medial circumference (cm) | 10.3 | 1.6 | 11.9 | 1.5 | **0.000** | 15.5 |
| Vertical upper circumference (cm) | 9.4 | 2.1 | 9.9 | 2.0 | **0.04** | 5.3 |
| Vertical lower circumference (cm) | 8.7 | 3.2 | 8.6 | 1.6 | 0.82 | -1.1 |
| Transverse circumference (cm) | 21.6 | 2.7 | 24.5 | 2.8 | **0.000** | 13.4 |
| Vertical circumference (cm) | 17.2 | 2.5 | 19.1 | 3.3 | **0.02** | 11.0 |
| Breast protrusion (cm) | 9.9 | 1.1 | 11.6 | 1.2 | **0.000** | 17.2 |
| Breast volume ($cm^3$) | 760.4 | 100.6 | 1053.7 | 162.9 | **0.000** | 38.6 |

TABLE 6. **Breast indicators and their changes in women with medium size breasts during pregnancy**

| Indicator | 1st trimester | | 3rd trimester | | P | Relative change (%) |
|---|---|---|---|---|---|---|
| | M | SN | M | SN | | |
| Breast base width (cm) | 14.4 | 0.9 | 15.7 | 0.8 | **0.000** | 9.0 |
| Breast base height (cm) | 12.0 | 1.0 | 12.6 | 1.2 | **0.002** | 5.0 |
| Jugular fossa - the nipple (cm) | 22.4 | 1.9 | 23.4 | 1.9 | **0.000** | 4.5 |
| Jugular fossa - 5 cm lateral to the nipple (cm) | 21.8 | 1.9 | 22.7 | 2.1 | **0.000** | 4.1 |
| The nipple – inframammary (cm) | 7.8 | 1.1 | 8.0 | 1.0 | 0.07 | 2.6 |
| The nipple – inframammary fold (lifting the breast) (cm) | 9.7 | 1.6 | 10.7 | 1.6 | **0.000** | 10.3 |
| Medial breast pole pinch (cm) | 23.2 | 6.5 | 23.0 | 8.8 | 0.74 | -0.9 |
| Lateral breast pole pinch (cm) | 23.4 | 8.9 | 22.5 | 9.3 | 0.91 | -3.8 |
| Upper breast pole pinch (cm) | 23.2 | 7.8 | 23.2 | 7.9 | 0.35 | 0.0 |
| Distance between the breasts (lower pole) (cm) | 4.6 | 1.2 | 5.5 | 1.3 | **0.000** | 19.6 |
| Distance between the nipples (cm) | 21.4 | 1.9 | 23.3 | 2.2 | **0.000** | 8.9 |
| Height of the nipple (cm) | 0.7 | 0.3 | 0.8 | 0.3 | **0.0099** | 14.3 |
| Vertical dimension of the areola (cm) | 4.9 | 1.0 | 5.4 | 1.0 | **0.000** | 10.2 |
| Horizontal dimension of the areola (cm) | 4.7 | 1.0 | 5.3 | 1.0 | **0.000** | 12.8 |
| Horizontal lateral circumference (cm) | 13.7 | 1.5 | 14.8 | 1.8 | **0.000** | 8.0 |
| Horizontal medial circumference (cm) | 12.1 | 1.8 | 13.5 | 1.9 | **0.000** | 11.6 |
| Vertical medial circumference (cm) | 11,6 | 1,9 | 11,8 | 2,1 | 0,52 | 1,7 |
| Vertical lower circumference (cm) | 9.2 | 1.6 | 10.5 | 2.4 | **0.000** | 14.1 |
| Transverse circumference (cm) | 26.2 | 3.3 | 29.2 | 2.7 | **0.000** | 11.5 |
| Vertical circumference (cm) | 20.6 | 2.7 | 21.6 | 3.2 | **0.009** | 4.9 |
| Breast protrusion (cm) | 12.5 | 1.2 | 13.9 | 1.2 | **0.000** | 11.2 |
| Breast volume ($cm^3$) | 1129.9 | 143.3 | 1441.1 | 209.0 | **0.000** | 27.5 |

TABLE 7. **Breast indicators and their changes in women with large size breasts during pregnancy**

| Indicator | 1st trimester | | 3rd trimester | | P | Relative change (%) |
|---|---|---|---|---|---|---|
| | M | SN | M | SN | | |
| Breast base width (cm) | 16.6 | 1.7 | 17.7 | 1.6 | **0.000** | 6.6 |
| Breast base height (cm) | 13.3 | 1.3 | 13.6 | 1.5 | 0.37 | 2.3 |
| Jugular fossa - the nipple (cm) | 24.5 | 2.7 | 25.6 | 2.6 | **0.02** | 4.5 |
| Jugular fossa - 5 cm lateral to the nipple (cm) | 23.8 | 2.9 | 24.8 | 2.5 | **0.003** | 4.2 |
| The nipple – inframammary (cm) | 8.4 | 1.0 | 8.2 | 1.3 | 0.67 | -2.4 |
| The nipple – inframammary fold (lifting the breast) (cm) | 11.5 | 2.3 | 12.4 | 2.4 | **0.007** | 7.8 |
| Medial breast pole pinch (cm) | 24.0 | 6.5 | 25.2 | 7.8 | 0.77 | 5.0 |
| Lateral breast pole pinch (cm) | 23.9 | 7.7 | 24.7 | 8.7 | 0.97 | 3.3 |
| Upper breast pole pinch (cm) | 23.3 | 6.9 | 23.6 | 7.6 | 0.76 | 1.3 |
| Distance between the breasts (lower pole) (cm) | 5.1 | 1.2 | 5.4 | 1.8 | 0.55 | 5.9 |
| Distance between the nipples (cm) | 23.9 | 2.9 | 26.0 | 3.0 | **0.000** | 8.8 |
| Height of the nipple (cm) | 0.7 | 0.3 | 0.8 | 0.3 | 0.14 | 14.3 |
| Vertical diameter of the areola (cm) | 5.8 | 1.1 | 6.1 | 1.0 | **0.04** | 5.2 |
| Horizontal diameter of the areola (cm) | 5.2 | 1.0 | 5.8 | 0.9 | **0.000** | 11.5 |
| Horizontal lateral circumference (cm) | 15.4 | 2.5 | 16.8 | 2.3 | **0.011** | 9.1 |
| Horizontal medial circumference (cm) | 14.1 | 2.5 | 15.4 | 2.4 | **0.002** | 9.2 |
| Vertical upper circumference (cm) | 12.9 | 2.8 | 13.5 | 2.5 | 0.09 | 4.7 |
| Vertical lower circumference (cm) | 10.7 | 1.7 | 12.2 | 2.2 | **0.000** | 14.0 |
| Transverse circumference (cm) | 30.0 | 4.9 | 33.1 | 5.8 | **0.000** | 10.3 |
| Vertical circumference (cm) | 23.6 | 4.3 | 25.9 | 4.3 | **0.000** | 9.7 |
| Breast protrusion (cm) | 14.6 | 1.4 | 15.3 | 1.9 | 0.09 | 4.8 |
| Breast volume ($cm^3$) | 1693.8 | 462.4 | 1978.8 | 648.5 | **0.012** | 16.8 |

TABLE 8. **The distribution of women into groups by breast size at the beginning and the end of pregnancy**

| Groups by the size of breasts at the beginning of pregnancy | | Groups by the size of breasts at the end of pregnancy | | | In total |
|---|---|---|---|---|---|
| | | Small breasts | Medium breasts | Large breasts | |
| **Small breasts** | N | 13 | 5 | 0 | 18 |
| | % | **72.2** | **27.8** | **0.0** | 100.0 |
| **Medium breasts** | N | 4 | 23 | 6 | 33 |
| | % | **12.1** | **69.7** | **18.2** | 100.0 |
| **Large breasts** | N | 0 | 5 | 12 | 17 |
| | % | **0.0** | **29.4** | **70.6** | 100.0 |
| **In total** | | 17 | 33 | 18 | 68 |
| | | 25.0 | 48.5 | 26.5 | 100.0 |

The breasts indicators of 70 per cent of subjects during pregnancy belonged to the same breast size group, i.e. these women by breast size, both in early pregnancy and late pregnancy, were assigned to the same breast size group. The breasts of the remaining 30 per cent of women either increased and were attributed to a "larger breasts" group (11 cases), or decreased and were assigned to a "smaller breasts" group (9 cases) (Table 8).

### *4.2. Comparison of the general body size indicators for the 1st and the 3rd trimesters*

The body circumferences in pregnant women with small breasts are increasing, except for the wrist, forearm and upper arm (Table 9). The statistically significant rise in the indicators was most likely to be associated with the increased circumferences of the chest and waist regions. The circumferences of all the measured body parts (including wrist, forearm, upper arm circumferences) showed an upward trend in women with medium-

size breasts. An accelerating pattern, similar to the one seen in women with medium breasts, was observed in pregnant women with large breasts: the body circumferences showed a statistically significant increase (Table 10).

TABLE 9. **Changes of anthropometric indicators in pregnant women with small breasts**

| Indicator N=21 | 1st trimester | | 3rd trimester | | P | Relative change (%) |
|---|---|---|---|---|---|---|
| | M | SN | M | SN | | |
| Height (cm) | 167.5 | 5.6 | – | – | | |
| Weight (kg) | 58.2 | 7.5 | 72.6 | 7.1 | **0.000** | 24.7 |
| BMI | 20.20 | 1.99 | 25.95 | 2.18 | **0.000** | 28.5 |
| Neck circumference (cm) | 32.6 | 1.5 | 34.4 | 1.5 | **0.000** | 5.5 |
| Shoulder circumference (cm) | 98.3 | 4.7 | 101.0 | 4.8 | **0.000** | 2.7 |
| Upper arm (relaxed) circumference (cm) | 25.0 | 2.8 | 26.7 | 3.5 | >0.05 | 6.8 |
| Upper arm (contracted) circumference (cm) | 26.3 | 2.8 | 28.0 | 3.2 | >0.05 | 6.5 |
| Forearm circumference (cm) | 22.7 | 2.4 | 23.9 | 2.9 | >0.05 | 5.3 |
| Wrist circumference (cm) | 15.0 | 0.7 | 15.6 | 0.8 | >0.05 | 4.0 |
| Chest circumference above the breast (cm) | 84.2 | 3.4 | 88.9 | 3.3 | **0.000** | 5.6 |
| Chest circumference at the breast level (cm) | 86.7 | 4.5 | 95.3 | 3.5 | **0.000** | 9.9 |
| Chest circumference below the breast (cm) | 76.5 | 4.1 | 82.4 | 4.0 | **0.000** | 7.7 |
| Waist circumference (cm) | 77.6 | 5.3 | 97.9 | 6.7 | **0.000** | 26.2 |
| Hip circumference (cm) | 95.1 | 6.6 | 103.4 | 4.5 | **0.000** | 8.7 |
| Waist-hip ratio | 0.82 | 0.07 | 0.94 | 0.07 | **0.000** | 14.6 |
| Thigh circumference (cm) | 52.8 | 4.7 | 56.3 | 3.9 | **0.000** | 6.6 |
| Calf circumference (cm) | 34.4 | 2.0 | 36.3 | 1.8 | **<0.01** | 5.5 |

TABLE 10. **Changes of anthropometric indicators in pregnant women with large breasts**

| Indicator N=20 | 1st trimester | | 3rd trimester | | P | Relative change (%) |
|---|---|---|---|---|---|---|
| | M | SN | M | SN | | |
| Height (cm) | 167.4 | 6.5 | – | – | – | – |
| Weight (kg) | 69.6 | 12.8 | 84.1 | 8.5 | **0.000** | 20.8 |
| BMI | 24.62 | 5.14 | 29.92 | 3.77 | **0.000** | 21.5 |
| Neck circumference (cm) | 35.0 | 2.5 | 36.0 | 3.3 | >0.05 | 2.9 |
| Shoulder circumference (cm) | 102.5 | 7.9 | 106.4 | 7.9 | **<0.05** | 3.8 |
| Upper arm (relaxed) circumference (cm) | 29.5 | 3.8 | 31.3 | 4.4 | **0.000** | 6.1 |
| Upper arm (contracted) circumference (cm) | 31.0 | 4.3 | 33.1 | 4.7 | **0.000** | 6.8 |
| Forearm circumference (cm) | 25.4 | 2.6 | 26.9 | 2.8 | **0.000** | 5.9 |
| Wrist circumference (cm) | 16.5 | 2.2 | 16.8 | 1.3 | **<0.05** | 1.8 |
| Chest circumference above the breast | 92.7 | 7.9 | 97.3 | 6.1 | **0.000** | 5.0 |
| Chest circumference at the breast level (cm) | 100.7 | 9.0 | 108.4 | 7.6 | **0.000** | 7.6 |
| Chest circumference below the breast (cm) | 86.5 | 9.6 | 95.1 | 7.1 | **0.000** | 9.9 |
| Waist circumference (cm) | 88.8 | 13.0 | 110.7 | 9.2 | **0.000** | 24.7 |
| Hip circumference (cm) | 102.9 | 9.1 | 109.1 | 6.6 | **0.000** | 6.0 |
| Waist-hip ratio | 0.86 | 0.08 | 1.01 | 0.05 | **0.000** | 17.4 |
| Thigh circumference (cm) | 58.1 | 6.7 | 62.3 | 5.2 | **<0.01** | 7.2 |
| Calf circumference (cm) | 37.4 | 3.1 | 39.7 | 2.7 | **0.000** | 6.1 |

### *4.3. Comparison of the subcutaneous fat tissue (passive body mass quantity) development and its topography indicators (skinfolds) for the first and third trimesters*

The passive body mass in pregnant women with small breasts builds up in the upper area of the body – the fat tissue increased from 24.2 per cent up 27.1 per cent (p> 0.05). The largest changes in anthropometric indices were registered in pregnant females with small breasts. The subcutaneous fat skinfolds of pregnant women with medium breasts showed a more equal and smoother

increase than those in women with small breasts. Also, the passive body mass also accumulated significantly in the forearms and upper arms. The adipose tissue significantly grew from 28.5 per cent at the beginning of pregnancy up to 30.6 per cent in the third trimester. The fluctuations observed in the subcutaneous fat skinfolds of women with large breasts were insignificant, the adipose tissue did not significantly increase.

At the start of the study, the association between the women's body size and breast size indices was statistically significant ($p<0.000$). However, in the early pregnancy, about half of the subjects from the lean women's group (N=10; 52.6 per cent) had small breasts, the other half - medium-sized breasts (N= 9; 47.4 per cent). The lean women did not have large breasts. The normal body build women's group comprised women with small breasts (N=11; 26.2 per cent), 23 (54.8 per cent) with medium-sized breasts and 8 (19 per cent) with large breasts.

Obese women did not have small breasts, while large breasts were found in 12 (60 per cent) of them and medium-sized breasts - in 8 (40 per cent).

Women with small breasts were either lean or of normal body build. More than half of women with medium size breasts, were also of medium build, whereas about one-fifth of them - either lean or obese. Most subjects with large breasts (60 per cent) were obese.

By the end of pregnancy, the shift towards a group of larger breasts size was observed in lean women (their breasts enlarged by 5 per cent), while the trend towards a smaller breast size category was detected in pregnant females with larger breasts (9.5 per cent of them had even small breasts). Thus, in late pregnancy (third trimester) the distribution of women according to the passive body mass and breast size provides a slightly different pattern. Hence, the individual trends in the breast changes during the pregnancy were distinctive to females with different adipose tissue development and various breast size category.

## 5. Changes in the breast parameters and other anthropometric indicator during pregnancy in relation to the body size

### *5.1. Comparison of the breast size and shape indicators in the third trimester of pregnancy*

Most indicators in the lean women's category during pregnancy increased significantly. The breast volume in this group increased by almost a third – by 28.3 per cent. An increase of almost 20 per cent was observed in the medial, lateral and upper breast pole pinches – 18.9 per cent, 17.2 per cent and 17.5 per cent (respectively).

The breast size in the medium body-sized women (N=51) during pregnancy increased at similar intensity as in the lean women. Even 17 breast size indicators showed a rise in this group of pregnant women, the most significant growth was seen in breast circumferences. The breast volume increased by 28.1 per cent. However, it should be noted that breast rates in the pregnant women of the normal build body size increased more moderately than the analogous parameters of the lean women.

The breast volume of the obese women in the third trimester increased by 19.9 per cent. Even though this increase was significant ($p<0.002$), however, it was lower than that observed in the lean women and women with normal build. It should be noted that the medial, lateral and upper breast pole pinches even dropped and gained the negative relative changes values (Table 12).

TABLE 11. **Changes of breast indices in lean women during pregnancy**

| Indicator | 1st trimester | | 3rd trimester | | p | Relative change (%) |
|---|---|---|---|---|---|---|
| | M | SN | M | SN | | |
| Breast base width (cm) | 13.5 | 0.9 | 15.0 | 1.3 | **0.000** | 11.1 |
| Breast base height (cm) | 11.7 | 1.1 | 12.5 | 1.2 | **0.003** | 6.8 |
| Jugular fossa - the nipple (cm) | 21.0 | 1.7 | 22.1 | 2.1 | **0.003** | 5.2 |
| Jugular fossa - 5 cm lateral to the nipple (cm) | 19.9 | 1.8 | 20.8 | 2.0 | **0.03** | 4.5 |
| The nipple – inframammary (cm) | 7.3 | 1.1 | 7.8 | 1.2 | **0.02** | 6.8 |
| The nipple – inframammary fold (lifting the breast) (cm) | 8.6 | 1.3 | 9.3 | 1.5 | **0.000** | 8.1 |
| Medial breast pole pinch (cm) | 20.1 | 6.3 | 23.9 | 9.2 | 0.15 | 18.9 |
| Lateral breast pole pinch (cm) | 20.9 | 8.0 | 24.5 | 8.5 | 0.23 | 17.2 |
| Upper breast pole pinch (cm) | 20.0 | 8.0 | 23.5 | 8.0 | **0.049** | 17.5 |
| Distance between the breasts (lower pole) (cm) | 4.5 | 1.0 | 4.8 | 0.9 | 0.12 | 6.7 |
| Distance between the nipples (cm) | 20.4 | 1.4 | 22.3 | 1.9 | **0.000** | 9.3 |
| Height of the nipple (cm) | 0.7 | 0.2 | 0.8 | 0.2 | **0.03** | 14.3 |
| Vertical diameter of the areola (cm) | 4.3 | 0.8 | 4.7 | 1.1 | **0.006** | 9.3 |
| Horizontal diameter of the areola (cm) | 4.2 | 0.7 | 4.8 | 1.1 | **0.002** | 14.3 |
| Horizontal lateral circumference (cm) | 12.9 | 1.7 | 13.0 | 2.0 | **0.008** | 0.8 |
| Horizontal medial circumference (cm) | 11.1 | 1.6 | 11.8 | 1.7 | **0.002** | 6.3 |
| Vertical upper circumference (cm) | 10.7 | 2.0 | 10.4 | 1.9 | 0.59 | -2.8 |
| Vertical lower circumference (cm) | 9.2 | 2.6 | 9.0 | 1.7 | 0.88 | -2.2 |
| Transverse circumference (cm) | 24.1 | 3.2 | 24.9 | 3.7 | **0.004** | 3.3 |
| Vertical circumference (cm) | 19.1 | 2.6 | 19.6 | 2.6 | **0.02** | 2.6 |
| Breast protrusion (cm) | 11.3 | 1.8 | 12.2 | 1.4 | **0.002** | 8.0 |
| Breast volume ($cm^3$) | 937.8 | 223.1 | 1203.4 | 251.5 | **0.000** | 28.3 |

TABLE 12. **Changes of breast indices in obese women during pregnancy**

| Indicator | 1st trimester | | 3rd trimester | | p | Relative change (%) |
|---|---|---|---|---|---|---|
| | M | SN | M | SN | | |
| Breast base width (cm) | 16.4 | 2.5 | 17.1 | 1.6 | **0.000** | 4.3 |
| Breast base height (cm) | 13.2 | 1.4 | 13.5 | 1.6 | 0.27 | 2.3 |
| Jugular fossa - the nipple (cm) | 24.3 | 2.9 | 24.8 | 2.5 | **0.000** | 2.1 |
| Jugular fossa - 5 cm lateral to the nipple (cm) | 23.8 | 3.1 | 24.0 | 2.7 | **0.000** | 0.8 |
| The nipple – inframammary (cm) | 8.4 | 1.1 | 8.6 | 1.2 | 0.48 | 2.4 |
| The nipple – inframammary fold (lifting the breast) (cm) | 11.2 | 2.2 | 11.8 | 2.0 | **0.002** | 5.4 |
| Medial breast pole pinch (cm) | 27.6 | 5.4 | 25.9 | 8.6 | 0.27 | -6.2 |
| Lateral breast pole pinch (cm) | 28.2 | 5.9 | 26.0 | 8.8 | 0.23 | -7.8 |
| Upper breast pole pinch (cm) | 27.2 | 5.5 | 25.8 | 7.9 | 0.32 | -5.1 |
| Distance between the breasts (lower pole) (cm) | 4.7 | 1.2 | 5.4 | 1.7 | 0.10 | 14.9 |
| Distance between the nipples (cm) | 23.1 | 3.3 | 24.7 | 3.1 | **0.000** | 6.9 |
| Height of the nipple (cm) | 0.7 | 0.3 | 0.8 | 0.3 | **0.003** | 14.3 |
| Vertical diameter of the areola (cm) | 5.4 | 1.3 | 5.8 | 1.2 | **0.000** | 7.4 |
| Horizontal diameter of the areola (cm) | 5.2 | 1.4 | 5.8 | 1.5 | **0.000** | 11.5 |
| Horizontal lateral circumference (cm) | 14.8 | 2.6 | 16.3 | 2.2 | **0.002** | 10.1 |
| Horizontal medial circumference (cm) | 13.7 | 2.7 | 14.6 | 2.3 | **0.001** | 6.6 |
| Vertical upper circumference (cm) | 12.6 | 2.8 | 12.6 | 2.5 | 0.24 | 0.0 |
| Vertical lower circumference (cm) | 10.1 | 2.2 | 11.2 | 2.2 | **0.000** | 10.9 |
| Transverse circumference (cm) | 28.8 | 5.0 | 31.1 | 5.5 | **0.001** | 8.0 |
| Vertical circumference (cm) | 22.8 | 4.7 | 24.2 | 5.0 | **0.012** | 6.1 |
| Breast protrusion (cm) | 13.6 | 1.9 | 15.1 | 1.7 | **0.001** | 11.0 |
| Breast volume ($cm^3$) | 1556.1 | 537.6 | 1866.2 | 606.1 | **0.002** | 19.9 |

### *5.2. Comparison of the general body size indicators for the third trimesters of pregnancy*

In the lean women's group, all the body size circumferences were significantly growing during pregnancy.

All the body size circumferences in the pregnant women of the normal body build showed a statistically significant increase during pregnancy. The waist circumference in this category of women increased by almost one third (29.0 per cent). In contrast with the lean pregnant women's group, the circumferences of the upper extremities in the normal body build subjects grew significantly.

A statistically significant rise in all the pregnant body circumferences was recorded in the obese women's group over the period from the 1st to the 3rd trimesters of pregnancy. The largest relative changes were observed in the waist circumference (21.7 per cent) and in the WHI (waist to hip index) (18.8 per cent).

### *5.3. Comparison of the subcutaneous tissue (passive mass quantity) development and its topography indicators (skinfolds) for the first and third trimesters of pregnancy*

All the skinfolds parameters in the lean pregnant women showed a statistically significant increase: the biceps skinfold increased by 59.7 per cent, subscapular – 53.6 per cent, forearm – 44.1 per cent, the other skinfolds – by approximately one third: axillary – 37.8 per cent, suprailiac – 33.3, submental – 32.5 per cent, pectoral II – 31.5 per cent, thigh - 30.0 per cent. Therefore, the most considerable increase in the adipose tissue in the lean pregnant women were observed in the upper part of the body. Overall, the passive body mass volume starting from the beginning of pregnancy increased from 24.2 up to 27.1 per cent.

An increase in the subcutaneous fat skinfolds, similar to that of the lean women, is seen in the pregnant women with the normal body build. The passive body mass quantity change is significant, yet slightly less pronounced than in the lean women.

The diminishing trend in the subcutaneous fat skinfolds of the obese pregnant women was visible in even 8 skinfolds (submental, pectoral I and II, axillary, triceps, forearm, thigh and calf skinfolds), but all the changes registered in the skinfolds were not statistically significant. The relative passive body mass remained almost unchanged.

### 6. The peculiarities of certain metabolism indicators (prolactin, lipids) in pregnant women for the first and third trimesters of pregnancy and their multiple relationships with the breast and body size parameters

We investigated the changes of the levels of blood serum prolactin and lipid in all pregnant women (N=105) during pregnancy. During pregnancy, a statistically significant ($p<0.001$) increase was observed in the blood serum levels of prolactin, total cholesterol, HDL cholesterol, LDL cholesterol and triglyceride levels. The prolactin levels during pregnancy increased even 8.5 times (Table 13).

TABLE 13. **Changes of the blood serum prolactin and lipid metabolism parameters in pregnant women from 2013 through 2015**

| Indicator | 1st trimester | | | 3rd trimester | | | Relative change (%) | P |
|---|---|---|---|---|---|---|---|---|
| | N | M | SN | N | M | SN | | |
| Prolactin | 103 | 42.4 | 23.8 | 83 | 400.2 | 211.4 | 843.9 | **<0.001** |
| Ch | 105 | 4.76 | 0.82 | 85 | 6.54 | 1.58 | 37.4 | **<0.001** |
| HDL Ch | 105 | 1.77 | 0.36 | 83 | 2.00 | 0.42 | 13.0 | **<0.001** |
| LDL Ch | 105 | 2.52 | 0.61 | 85 | 3.66 | 1.35 | 45.2 | **<0.001** |
| TG | 104 | 1.09 | 0.44 | 85 | 2.33 | 0.92 | 113.8 | **<0.001** |

The comparison of these findings with the analogous data obtained in 1986 revealed the same trend in changes in lipid parameters of pregnant women (Table 14).

TABLE 14. **Changes of the levels in the blood serum lipids during pregnancy in subjects examined in 1986**

| Indicator | 1st trimester | | | 3rd trimester | | | Relative change | P |
|---|---|---|---|---|---|---|---|---|
| | N | M | SN | N | M | SN | (%) | |
| Ch | 228 | 4.97 | 0.98 | 274 | 6.58 | 1.12 | 32.4 | **<0.001** |
| HDL Ch | 224 | 1.85 | 0.66 | 270 | 2.02 | 0.64 | 9.2 | **<0.001** |
| LDL Ch | 217 | 2.34 | 0.89 | 271 | 3.08 | 0.96 | 31.6 | **<0.001** |
| TG | 224 | 1.67 | 0.74 | 271 | 3.35 | 1.57 | 100.6 | **<0.001** |

According to the biochemical values obtained from the study of 2013–2015, both, at the beginning and end of pregnancy, the primiparous and multiparous women showed a statistically significant difference only in the blood serum prolactin concentration levels: in primiparous females the serum prolactin average concentration level was 50.9 mU/l, while in multiparous - 34.3 mU/l.

The blood serum lipid metabolism parameters of both groups of women in early pregnancy were not statistically different, although in multiparous females almost all indicators in absolute numbers were higher than analogous indicators in primiparous women. At the end of pregnancy, despite the increase in all the indicators, the differences between the groups remained not significant, while the blood serum prolactin level reached a similar level in both groups of women. However, both in primiparous and multiparous pregnant females – all the changes (in all tested biochemical parameters) during the pregnancy were statistically significant.

The pregnant women were divided into groups by the breast size (small, medium, large), and the changes in the serum prolactin and lipid metabolism indices during pregnancy were compared (Table 15).

TABLE 15. **Changes of blood serum prolactin and lipid parameters in women with small, medium and large breasts during pregnancy**

| Indicator | 1st trimester | | | 3rd trimester | | | Relative change (%) | P |
|---|---|---|---|---|---|---|---|---|
| | N | M | SN | N | M | SN | | |
| Small breasts | | | | | | | | |
| Prolactin | 20 | 37.6 | 16.7 | 17 | 424.9 | 166.5 | 1030.0 | **<0.001** |
| Ch | 21 | 4.84 | 1.09 | 18 | 7.01 | 2.09 | 44.8 | **<0.001** |
| HDL Ch | 21 | 1.86 | 0.33 | 18 | 2.14 | 0.39 | 15.1 | **0.009** |
| LDL Ch | 21 | 2.52 | 0.90 | 18 | 4.02 | 1.74 | 59.5 | **0.002** |
| TG | 20 | 1.15 | 0.53 | 18 | 2.49 | 0.99 | 116.5 | **<0.001** |
| Medium breasts | | | | | | | | |
| Prolactin | 40 | 42.8 | 27.1 | 31 | 375.9 | 163.5 | 778.3 | **<0.001** |
| Ch | 40 | 4.71 | 0.71 | 32 | 6.22 | 1.45 | 32.1 | **<0.001** |
| HDL Ch | 40 | 1.72 | 0.36 | 32 | 1.93 | 0.44 | 12.2 | **0.04** |
| LDL Ch | 40 | 2.54 | 0.48 | 32 | 3.61 | 1.33 | 42.1 | **<0.001** |
| TG | 40 | 1.04 | 0.44 | 32 | 2.20 | 0.93 | 111.5 | **<0.001** |
| Large breasts | | | | | | | | |
| Prolactin | 20 | 47.1 | 27.9 | 16 | 348.1 | 118.8 | 639.1 | **<0.001** |
| Ch | 20 | 4.86 | 0.70 | 16 | 6.91 | 1.57 | 42.2 | **<0.001** |
| HDL Ch | 20 | 1.68 | 0.35 | 16 | 1.91 | 0.35 | 13.7 | 0.09 |
| LDL Ch | 20 | 2.61 | 0.48 | 16 | 3.88 | 1.42 | 48.7 | **0.002** |
| TG | 20 | 1.23 | 0.53 | 16 | 2.55 | 0.93 | 107.3 | **<0.001** |

Most evident increase in the concentration of biochemical indices was found in the small breasts group, more moderate changes were visible in the medium-sized breasts and minimum changes – in the large breasts group: prolactin level in small breasts group increased by 11.3 times, in medium breasts group – 8.78 times and in large breasts group – 7.39 times. All the lipid metabolic rates during pregnancy increased significantly. Similar metabolic trends were identified after comparing the indicators of lean, normal body build and obese pregnant women (Table 16).

TABLE 16. **Changes of blood serum prolactin and lipid parameters in the lean, normal body build and obese women**

| Indicator | 1st trimester | | | 3rd trimester | | | Relative change (%) | P |
|---|---|---|---|---|---|---|---|---|
| | N | M | SN | N | M | SN | | |
| Lean women | | | | | | | | |
| Prolactin | 26 | 35.9 | 16.1 | 15 | 387.8 | 217.7 | 980.2 | **<0.001** |
| Ch | 27 | 4.67 | 0.66 | 17 | 6.69 | 1.21 | 43.3 | **<0.001** |
| HDL Ch | 27 | 1.84 | 0.38 | 16 | 1.94 | 0.45 | 5.4 | 0.44 |
| LDL Ch | 27 | 2.37 | 0.46 | 17 | 3.89 | 1.32 | 64.1 | **<0.001** |
| TG | 26 | 1.05 | 0.52 | 17 | 2.37 | 0.60 | 125.7 | **<0.001** |
| Normal body build women | | | | | | | | |
| Prolactin | 50 | 44.7 | 23.2 | 46 | 417.2 | 242.6 | 833.3 | **<0.001** |
| Ch | 51 | 4.83 | 1.00 | 46 | 6.51 | 1.81 | 34.8 | **<0.001** |
| HDL Ch | 51 | 1.78 | 0.36 | 45 | 2.00 | 0.42 | 12.4 | **0.004** |
| LDL Ch | 51 | 2.59 | 0.74 | 46 | 3.57 | 1.36 | 37.8 | **<0.001** |
| TG | 51 | 1.08 | 0.41 | 46 | 2.27 | 1.01 | 110.2 | **<0.001** |
| Obese women | | | | | | | | |
| Prolactin | 27 | 44.2 | 30.1 | 22 | 373.2 | 124.0 | 744.3 | **<0.001** |
| Ch | 27 | 4.74 | 0.55 | 22 | 6.48 | 1.36 | 36.7 | **<0.001** |
| DTL Ch | 27 | 1.67 | 0.35 | 22 | 2.02 | 0.43 | 20.9 | **0.003** |
| MTL Ch | 27 | 2.56 | 0.45 | 22 | 3.68 | 1.41 | 43.7 | **<0.001** |
| TG | 27 | 1.15 | 0.42 | 22 | 2.45 | 0.95 | 113.0 | **<0.001** |

The most significant changes during pregnancy were found in the blood serum prolactin levels which increased by 10.8 times in lean women, 9.33 times – in women of normal build and 8.44 times – in obese subjects. The women with small breasts and lean women during pregnancy experienced the largest changes in metabolic parameters, while only slight fluctuations were observed in the analogous indicators of women with large breasts and obese women. Interestingly, the cholesterol level was higher in lean and obese females – both at the beginning and the end of pregnancy.

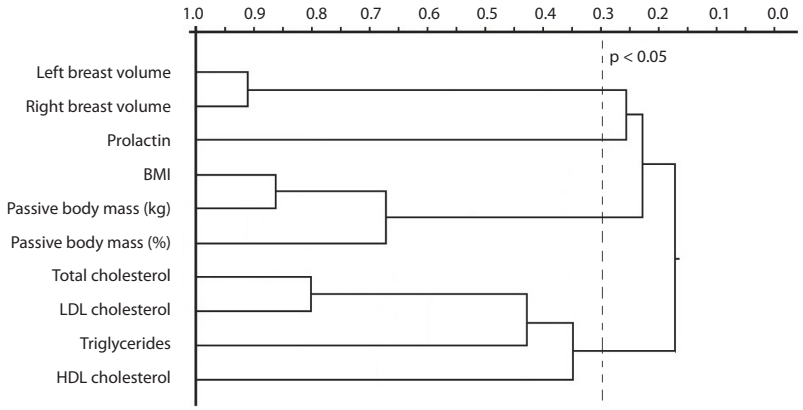


FIG. 6. **Dendrogram of cluster analysis of blood serum lipids, BMI, passive body mass and breast volume correlation matrix in pregnant primiparous (the first trimester)**

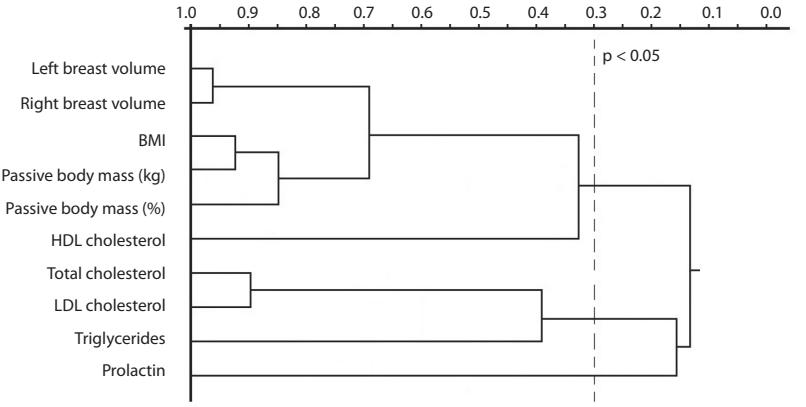


FIG. 7. **Dendrogram of cluster analysis blood serum lipids, BMI, passive body mass and breast volume correlation matrix in pregnant multiparous (the first trimester)**

The dendrograms of cluster analysis (Fig. 6-7) illustrate the relationships of blood serum lipid parameters - total cholesterol, HDL cholesterol, LDL cholesterol, triglycerides, prolactin and passive body weight, BMI and breast volume in primiparous and multiparous subjects in early pregnancy.

It is obvious from the dendogram of primiparous subjects, that the parameters fall into three distinct clusters as follows: the first comprises the lipid metabolism indicators, the second - BMI and passive body weight and the third cluster - breast volume indicators and serum prolactin concentration levels.

The distribution of these indicators in the multiparous group's dendrogram differs by two features: 1) prolactin does not correlate with other indicators 2) HDL cholesterol is "separated" from the other lipids and appears to enter the same cluster as breast volume, BMI and passive body mass.

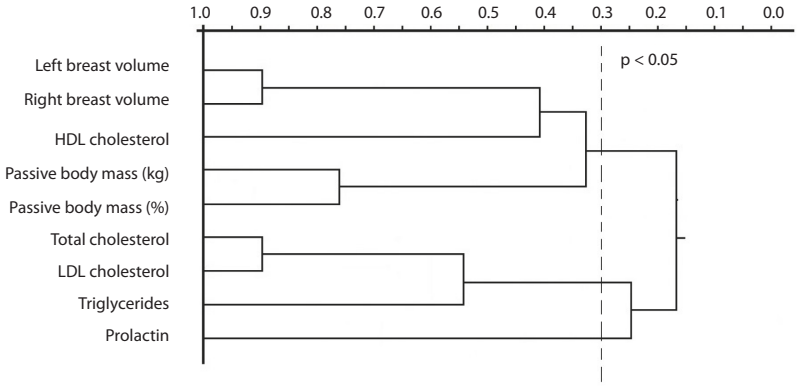


FIG. 8. **Dendrogram of cluster analysis blood serum lipids, passive body mass and breast volume correlation matrix in pregnant primiparous (the third trimester)**

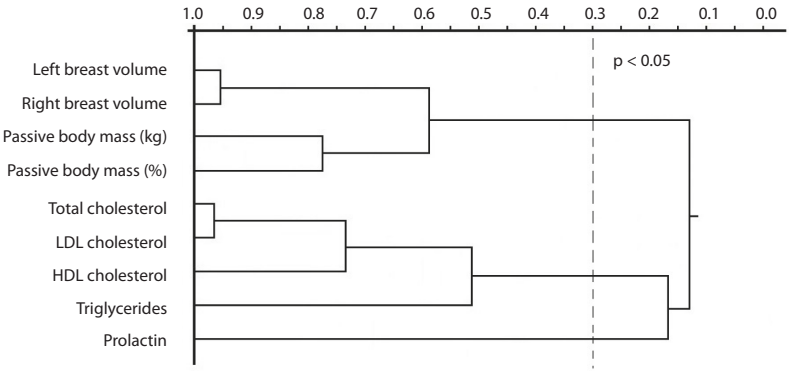


FIG. 9. **Dendrogram of cluster analysis of blood serum lipids, passive body mass and breast volume correlation matrix in pregnant multiparous (the third trimester)**

The dendrograms of cluster analysis (Fig. 8-9) illustrate the relationship between the same parameters (except for BMI) in the examined groups at the end of pregnancy. The cluster analysis of primiparous groups shows that, by the end of pregnancy, compared with the beginning of pregnancy, certain changes in the examined relationships were visible. Prolactin level did not correlate with the breast volume, it is more closely related to serum lipid parameters, whereas HDL cholesterol separates from the lipid cluster and connects to the anthropometric indicators. The occurrence of this situation is analogous to the one typical of the multiparous women's group in early pregnancy. Similar relationships are observed in the multiparous subjects at the end of pregnancy as in early pregnancy, only HDL cholesterol levels correlate stronger with other serum lipids.

The analysis of multiple correlations between of the breast volume and anthropometric indicators (body circumferences, skinfolds) as well as biochemical indicators was carried out. The dendrogram of correlation matrix clustering (1st trimester) shows (Figure 10) that the majority of the body circumferences concentrate into a tight cluster, also comprising breast size indices. Only the neck and wrist circumferences show a weaker relationship with these indicators.

The other considerably dense cluster is formed by the intercorrelated skinfolds. Furthermore, we see the interconnecting clusters of the body circumferences and skinfolds. The third cluster is formed by the blood serum biochemical indicators (including prolactin), however, the latter cluster does not correlate with the anthropometric parameters.

At the end of pregnancy, after performing the same statistical procedure, we obtained an essentially analogous dendrogram of the cluster analysis of the correlation matrix (Figure 11). All the indicators under analysis are also distributed into three more distinctly separated clusters: the first one comprises all the body circumferences and breast size indicators, the second – skinfolds, while the third the most remote cluster, is formed by blood serum biochemical parameters.

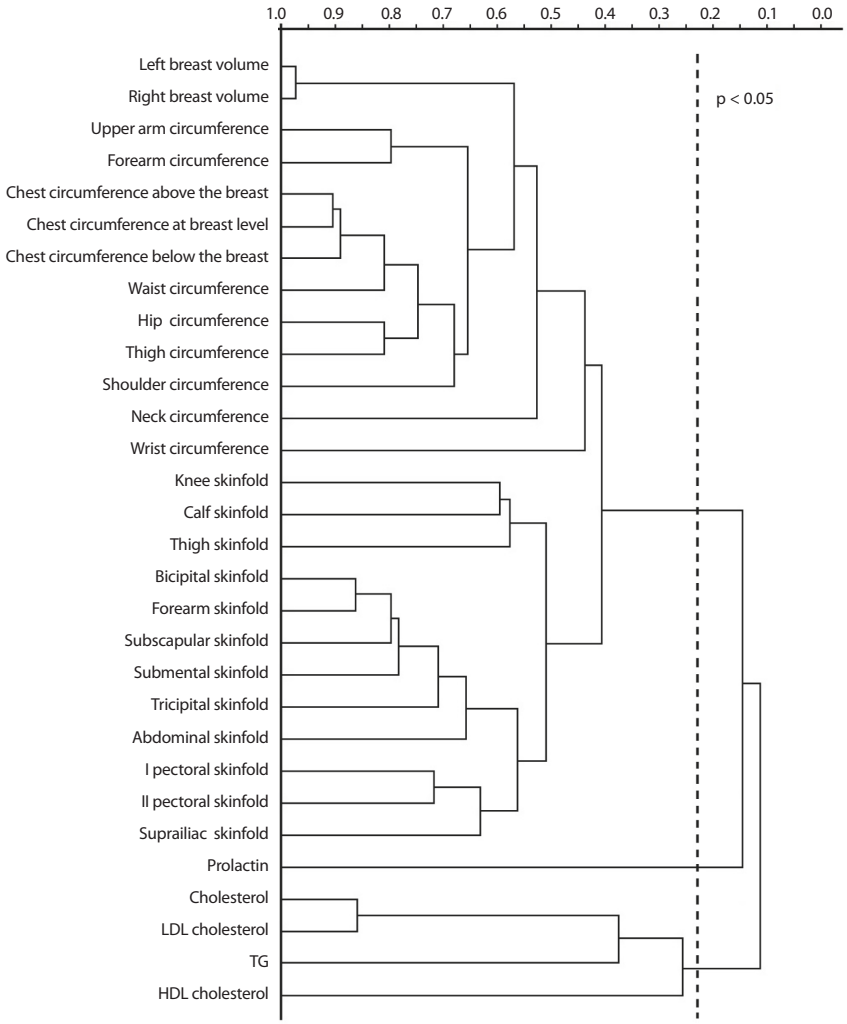


FIG. 10. **Dendrogram of cluster analysis of breast volume and anthropometric indicators correlation matrix (the whole sample, the first trimester)**

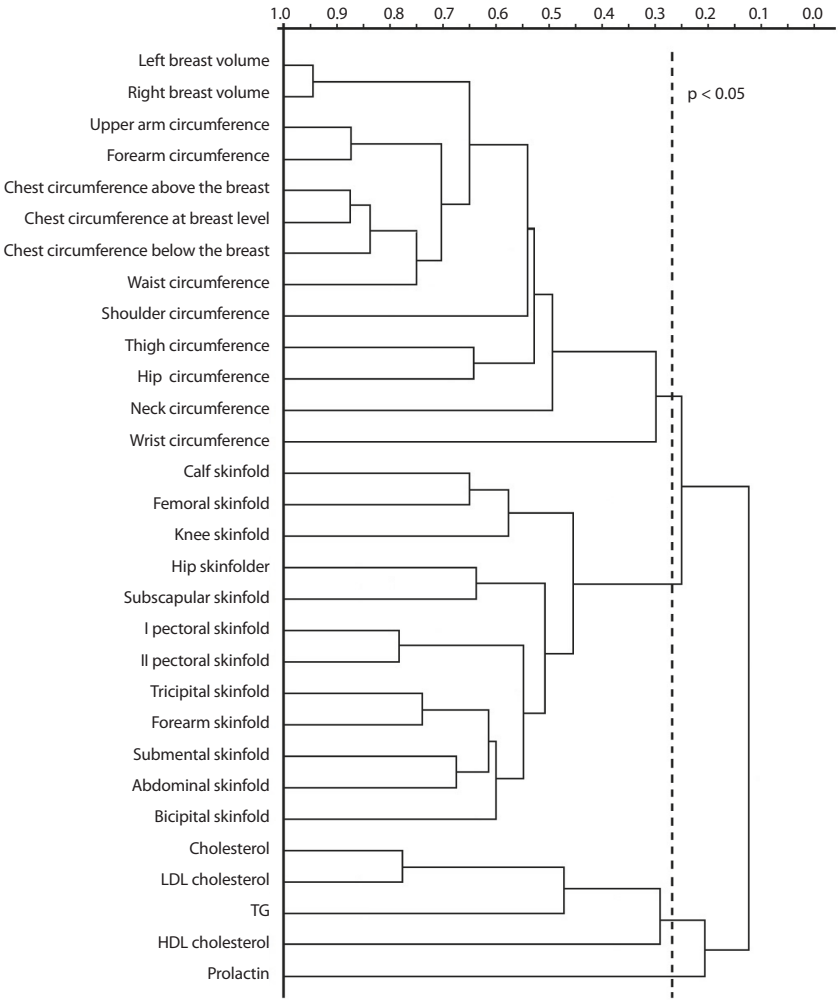


FIG. 11. **Dendrogram of the cluster analysis of the breast volume and anthropometric indicators correlation matrix (the whole sample, the third trimester)**

## 7. The changes of self-esteem in pregnant females and attitudes towards their body image during pregnancy

We surveyed pregnant women seeking to evaluate the changes in their self-esteem and attitudes towards their body size and shape. Pregnant females had higher self-esteem than young 18-20 years old nulliparous females: all pregnant females, on average, ranked their self-esteem (according to Rosenberg's self-esteem scale, 1965) by 34.1 points (SD=3.5; min=27; max=40), and were assigned to a high self-esteem category, while only 11 per cent of young girls had high, about 75 per cent of them – average, and even 14 per cent – low self-esteem. Apart from that, women during pregnancy rated their different body parts much more positively (on average – by 4.03 points at the beginning, and by 3.99 points – at the end of puberty, Table 17) than young 18–20 year-old nulliparous females (on average – by 3.85 points; $p<0.05$).

TABLE 17. **Self-evaluation of different body parts by females at the beginning and the end of pregnancy**

| **Body part** | **The average ratings according to a 5-point-Likert scale** | | |
|---|---|---|---|
| | 1st trimester | 3rd trimester | p (*t-test)* |
| Breasts | 4.02 | 4.03 | 0.95 |
| Waist | 3.62 | 3.51 | 0.51 |
| Hip | 3.78 | 3.59 | 0.23 |
| Thighs | 3.54 | 3.46 | 0.64 |
| Calves | 3.88 | 3.86 | 0.87 |
| Feet | 4.44 | 4.37 | 0.54 |
| Upper arms | 4.08 | 4.14 | 0.65 |
| Forearms | 4.43 | 4.44 | 0.97 |
| Hands | 4.48 | 4.51 | 0.80 |

Hence, the pregnancy orientates females to change their priorities from the care for their perfect physical appearance to a much more valuable antecedence – motherhood and the care for her child's wellbeing. However, this survey posed a need for further research of the body image changes after pregnancy due to the fact that a woman's body after breast feeding, in particular, her breast size and shape, undergoes considerable changes.

## DISCUSSION

Pregnancy is a spell of a woman's life, which is characterized by dramatic functional and structural changes in a pregnant body. Even in normal pregnancy, significant changes in women's physical condition are observed. The anthropometric and metabolic indicators of a pregnant female body are constantly changing – the pregnant body is continuously accumulating passive body weight, the breasts are enlarging, also, the changes are observed in the topography of skinfolds, etc. These pregnancy-related transformations of the body are determined by both endogenous factors such as the metabolism at various metabolic chain levels, heredity peculiarities and exogenous factors, such as prenatal diseases, common diseases, the climate, environmental pollution, lifestyle, harmful habits, diet and so on *(Kirchengast, 2007; Pölzlberger et al., 2017).*

Over the past decade, the maternal age at pregnancy in Lithuania has steadily increased. If in 2007 the average maternal age was 27.8 years, in 2009 – 28.3, in 2013 – 28.6, in 2015 – 28.9. (*Medical data of Birth Register from 2000 through 2016).* According to the Eurostat data published in 2015, the average age of the EU women giving birth for the first time was 28.7 years. Thus, the age of our subjects did not differ from the general average age range of pregnant women in Lithuania. The primiparous subjects on average were aged 28.9, multiparous – 31.2 years.

**The comparison of the breast volume, body size and the passive body mass in pregnant women and young nulliparous women.** The differences in the breast volume were observed from the first trimester: the breast volume in young nulliparous (602.4 $cm^3$) was approximately twice smaller than in primiparous women (1145.9 $cm^3$). The pregnant women's height and BMI did not show a statistically significant difference compared to the analogous parameters of young nulliparous, however, the trends of the increased height in primiparous women and larger BMI in multiparous women were observed. All the measured body circumferences were larger in primiparous and multiparous women compared to young nulliparous females.

Our study showed that an essentially different female body build was characteristic to women 30 years ago, when the passive body mass during pregnancy was accumulating mainly in the ginoide areas (hip, thigh) of pregnant women. Recently, the localisation of the subcutaneous fat tissue has shifted to the upper part of a woman's body *(Drąsutienė et al., 2007; Izumi et al., 2016)*. These findings are in line with the other studies that found a switch from "pear" shaped figure towards the "apple" or the inverted triangle (V) form in young females *(Thoma et al., 2012)*. Overall, it is noteworthy that in early pregnancy the total passive body weight of pregnant women did not differ significantly from the subcutaneous adipose tissue development observed in young nulliparous girls. Significantly higher passive body mass indicators were found in multiparous women, whereas these indicators did not differ in primiparous and young nulliparous girls.

The data of our study are consistent with the findings of the research performed by other scientists – anthropologists of Vilnius University: women with lower BMI during pregnancy gain more subcutaneous fat tissue compared to those with higher BMI. These findings differ from the data on the dynamics of body circumferences presented by a former study which showed that just 10 years ago, during the first pregnancy, a more gynoid body type was formed and remained unchanged over the period until the next childbirth *(Volochovič et al., 2010; Vanky et al., 2012; Jackson et al., 1980)*. However, our data are in line with the latter study with respect that certain body build obtained during the first pregnancy remains the same during later pregnancies as well. In our study, a diverse pattern in the subcutaneous fat tissue distribution, i.e. a distinct topography of skinfolds, was observed among the different breast-size and body build groups of the investigated pregnant females, though in all pregnant females, the suprailiac, subscapular, tricipital skinfolds (i.e. located on the trunk and the upper area of the body) were significantly larger, and the thigh skinfold was even slightly larger than in young nulliparous women. It means that a "V" shaped body in modern young females is likely to be developing most intensively during the pregnancy, however, according to our former study *(Volochovič et al., 2010)* females, who have accumulated more

subcutaneous body fat on the upper part of the trunk and the upper arm during the pregnancy, were more often suffering from a metabolic syndrome in their later life – in the 40-50-ties.

Summing up, our study showed that the passive body mass during pregnancy tended to accumulate in the upper part of the pregnant woman's body. Therefore, our study is relevant not only to anthropologists, but also to clinicians who will assess the current future health risk of today's pregnant women in terms of a potential threat to develop obesity, metabolic syndrome, diabetes, cardiovascular diseases, etc.

**Changes in the women's breast size during pregnancy.** The most suitable method to determine the breast size, anthropometric indicators and the passive body mass in pregnant women is the non-invasive anthropometric method *(McGillick et al., 2016; Tutkuvienė et al., 2008)*. Our findings show that the breast parameters significantly increased in all pregnant women during their pregnancy. The breast size of our pregnant subjects was associated not only with the women's age, but also with a more evident localization of the passive body mass in the upper part of the body. We also found that the breast size was related to a woman's body size indices, however, only half of women during the pregnancy retained the same category of the body build and breast size (the body build and the breast size did not coincide in almost half of females), and even one third of females "jumped" to the other breast-size group during the pregnancy. Moreover, the total amount of passive body mass was not most strongly related to large breasts, but only the skinfolds located on the upper part of the trunk and the upper arm (the latter topography of the subcutaneous body fat is assumed as the health risk marker related to a metabolic syndrom and the associated diseases). The scholarly literature provides a wide range of studies that examine the associations of obesity, pregnancy and childbirth pathology in pregnant women, the relationship between the health of a pregnant woman and a fetus. *(Nelson et al., 2010; Yessoufou et al., 2011)*. For the first time in Lithuania, the findings of our study have demonstrated the negative changes in fat patterning during pregnancy– a trend towards the upper body parts during pregnancy.

Thus, from the first trimester of pregnancy, a woman's health risk for her later life stages can be forecasted and timely preventive measures taken in order to improve the health of the future generations *(Gaillard et al., 2016; Koyanagi et al., 2013)*.

**Relationships between the anthropometric and metabolic parameters of pregnant women.** Dendrograms of the cluster analysis of correlation matrix of breast volume and anthropometric indicators were performed for different groups of pregnant females in terms of the distribution of women by childbirth rate (primiparous and multiparous), at the beginning and by the end of pregnancy. In almost all cases, a stronger correlation of indices was observed within the separate clusters (for example, between the anthropometric or biochemical indices rather than between the main three clusters of indicators, i.e. there was very mild correlation between the body size parameters, the breast size (with the exception of circumferences) and the investigated biochemical indicators (with the exception of prolactin concentration). It is evident that the breast size is tightly interconnected with the many body circumferences (in particular – with the upper trunk and upper arm) and forms a separate cluster, which is not connected to the other clusters.

All the skinfolds were closely interrelated to one separate cluster, as well as the blood serum indicators were closely connected to one cluster.

In the future, it would be worth searching for other possible biochemical markers (other hormones) that might be related to the breast and body changes during pregnancy, also, for the clues how all these changes could be associated with lactation possibilites, fetal development and women's health in later life in order to predict health risk indicators as early as possible – both for the child and the mother. Besides, it is necessary to continue the present study after childbirth – to follow the changes in the body size and shape, also breast remodeling after lactation, shifts in self-esteem and body image after pregnancy (young females today are under a strong pressure to have an ideal figure). It would be interesting to explore the variability of changes in the breast and body size after delivery and the lactation period in order to establish which type of breasts undergo most dramatic changes, how it might be related to the breast functions and the general health status of a female.

## CONCLUSIONS

1. The differences in the breast parameters and other anthropometric indicators between **pregnant women and young nulliparous** women were obvious even in the first trimester of pregnancy: the **breast volume** in pregnant subjects was almost twice larger than that of young nulliparous women; as for **other body anthropometric indicators** - the primiparous women were taller in height and tended to have a more cylindrical shape of the body than the young nulliparous women, while multiparous women had an increased BMI, in addition to that, in pregnant and older women, the subcutaneous adipose tissue was more concentrated in the upper part of their body in comparison with young nulliparous women.
2. The differences were observed in the breast parameters, other anthropometric indicators and their changes in **primiparous and multiparous women** during pregnancy:
   - the **breast volume** showed almost no difference, however, the multiparous women's breasts were more sagging down and towards the lateral side, were with larger nipples, in late pregnancy the breast size and shape in all pregnant women became similar;
   - the **primiparous women were slightly taller in height but their BMI, circumferences and the passive body mass** indices were smaller, while by the end of pregnancy their subcutaneous fat skinfolds were more pronounced than those in multiparous women (especially - the trunk and upper part of the body), as a result of this, the differences in circumferences disappeared;
   - **compared to the data of 1986**, the modern pregnant women, even in early pregnancy had relatively more subcutaneous adipose tissue on the trunk area, in addition, during pregnancy they accumulated more of the passive body mass on the upper body part than the pregnant women 30 years ago, who had a more ginoide body shape at early and late pregnancy (which is considered to be a negative change in the body shape that indicates a greater risk for health of modern pregnant women in terms of metabolic syndrome and the related diseases).

3. **Depending on the breast size**, the breast parameters and other anthropometric indicators were changing differently:
    - the largest **changes in the breast size** during pregnancy were observed in the small breasts group while the least growth was seen in large breasts, in addition to that, the breasts were changing on an individual basis – the breast size of about one third of pregnant women shifted to another breast group, larger or smaller in size;
    - **other body anthropometric indicators** showed the largest changes in the small breasts women's group (their trunk gained most adipose tissue); in females with medium breasts, all general anthropometric indices changed mostly in proportion, while the general body size indicators of the women with big breasts showed the smallest change, apart from that, women with small breasts accumulated most of the subcutaneous fat tissue, especially on the upper part of the body, whereas the fat skinfolds of women with large breasts during pregnancy remained almost unchanged.
4. **Depending on the body size and development of adipose tissue**, the breast size and other anthropometric indicators during pregnancy showed variations in change in the lean, normal body build and obese women:
    - **the breast size category** in early pregnancy was consistent with the female body build only in about half of the women, in late pregnancy - more women with small breasts "shifted" to the category of women with larger breasts while women with large breasts – to the smaller breast size category; the breast volume of lean women increased by almost a third and by fifth – in the obese women's category;
    - **other body anthropometric indicators** showed the most tangible changes in the lean women's group (their waist circumference increased most), body size and shape variations in pregnant females with a normal body build were proportionate, while the obese women's body changed the least, apart from that, the subcutaneous fat skinfolds in obese women during the pregnancy even diminished, while in

lean women - significantly increased (in particular - subscapular and tricipital), and that is a negative prenatal morphological marker of modern pregnant women (according to the findings of the year 1986, during pregnancy the subcutaneous fat skinfolds of the thigh and other ginoide body parts were most pronounced).

5. **Multiple relationships of serum prolactin and lipids** with breast parameters and body size indicators in pregnant women during pregnancy:
   - **the biochemical indicators of primiparous and multiparous women** at the beginning and by the end of pregnancy did not show any statistically significant difference, only in primiparous the prolactin levels in early pregnancy were about one third higher than in multiparous (at the end of pregnancy it was similar);
   - in pregnant women with **various breast categories and body build,** all the parameters of lipid metabolism significantly increased, for example, prolactin – on average even by 8.5 times (the largest increase was observed in women with small breasts, as well as in the lean women's group): the larger the breasts and the more obese woman – the larger prolactin levels in early pregnancy, but less fluctuations were observed during pregnancy; interestingly, total cholesterol was higher in lean and obese woman than in pregnant females of a normal body build.
   - **the general cluster analysis of the breast size, the body anthropometric parameters and the examined biochemical indicators** did not show any strong correlations between the groups of all these parameters – the dendrograms can be divided into three poorly intertwined clusters (the breast size and the body size parameters, skinfolds, biochemical parameters), nevertheless, the dendrograms of breast and biochemical indicators in early pregnancy showed that the breast size of primiparous women was closely adjoined to the prolactin concentration (it can be associated with more pronounced changes in the primiparous women's breasts and all other body parts compared to those in multiparous females).

6. **Pregnant women's self-esteem and body image during pregnancy.** Pregnant women's self-esteem was higher and the attitude to their overall appearance and separate body parts was more positive than that of the young nulliparous women. Pregnancy orientates a woman on maternity priority, and her appearance becomes not so important to her.

## REFERENCES

A list of references is provided in the manuscript of the Dissertation.

**SUMMARY OF THE DISSERTATION**
**IN THE LITHUANIAN LANGUAGE**

KRŪTŲ MORFOLOGINIŲ PARAMETRŲ, KŪNO DYDŽIO BEI FORMOS IR KRAUJO SERUMO PROLAKTINO BEI LIPIDŲ KITIMAI PER NĖŠTUMĄ, DAUGIALYPĖS ŠIŲ RODIKLIŲ SĄSAJOS IR SVEIKATOS RIZIKOS MORFOLOGINIAI ŽYMENYS

**REZULTATŲ APIBENDRINIMAS IR IŠVADOS**

1. **Nėščių ir jaunų negimdžiusių moterų krūtų parametrų ir kitų antropometrinių rodiklių palyginimas.** Jau pirmuoju nėštumo trečdaliu išryškėjo nėščių ir jaunų negimdžiusių moterų krūtų parametrų ir kitų antropometrinių rodiklių akivaizdūs skirtumai:
   - **Krūtų parametrų kitimai.** Nėščiųjų krūtų tūris buvo beveik dvigubai didesnis nei jaunų negimdžiusių moterų (nėščių pirmakarčių – 1145,9 $cm^3$, pakartotinai gimdančių – 1194,2 $cm^3$, jaunų negimdžiusių – 602,4 $cm^3$ ).
   - **Kūno dydžio rodiklių kitimai**. Nėščių moterų ūgis ir KMI patikimai nesiskyrė nuo jaunų negimdžiusių moterų šių kūno dydžio rodiklių, tačiau išryškėjo pirmakarčių gimdyvių aukštesnio ūgio bei pakartotinai gimdančių moterų – didesnio KMI tendencija. Nėščių, ypač pakartotinai gimdančių moterų, visos kūno apimtys, išskyrus šlaunies, buvo didesnės nei jaunų negimdžiusių moterų (t. y. nėščiųjų liemuo buvo stambesnis).
   - **Pasyviosios kūno masės ir odos riebalinių klosčių kitimai**. Nėščių (pirmojo nėštumo trečdalio) moterų bendra pasyvioji kūno masė patikimai nesiskyrė nuo jaunų negimdžiusių moterų poodinio riebalinio audinio gausos, tačiau vyresnių ir nėščių moterų riebalinis audinys buvo daugiau susikaupęs viršutinėje jų kūno dalyje (liemens srities ir žasto odos riebalinės klostės buvo didesnės)palyginus su jaunomis negimdžiusiomis moterimis.

2. **Pirmakarčių ir pakartotinai gimdančių moterų krūtų parametrų ir kitų antropometrinių rodiklių palyginimas.** Skyrėsi pirmakarčių ir pakartotinai gimdančių moterų krūtų parametrų ir kitų antropometrinių rodiklių pokyčiai per nėštumą:
    - **Krūtų parametrų kitimai**. Pirmakarčių moterų krūtų tūris, daugelis krūties kūgio formą ir areolę atspindinčių matmenų nėštumo pradžioje beveik nesiskyrė nuo pakartotinai gimdančių, išskyrus pastarųjų moterų patikimai didesnį krūtų nusvyrimą žemyn ir į lateralinę pusę bei didesnius krūtų spenelius. Pirmą kartą gimdančių moterų krūties tūris per nėštumą padidėjo mažiau nei gimdančių pakartotinai, tačiau skirtumas buvo statistiškai nereikšmingas, be to, nėštumo pabaigoje šiek tiek sumažėjo krūties kūgio lokalizacijos skirtumai dėl atsiradusių kai kurių krūties kūgio formos skirtybių – pakartotinai gimdančių moterų santykinai labiau padidėjo krūties kūgio medialinė ir apatinė dalis (tuo lyg suartindama ir pakeldama krūtis).
    - **Kūno dydžio rodiklių kitimai**. Nėštumo pradžioje pirmakartės nėščiosios buvo mažesnio **svorio** ir šiek tiek didesnio ūgio nei gimdančios pakartotinai. Pirmakarčių moterų svorio prieaugis per nėštumą buvo santykinai didesnis nei gimdančių pakartotinai. Nėštumo pradžioje pirmą kartą gimdančios moterys turėjo mažesnes kūno apimtis (ypač tas, kurios labiau siejasi su skeleto ir raumenų išvešėjimu) nei gimdančios pakartotinai, tačiau nėštumo pabaigoje apimčių skirtumai buvo nepatikimi.
    - **Pasyviosios kūno masės ir odos riebalinių klosčių kitimai**. Nėštumo pradžioje pirmakarčių moterų pasyviosios kūno masės santykinis ir absoliutus kiekis, visos odos riebalinės klostės buvo šiek tiek mažesnės nei pakartotinai gimdančių moterų, nors skirtumai buvo statistiškai nereikšmingi, tačiau nėštumo pabaigoje visų nėščiųjų pasyviosios masės gausa visai nesiskyrė – pirmą kartą gimdančių moterų poodinis riebalinis audinys išvešėjo santykinai labiau nei pakartotinai gimdančių moterų, nes visos pirmakarčių moterų odos riebalinės klostės (ypač

liemens ir kūno viršutinės dalies) nėštumo pabaigoje tapo jau šiek tiek didesnės nei pakartotinai gimdančių (nors šis skirtumas nebuvo statistiškai reikšmingas).

- **Šiuolaikinių nėščių moterų antropometrinių rodiklių palyginimas su 1986 metų tyrimo duomenimis.** Palyginus su 1986 metų duomenimis, šiuolaikinės nėščios moterys jau nėštumo pradžioje turėjo santykinai daugiau poodinio riebalinio audinio liemens srityje, be to, per nėštumą jos daugiau sukaupė pasyviosios masės liemens ir kūno viršutinėje dalyje nei nėščiosios prieš 30 metų, kurios pasižymėjo labiau ginoidine kūno forma ir nėštumo pradžioje, ir pabaigoje. Taigi nustatėme negatyvų kūno formos pokytį, kuris rodo didesnę šiuolaikinių moterų metabolinio sindromo ir su juo susijusių ligų riziką.

3. **Nėščiųjų krūtų ir kitų antropometrinių rodiklių palyginimas atsižvelgiant į krūtų dydį**. Nėštumo laikotarpiu įvairaus krūtų dydžio moterų krūtų parametrai ir kiti antropometriniai rodikliai kito skirtingai:
   - **Krūtų parametrų kitimai**. Mažų krūtų moterys patyrė per nėštumą didžiausius krūtų dydžio pokyčius, mažiausiai kito didelių krūtų dydis. Nėštumo pabaigoje 70 proc. nėščiųjų krūtų dydis liko toje pačioje krūtų dydžio grupėje, 30 procentų nėščiųjų krūtų dydis atsidūrė kitoje – didesnių arba mažesnių krūtų dydžio grupėse.
   - **Kūno dydžio rodiklių kitimai**. Visose krūtų dydžio grupėse didžiausius santykinius kūno dydžio pokyčius patyrė šie rodikliai: svoris, juosmens apimtis, JKI, krūtinės apimtis. Mažų krūtų nėščiųjų kūno apimtys, išskyrus rankų, didėjo statistiškai reikšmingai. Šis padidėjimas buvo susijęs su krūtinės ir liemens srities apimčių poslinkiais. Vidutinių krūtų moterų visos kūno apimtys tai pat didėjo per nėštumą, tačiau šios grupės nėščiųjų reikšmingai didėjo ir rankų apimtys. Didelių krūtų moterų kūno apimtys didėjo per nėštumą panašiai kaip vidutinių krūtų moterų grupės analogiški rodikliai.

- **Pasyviosios masės ir odos riebalinių klosčių kitimai**. Mažų krūtų nėščiųjų reikšmingai didėjo per nėštumą pomentinė ir žasto priekinė odos riebalinės klostės ir pasyvioji kūno masė kaupėsi daugiau viršutinėje kūno dalyje. Šios moterų grupės pasyvioji kūno masė didėjo per nėštumą nuo 24,2 proc. iki 27,1 proc. Vidutinio dydžio krūtų riebalinis audinys kaupėsi jau ir rankų srityje, pasyviosios kūno masės kaupimosi pokytis buvo tolygesnis palyginti su mažų krūtų nėščiųjų analogiškais rodikliais. Didelių krūtų grupės nėščiųjų odos riebalinių klosčių kitimai buvo nereikšmingi. Šios grupės moterų pasyviosios kūno masės gausa nėštumo laikotarpiu patikimai nepadidėjo.

4. **Nėščiųjų krūtų ir kitų kūno rodiklių palyginimas pagal riebalinio audinio gausą**. Atsižvelgiant į riebalinio audinio gausą, per nėštumą skirtingai kito liesų, vidutinio stambumo ir apkūnių nėščiųjų krūtų ir kiti antropometriniai rodikliai:
   - **Krūtų parametrų kitimai**. Nėštumo pradžioje maždaug pusė liesų moterų turėjo mažas krūtis, o likusios – vidutinio didumo krūtis; vidutinio kūno sudėjimo moterų krūtys buvo arba vidutinio dydžio (beveik 55 proc.), arba mažos (ketvirtadalio šių moterų), arba didelės (maždaug penktadalio šių moterų); stambaus kūno sudėjimo moterys turėjo arba vidutinio dydžio (apie 40 proc.), arba dideles krūtis (maždaug 60 proc.). Įdomu tai, kad nėštumo pabaigoje daugiau liesų moterų jau turėjo vidutines ir net dideles krūtis, vidutinio kūno sudėjimo moterų krūtys nėštumo laikotarpiu neturėjo aiškių dydžio pokyčio tendencijų, o apkūnios moterys nėštumo pabaigoje dažniau nei pradžioje turėjo vidutinio stambumo ir net mažas krūtis. Liesųir vidutinio stambumo moterų dauguma krūtų dydžio rodiklių didėjo labai panašiai ir statistiškai reikšmingai (tūris padidėjo beveik trečdaliu – maždaug 28 proc.), tuo tarpu apkūnių moterų krūtų tūris padidėjo mažiau – apie 20 proc.
   - **Kūno dydžio rodiklių kitimai.** Liesų nėščių moterų grupės visos kūno apimtys per nėštumą didėjo ypač reikšmingai. Kaip ir mažų krūtų nėš-

čiųjų, liesų moterų rankų apimtys nors ir didėjo absoliučiais skaičiais, tačiau pokyčiai nebuvo statistiškai reikšmingi. Vidutinio kūno sudėjimo nėščiųjų visos kūno apimtys per nėštumą taip pat didėjo reikšmingai. Skirtingai nuo liesų nėščiųjų joms reikšmingai didėjo ir rankų apimtys. Apkūnių moterų kūno apimtys taip pat didėjo statistiškai reikšmingai, tačiau saikingiau nei kitų moterų.

- **Pasyviosios masės ir odos riebalinių klosčių kitimai**. Liesų moterų odos riebalinės klostės per nėštumą didėjo ypač statistiškai reikšmingai: pomentinė ir žasto priekinė – net 54-60 proc., pažasties ir didėjo dilbio – maždaug 38-44 proc., o klubinė, II krūtinės ir posmakrinė klostės padidėjo maždaug trečdaliu, tuo tarpu šlaunies klostė padidėjo 30 proc. Liesų nėščiųjų riebalinis audinys padidėjo nuo 24,2 iki 27,4 proc. (apie 13 proc.), tačiau ypač daug poodinio riebalinio audinio susikaupė viršutinėje kūno dalyje. Vidutinio kūno sudėjimo nėščiųjų odos riebalinės klostės didėjo panašiai kaip ir liesų nėščiųjų. Pasyviosios kūno masės kiekio pokytis buvo reikšmingas, tačiau saikingesnis nei liesų nėščiųjų. Apkūnių nėščiųjų odos riebalinės klostės per nėštumą net sunyko – nustatyti aštuonių klosčių neigiami santykiniai pokyčiai: mažėjo posmakrinės, I ir II krūtinės, pažasties, žasto užpakalinė, dilbio, šlaunies, blauzdos klostės. Įdomu tai, kad prieš 30 metų (1986 m.) nėščiosios visiškai kitaip kaupė riebalinį audinį nėštumo laikotarpiu – tąsyk daugiausiai riebalinio audinio per nėštumą daugėdavo šlaunies ir kitose ginoidinėse moters kūno vietose. Vadinasi, šiuolaikinių moterų riebalinis audinys nėštumo laikotarpiu kaupiasi daugiau centrinėje bei viršutinėje kūno srityje, ir tai yra negatyvus šiuolaikinių moterų morfologinis žymuo.

5. **Nėščių moterų kraujo serumo prolaktino ir lipidų rodiklių ypatumai pirmuoju ir trečiuoju nėštumo trečdaliais ir jų daugialypės sąsajos su nėščiųjų krūtų parametrų ir kūno dydžio rodikliais**:
   - **Pirmakarčių ir pakartotinai gimdančių moterų biocheminių rodiklių** dydžiai nėštumo pradžioje ir pabaigoje statistiškai reikšmingai

nesiskyrė, tik nėštumo pradžioje pirmą kartą gimdančių moterų prolaktino koncentracijos vidurkis buvo ženkliai didesnis nei antrakarčių (50,9 mU/l ir 34,3 mU/l – atitinkamai). Tačiau pakartotinai gimdančių beveik visi rodikliai absoliučiais dydžiais buvo didesni nei pirmakarčių moterų analogiški rodikliai. Nėštumo laikotarpiu statistiškai reikšmingai didėjo kraujo serumo prolaktino, bendrojo cholesterolio, DTL cholesterolio, MTL cholesterolio ir trigliceridų koncentracijos, o prolaktino koncentracija nėštumo laikotarpiu padidėjo net 8,5 karto (skirtumai tarp pirmakarčių ir antrakarčių išliko nereikšmingi, o kraujo serumo prolaktino kiekis pasiekė panašų lygį abiejose moterų grupėse).

- **Palyginus mažų, vidutinių ir didelių krūtų moterų kraujo serumo prolaktino kiekį** nėštumo pirmuoju ir trečiuoju trečdaliais, labiausiai koncentracija didėjo mažų krūtų grupėje, saikingesni pokyčiai buvo vidutinių krūtų ir mažiausi – didelių krūtų grupėje: prolaktino koncentracija mažų krūtų grupės moterų padidėjo 11,3 karto (nėštumo pabaigoje net buvo didesnė nei kitų moterų), vidutinių krūtų – 8,78 karto ir didelių krūtų grupės – 7,39 karto. Visi lipidų apykaitos rodikliai didėjo per nėštumą statistiškai patikimai. Palyginus mažų, vidutinių ir didelių krūtų moterų tiriamus medžiagų apykaitos rodiklių kitimus nėštumo laikotarpiu, nustatyta, kad nors absoliučiais skaičiais rodiklių koncentracijos didėjo, tačiau statistiškai reikšmingo skirtumo tarp šių moterų grupių nebuvo.
- **Palyginus įvairaus kūno stambumo moterų kraujo serumo prolaktino ir lipidų rodiklius,** didžiausius pokyčius per nėštumą patyrė liesų nėščiųjų kraujo serumo prolaktino koncentracija – padidėjo 10,8 karto, vidutinio apkūnumo nėščiųjų – 9,33 karto ir apkūnių – 8,44 karto. Pastebėta, kad kuo didesnės krūtys ir kuo stambesnė moteris – tuo prolaktino koncentracija buvo didesnė nėštumo pradžioje, tačiau mažiau kito per nėštumą (ypač mažų krūtų moterims), be to, kuo liesesnė ir mažesnių krūtų moteris – tuo

bendrasis cholesterolis buvo netgi didesnis. Palyginus tarpusavyje šių trijų grupių moterų medžiagų apykaitos rodiklių pokyčius per nėštumą, matomas akivaizdus visų rodiklių koncentracijų absoliučių skaičių didėjimas, tačiau statistinio patikimumo tarp šių moterų grupių rodiklių negauta.

- **Krūtų dydžio, kūno antropometrinių parametrų ir tirtų biocheminių rodiklių bendra klasterinė analizė** stiprių koreliacinių ryšių tarp visų minėtų parametrų neparodė – dendrogramose galima išskirti tris menkai tarpusavyje susijusius klasterius (krūtų dydžio ir kūno apimčių; odos riebalinių klosčių; biocheminių parametrų). Tačiau krūtų ir biocheminių rodiklių dendrogramose nėštumo pradžioje pirmakarčių krūtų dydis glaudžiau šliejosi prie prolaktino koncentracijos, ir tai gali būti susiję su jų krūtų i viso kūno akivaizdesniais kitimais nei kitų pakartotinai gimdančių moterų.

6. **Nėščių moterų savivertė ir kūno įvaizdis nėštumo laikotarpiu.** Nėščiųjų savivertė buvo aukštesnė**,** o požiūris į bendrą išvaizdą ir atskiras kūno dalis buvo labiau pozityvus nei jaunų negimdžiusių moterų. Nėštumas orientuoja moterį motinystės prioritetui, ir išvaizda jai tampa ne tokia svarbi.

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ARTICLES PUBLISHED ON THE PRESENT RESEARCH FINDINGS:

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2. Drąsutis Jonas, Sakalauskaitė Indrė, Barkus Arūnas, Drąsutienė Gražina, Ramašauskaitė Diana, Norvilaitė Kristina, Tutkuvienė Janina. Associations of anthropometric parameters, breast volume and serum lipids and prolactin among primiparous and multiparous women during pregnancy. Laboratorinė medicina 2016; t. 18, Nr.4(72): 176-84 (in Lith.)
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   Department of Anatomy, Histology and Anthropology, Faculty of Medicine, Vilnius Univcersity, Vilnius, Lithuania

2. J. Drąsutis. I. Sakalauskaitė, J. Tutkuvienė. MORPHOLOGICAL BREAST CHANGES DURING THE PREGNANCY IN RELATION TO HORMONAL STATUS AND TOPOGRAPHY OF SUBCUTANEOUS SKINFOLDS.
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   Department of Anatomy, Histology and Anthropology, Faculty of Medicine, Vilnius Univcersity, Vilnius, Lithuania

3. J. Drąsutis. I. Sakalauskaitė, A. Barkus and J. Tutkuvienė. CHANGES OF BREAST VOLUME IN RELATION TO THE OTHER BODY BIOCHEMICAL PARAMETERS DURING THE PREGNANCY: A COMPARISON OF FEMALES WITH SMALL, MEDIUM AND LARGE BREAST SIZE.
   The 3rd International Conference Evolutionary medicine: Pre-existing Mechanisms and Patterns of Current Health Issues; The 14th–19th of June, 2016, faculty of Medicine, Vilnius University Lithuanian Academy of Sciences.
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## CURRICULUM VITAE

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