

Physical activity of pregnant women

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Abstract

Physical activity of pregnant women was analysed based on literature data and personal clinical experience. Many anatomical, physiological and metabolic changes develop during pregnancy, which are to create optimal conditions for foetal development. Gestational adaptive changes are similar to those observed in sportsmen. Moreover, the biochemical basis of physical activity and effects of exercises on the development of pregnancy and foetal health were discussed.

Appropriate physical activity during pregnancy is beneficial for health.

Key words: physical activity, pregnancy

Undertaking or continuing physical activity during pregnancy has positive effects on the course of pregnancy, labour and puerperium. Physical activity during that time is not only beneficial for functioning of many important organs but also improves and increases metabolism of pregnant woman [1,2,3,4,5,6,7].

Pregnant women experience significant anatomical, physiological and metabolic adaptive changes, regarding the reproductive, cardiovascular, respiratory, endocrine and locomotor system, metabolism, psyche and others. Owing to the activity of corpus luteum and taking over its secretory function by the placenta, all systems undergo changes, which are to create optimal conditions for the growth and development of a foetus.

Maternal changes during pregnancy

Reproductive system

The uterus is an organ that undergoes the most visible changes in the course of pregnancy because its weight, which is 50-70g in the non-pregnant state, increases by approximately 1 kg.

Moreover, the number and size of blood and lymph vessels within the uterus increase. In the late stages of pregnancy, 600ml of blood flow through the placental attachment during one minute. Changes pertain also to internal and external genitalia. A characteristic external symptom of pregnancy, besides the enlarged uterus, is weight gain (12-14kg on average), mainly due to water retention (6.5-8.5L) [8].

Cardiovascular system

Adaptive changes during pregnancy include increases in the vascular placenta volume and cardiac output as well as decreases in arterial blood pressure and total peripheral vascular resistance.

Blood volume increases slowly already in the first trimester to raise considerably in the second one until the last weeks of pregnancy when it stops increasing and remains at the unchanged level (40% in comparison with non-pregnant women).

Cardiac output starts to rise already at the beginning of pregnancy, which results from increased heart rate (approximately 10 beats/min.) and cardiac output. By the gestational week 28-32, the increase reaches 40%. Cardiac output

increases by around 50%, mainly during the first half of pregnancy. Myocardial fibre hypertrophy and increases in heart size are observed (especially of the left ventricle and both atria). Maternal cardiac changes are similar to those observed in sportsmen.

In the last stage of pregnancy, the flow of blood through the uterus reaches 450-650ml per minute, which constitutes 17% of cardiac output and 2% of blood flow through the mammary glands. During that time, the flow through kidneys constitutes 20% of cardiac output, through the skin and brain- 10%, and through coronary arteries – 5% [9].

During pregnancy, despite considerably increased cardiac output, arterial blood pressure drops due to a decrease in peripheral vascular resistance, which is most likely caused by high levels of progesterone [10]. Moreover, the normally functioning vascular endothelium in a pregnant woman is believed to show high activity of local mediators that relax smooth muscles, which in consequence leads to additional decreases in peripheral vascular resistance. The blood pressure drop begins around the 8th gestational week, increases during the middle period and returns to pre-pregnancy values during the perinatal period.

Venous pressure in the lower limbs increases from around 10cm H₂O in the first trimester to 25cm H₂O in the perinatal period. Increase venous pressure is likely to be responsible for swelling and varices of the lower limbs as well as increased risk of deep venous thrombosis due to slowed down blood circulation in this area. Blood volume rises between the 6th and the 30th gestational week. A platelet count slightly decreases in the course of pregnancy.

Pregnancy is connected with increased risk of thromboembolic complications due to impaired circulation within the lower limbs and coagulation. The changes mainly include increased procoagulant activity and decreased plasma fibrinolytic activity. Pregnancy is a state of normal but transient hypercoagulation [11,12].

Respiratory system

In the early stages of pregnancy, the breasts change, i.e. they enlarge by approximately 2cm in diameter and by approximately 5 to 7 cm in circumference. Although in the course of pregnancy the diaphragm elevates by around 4cm due to a growing uterus, the maximum values of inspiration and expiration pressure do not change [13], apart from a slight decrease in lung volume by approximately 5%. Maximum inspiratory capacity increases by 10% and expiratory capacity rises as well. Moreover, alveolar ventilation increases early (50-70%). Respiratory changes are to cover higher oxygen requirements and facilitate gas exchange in the foeto-placental unit [12]. High concentrations of progesterone in pregnancy are responsible for chronic hyperventilation by increasing the respiration rate and lung capacity [12].

It is also worth stressing that during the late stages of pregnancy, the oxygen capacity decreases while shortness of breath and dyspnoea increase during intensive trainings [14].

Endocrine system

During pregnancy, the endocrine system shows increased activity and changes. The pituitary gland increases in size by over 100%. During the entire pregnancy it produces hormones, from among which prolactin plays a leading role in the production of milk and lactation whereas oxytocin is the main stimulator of uterine contractions. The thyroid gland increases the production of its main hormone – thyroxine; it enlarges moderately due to proliferation of the glandular tissue and increased vascularity. The renin-angiotensin-aldosterone system regulating fluid and electrolyte balance and blood pressure also increases its activity. The endocrine – placental gland is formed, which produces large amounts of hormones, including protein and steroid hormones.

Musculoskeletal system

The action of relaxin and steroid sex hormones leads to an increase in connective and collagen tissue flexibility, which results in relaxation of joint connections and increases in their mobility (pubic symphysis, sacroiliac joints) [15].

Enlargement of mammary glands and increases in the mass of pelvis moves the body's centre of gravity, which leads to changes in the spine (increased lordosis, anterior flexion of the head, which increases the pressure of ligaments and muscles in the central and lower spine). The abovementioned changes may cause pain, numbness and weakening of the lower limbs. As the pregnancy develops, the centre of gravity of the thorax moves forwards and downwards, which results in the shift of the body's centre of gravity [16,17]. The consequences of these changes are joint, ligament and musculo-fascial disorders causing pain in the lumbosacral spine and pelvis. Pains affect 45% of pregnant women [17]. During pregnancy, the lumbosacral spine loses stability and the spinal column support shifts. For an axial organ like our spine, pregnancy is a specific state. According to many authors, the postural reaction of pregnant women in the form of reversible changes in the spine curvature is strictly individual and may also be connected with lifestyle as well as the amount and type of physical activity before and during the pregnancy [17,18,19,]. Considering the above, it seems that the compensatory physical activity should be tailored to individual needs.

Metabolism –changes during pregnancy

Pregnancy greatly affects energy, hormonal and fat metabolism. The basic causes of profound metabolic changes in physiological pregnancy are insulin resistance and hyperinsulinaemia. Insulin is a hormone, which shifts the metabolic pathways towards anabolism. This pancreatic hormone transfers glucose to the cells, stimulates the glycolysis and pentose cycle, glycogen synthesis, biosynthesis of DNA and RNA, and

activates lipogenesis [20]. Hence, insulin increases the body's energy resources and synthesis of substances necessary for proper growth.

Noteworthy, during pregnancy the metabolism of insulin changes, due to the action of antagonistic hormones, such as placental lactogen, oestrogens, prolactin or progesterone. Therefore, pregnancy is characterised by relative and absolute insulin deficiency that requires activation of pancreatic reserves [21].

As far as the lipid profile is concerned, pregnancy can sometimes reduce lipid concentrations in women already affected by lipid disorders [22].

Biochemical basis of physical activity

The Vincent Pol University of Social Sciences and Humanities in Lublin has recently published an extremely interesting paper by Kinga Borowicz concerning biochemical and pathophysiological aspects of physical activity [23].

The driving force of muscle mechanical work and metabolic activity of cells are guaranteed by the following substances stored in the organism: unstable, high-energy compounds in the form of ATP and phosphocreatine [24] as well as lipid triglycerides [25]. This last information is essential during pregnancy, when patients gain weight above the recommended norm or show tendency to obesity.

As far as energy is concerned, the most efficient way of its provision both at rest and during physical activity is to use oxidative metabolism of glucose and unstable high-energy compounds [26]. Anaerobic glycolysis, on the other hand, is less beneficial. Not only does it provide less energy but also decreases the strength of muscle contractions (due to metabolic disorders, i.e. metabolic acidosis) and considerably impairs glycogenolysis and glycolysis.

The energy balance both at rest and during physical activity is a complex value since it depends on body weight, its surface,

temperature, emotional state, blood concentrations of hormones, type of physical activity, training level, age, etc. [27].

The total energy capable of storing phosphocreatine-ATP compounds is sufficient but only for short-lasting exercises such as a 10-minute sprint [28]. However, if the intensity of exercises is low and oxygen flows into the cells, the energy is produced by oxidative phosphorylation [29]. Maximum oxygen consumption – $VO_2 \max$ – is an indicator the ability to release oxygen for muscle work and a biomarker of health. The average values of $VO_2 \max$ for a young, healthy person are approximately 38ml/kg/min. for women and 44ml/kg/min. for men. Exercising may increase these values by 15%.

$VO_2 \max$. in females is 75% of that in males, which is associated with weight differences.

The appropriate tests have revealed that the maximum oxygen consumption ($VO_2/L/min.$) remains normal in pregnant women who are physically active. Moreover, a controlled prospective study has demonstrated that moderate physical activity in the II and III trimester of pregnancy (anaerobic exercises) does not change the mother-foetus reserve or impair foetal development [4]. Pędzikiewicz and colleagues [2] have showed that prolonged kinesiotherapy results in increased energy efficiency of muscles and improved energetic status of erythrocytes. According to the authors, in order to achieve metabolic adaptation in the muscles and erythrocytes, the specially designed exercises should be performed for at least three weeks. According to Mańka and colleagues [30], primary metabolic alkalosis in pregnant women is less extensive in those who exercise because it is levelled by substantial secondary metabolic alkalosis.

The abovementioned adaptive changes developing due to regular physical exercises increase the functional capacity of pregnant women [1,2,30].

Physical exercises for pregnant women

To design the appropriate physical exercises, their intensity and duration has to be tailored individually. Numerous studies have demonstrated that the intensity of exercises is essential for prevention of diseases and complications, although the proper technique of exercises lowers possible risk of complications as well [31]. Moreover, before introduction of the plan, physical activity and fitness of a woman as well as condition of pregnancy have to be assessed. It is recommended for women that were less active before pregnancy to achieve 60-70% of the maximum heart rate during exercises, while for those who were more physically active - 60-90% [32]. The other methods to measure the intensity of exercises can also be used, including the “speaking test” or Borg Rating of Perceived Exertion (RPE) Scale (RCOG 2007). The speaking test is appropriate when the patient can maintain conversation while exercising, whereas the Borg’s scale allows to assess the intensity of effort experienced by the patient according to the scale of 1 to 20 points. The average index for the level of exertion should be within 12-14 points.

Undertaking training during pregnancy or continuing previous physical activity brings notable benefits because of the following:

- a. physical exercises increase foetal tolerance to perinatal stress,
- b. foetal stress during labour (excretion of meconium, bradycardia, lower postnatal Apgar score) is lower and the abovementioned foetal parameters are better in parturients who exercised before the pregnancy in comparison with sportswomen who stopped exercising by the end of the I trimester.

Considering risks and benefits of exercising during pregnancy, it should be stressed that benefits definitely outweigh risks. Physical and psychological benefits, prevention of some cardiovascular diseases, osteoporosis, hypertension, and even reduced incidence some

cancers (colon or breast cancers) [5] speak in favour of exercising during pregnancy.

Clinical supervision as well as indications and contraindications for starting or stopping exercises are well-known and described in literature [32,33,34,35,36]. The Royal College of Obstetricians and Gynaecologists 2006 recommendations (RCOG 2007) include the following:

- a. as part of healthy lifestyle, women in physiologically normal pregnancies should be encouraged to undertake general and aerobic exercises 3 times a week, adjusting their intensity to the patient's physical activity prior to pregnancy,
- b. exercises should be continued throughout the entire pregnancy to maintain good physical fitness,
- c. pregnant women should be informed that undertaking physical exercises does not increase the percentage of obstetric and neonatal complications,
- d. exercises of moderate intensity should be continued during the puerperium.

According to many authors [34,37] an important role in motor activation of pregnant women is played by the labour psychoprophylaxis programme carried out in the antenatal classes. Apart from the benefits resulting from kinesis adaptation, the programme ensures full preparation for delivery. Unfortunately, these noble goals are realized only by 10% of pregnant women, as this is the percentage of women who attend the antenatal classes in Poland [38,39]. Lack of physical activity is problematic for women in all age groups but particularly for the pregnant ones [40,41,42]. In unemployed women and pregnant ones on sick leaves, the incidence of health problems is higher than in the remaining population. Gałazka and colleagues [41] in their study involving 50 pregnant women in different trimesters have found that 36% was never engaged in any physical activity.

According to an American study, 22% of pregnant women did not agree with the statement that the majority could continue to exercise regularly during pregnancy, which stands in contradiction with the theses included in the Report on Exercise during Pregnancy (report No. 267) prepared by the American College of Obstetricians and Gynecologists in 2002.

According to the PUBMED/MEDLINE database of 2012, 11 guideline companions were published in 9 countries (Australia, Canada, Denmark, France, Japan, Norway, Great Britain and the USA), focused on "Physical Activity During Pregnancy" [43]. No such general guidelines have been published in Poland.

The majority of reports recommend moderate physical activity during pregnancy (10/11), specify its frequency (9/11) and duration (9/11). Moreover, six reports include indications for cessation of physical activity during pregnancy.

According to the literature data of the last 50 years concerning physical activity during pregnancy [44] the following is recommended:

- a. to promote physical activity and its impact on the development of pregnancy and foetal health,
- b. to determine effects of guidelines on physical activity, especially in the course of physiological pregnancy,
- c. to determine in detail the duration and intensity of physical activity during pregnancy using new, objective research tools.

Currently, reports on physical activity during pregnancy are scarce, and concern patients from the developed countries [40]. Evidence-based medicine data demonstrate that physical activity during pregnancy is beneficial for the mother and child, and moderate, and periodically even more intensive, physical activity in the course of normal pregnancy has a very positive impact on

health. Any type of physical activity is beneficial for our organisms; it improves our health but also reduces the incidence of consequences of many metabolic and civilization diseases.

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