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RESEARCH ARTICLE

Physical Activity During Pregnancy – Effects on Fetal and Newborn Health and Future Maternal Well Being

Izhar ben Shlomo, MD*[1], Ron Mor, PhD[2]

[1]Emergency Medicine Program, Zefat Academic College, Safed, Israel
[2]Tel Hai Academic College, Katzrin Campus, Israel

* izhar.benshlomo@gmail.com

ABSTRACT

Physical activity (PA) is known to improve quality of life during pregnancy and prevent complications, associated with several chronic conditions. In this review, following a succinct summary of relevant physiological aspects of gestation and effort, we summarize recent literature on the effect of PA on fetal condition and newborn outcome as well as on future maternal well-being. Many women become aware of their health issues as they plan pregnancy or become pregnant turning the period of pregnancy into a window of opportunity to establish healthier routines of life for the future. It was found that physical activity leads to less weight gain during pregnancy, as well as lower weight retention. Active women experience improved course of labor as well as lower rates of post-partum depression. As the main concern of the pregnant woman is her future baby's condition, information regarding this is crucial for those practitioners wishing to help women establish new habits, the center of which is regularly scheduled physical activity. It was shown that newborns to active women are less likely to be either macrosomic or small for gestational age. Children of women who kept physically active during pregnancy had less autistic spectrum disorders and better brain growth, as well as less sleeping disorders.

Keywords: Physiology of pregnancy; Physiology of Exertion; Borg Scale; Fetal health; newborn health; Maternal well-being

Introduction

Physiological changes during pregnancy affect mainly the cardiovascular and respiratory systems and core body temperature regulation1. The major changes are expansion of plasma volume, increased cardiac output, decreased peripheral resistance, and increased uteroplacental blood flow, reaching the maximal rate of change during weeks 24-28. The resultant changes are increase of preload and decrease in afterload, in turn leading to minute reduction of blood pressure during the first and second trimesters of pregnancy, which returns to normal during the third trimester 2 . A concomitant increase in erythrocyte production enables adequate delivery of nutrients and oxygen to the placenta and the fetus. The vasodilation in the skin, concomitant to the central cardiovascular changes is a significant aid in heat dispersion, in turn preventing fetal exposure to relative hyperthermia. If physical activity is added to the already loaded cardiovascular system, it brings a gradual improvement in coping with the non-effort condition in between the effort episodes. The better heat dispersal mechanism is a centerpiece in preventing excessive exposure of the fetus to high temperature. All the above come alongside changes in the respiratory system enabling the increased rate of gas exchange and maintenance of the acid/base balance in both mother and fetus. Lung ventilation increases 50% and the oxygen dissociation curve from hemoglobin shifts to the right and downwards, which allows easier release of oxygen to the perfused tissues3, enabling in turn higher oxygen consumption by fetal organs. All the above changes weaken the reliance on heart rate as an indicator for the adequacy of effort, turning the subjective Borg Scale into the chief index to rely on, with a recommended level of 13-14 on this scale.

Effects of PA on fetal, newborn, and infant condition

The recent large meta-analysis by4 pointed out some major effects of maternal PA on newborns' health. The ratio of macrosomia in newborns was lower in women who trained regularly. Birthweight was lower and Apgar scores were better among newborns to trained women. Somewhat opposite findings were reported by5 who found that high and moderate levels of PA were associated with increased birthweight, while the proportion of newborns with low birthweight was reduced. Combined with de Castro's report one can rest assure that macrosomia was reduced while the latter increase in birthweight was within the normal range. On the other hand, Menke et al.6 found that overall, prenatal exercise was not associated with infant body composition at birth.

On a different level of outcome, Japan Environment and Children's Study 2011-2014, which encompassed 103,060 pregnant women, of which, 69,969 answered a questionnaire about their physical activity and sleep before and during pregnancy, reported that at 3-years the risk of autistic spectrum disorder (ASD) was lower (0.61) to infants of trained mothers. Alongside this, too short (6h<) or too long (>10h) sleep durations were associated with higher risk of ASD7. It is thus not surprising that according to another meta-analysis eight of the ten included studies found PA was positively associated with sleep during pregnancy8. Using the above Japanese database, Nakahara et al.7 found that higher levels of maternal PA, both before and during pregnancy, may reduce sleep and developmental problems in infants.

Based on a retrospective review of 40 fetal heart rate follow-ups, May et al.9 suggested that physical activity provides unique benefits to the fetal autonomic nervous system that may give the fetus an adaptive advantage. Another small longitudinal study on 44 pregnant women found that higher maternal PA level was associated with greater neonatal brain cortical thickness, possibly indicating better cortical development10. McMillan et al.11 evaluated the one-month-old babies of 71 women, divided to PA and non-PA groups. They employed the Peabody Developmental Motor Scales, 2nd Edition (PDMS-2) to find that maternal exercise during pregnancy can positively influence babies' neuromotor development, thus leading to infants who are more adept at movement, and presumably more likely to be active. Niño Cruz et al.12 on a relatively small meta-analysis found that five cohort studies found a positive association between PA practice during pregnancy and offspring neurodevelopment. Domingues et al.13 who followed up a cohort of 4000 infant-mother couples found that IQ at 48 months was slightly higher (5 points) among children from trained women. The Battelle's score at 12 and 24 months was higher among offspring from active mothers. However, after controlling for confounders at 48 months no association with maternal PA was observed.

As children of women with gestational diabetes mellitus (GDM) are more likely to be obese and have impaired glucose tolerance and diabetes in childhood and early adulthood, a meta-analysis indicated that exercise in early pregnancy was significantly protective (0.76) against the

development of GDM (Tobias et al.14. A large meta-analysis on 135 studies, which reported 166,094 cases were included, indicated that maternal PA lead to 39% reduction in the odds of macrosomia in newborns (>4000 g), but was not associated with other neonatal or infant outcomes that were examined15. Also, somewhat disappointingly, Louise et al.16 in their meta-analysis found no evidence that in already overweight and obese pregnant women, dietary and/or lifestyle intervention during pregnancy modifies the risk of early childhood obesity. In the same line of evidence, Morgan et al.17 identified no pathway involving maternal physical activity or maternal diet that affected infant growth in their final model. Contrary to their expectation Kong et al.18, who studied 802 mother-child pairs at 7-8 years of age, also did not find that higher maternal PA was associated with lower child adiposity outcomes.

In summary of the newborns' and children's benefits from maternal PA during pregnancy, it appears that the majority of evidence indicate an overall positive effect.

Effects of PA on maternal health and well-being, during and after pregnancy

In their large meta-analysis, de Castro et al4 found that PA led to less weight gain during pregnancy, as well as lower weight retention at four and seven months postpartum. This was also measured as faster weight loss immediately after birth. At the close physiological monitoring women who trained had faster maternal heart rate recovery. At the carbohydrate metabolism level, women who practiced PA were less likely to be diagnosed with GDM. Furthermore, the mean serum glucose levels after 1-hour glucose tolerance test were lower in the PA groups.

At the level of blood pressure, the mean was lower for the PA groups and the incidence of pre-eclampsia was lower as well19,20.

During labor, PA groups presented shorter first and second stages of labor21. Also, trained women had less episiotomies and birth canal lacerations22, as well as higher rate of spontaneous birth and a lower rate of instrumental deliveries or cesarean sections.

After labor and delivery, the women who practiced PA had better quality of life22 and lower rate of depression23. Contrary to this Mohammadi et al24 did not find that home-based exercise intervention during pregnancy and post-partum period had a preventive effect on post-partum depression and fatigue.

In conclusion for the maternal side of the consideration, there is overwhelming evidence to support the adoption of PA by pregnant women at all stages, whether to feel better or to have better experience of labor and post-partum recovery at all levels. It is not less important to leverage the understandable concerns of pregnant women to lead to the establishment of physical activity as part of their weekly or daily routine. It is also in agreement that women who are active have in general lower BMI and therefore upon getting pregnant in the future enter pregnancy in a better shape, not to mention those who benefit in their effort to conceive25.

Future research should investigate the opportune time (before or during pregnancy) to deliver behavior modification interventions that could prevent excessive gestational weight gain or elevated blood pressure to improve maternal health outcomes. Studies that will examine not only the current pregnancy but the resultant children and future pregnancies can provide further support for advocating active life style to all women.

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