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Building Healthier Babies & Adults for Tomorrow

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Building Healthier Babies & Adults for Tomorrow

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Health care providers should encourage their pregnant patients to participate in regular exercise throughout their pregnancy.



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This article is first in a Missouri Medicine micro-series on "Exercise and Human Performance Across the Life-Span". Mary Pat Wohlford-Wessels, PhD, Executive Vice-President, Research and Institutional Effectiveness is the coordinator for the series. Contact: mwohlford@kcumb.edu

Abstract

Current studies intimate the fetal cardiovascular and respiratory systems benefit from exercise throughout pregnancy. These changes persist after birth suggesting that exercise exposure has long-term health benefits lasting into adulthood. Individuals exposed to exercise in utero show no signs of cardiovascular disease (CVD) as adults. Considering the pandemic of CVD in the U.S., these findings suggest further research is warranted concerning the effects of exercise during pregnancy on childhood and adult health outcomes.

Introduction

Among the top health concerns facing Americans, heart disease continues to be a major problem in the U.S. According to the American Heart Association, approximately 875,000 people died in 2006 as the result of cardiovascular disease. Moreover, the rising tide of obesity along with accompanying co-morbid conditions is also disquieting. The American Heart Association points out that over 145 million

Americans over the age of 20 are overweight or obese. These alarming numbers are further compounded by economic issues related to cost and lost productivity. Currently, annual health care costs related to obesity are 147 billion dollars a year.¹ For researchers, this milieu creates a sense of urgency in which effective, yet budgetary conscience solutions must be found. A group of researchers at the Kansas City University of Medicine and Biosciences (KCUMB), led by Dr. Linda May, in collaboration with the Hogle Brain Imaging Center, is seeking effective interventions that will begin to eradicate these serious health issues. This research consortium has emphasized the need to begin addressing the questions associated with the benefits of exercise during pregnancy.

Exercise Benefits Pregnant Women

In the past, researchers have investigated the relationship between physical activity and pregnancy. Collectively, findings have supported that the acute cardiovascular, hormonal, nutritional, thermo-regulatory, and bio-mechanical responses of exercise are not

teratogenic, and do not compromise the pregnancy. Moreover, results of these studies revealed that physical exercise provided benefits for the mothers, such as an improved sense of well being along with diminished discomfort and pain. Placental adaptations were discovered that indicated an increase in blood flow and nourishment to the fetus. In conclusion, the studies found that exercise during pregnancy benefited the mother and the placenta.

But, how does exercise during gestation influence pregnancy outcomes, with regard to health and quality of life issues? A common worry often expressed in regard to exercise during pregnancy, is that aerobic and anaerobic physical activity is harmful to the fetus. This perspective, although well-intentioned is not supported through empirical investigations. One of the most direct approaches to assessing the influence of maternal exercise on the fetus has been to compare the occurrences of fetal demise in exercisers, relative to non-exercisers. Studies which examined this outcome found that swimming in the first trimester, and any amount or type of exercise thereafter decreased the risk of fetal loss.² In light of the information that exercise during pregnancy has not been harmful to an unborn fetus, research has begun to examine other pregnancy outcomes as they are related to exercise.

Another health issue associated with negative maternal outcomes has been the increasing number of women of reproductive age who are overweight or obese found at www.cdc.gov/obesity/data/trends.html#State. Missouri is one among the nine “fattest” states in the US, based on 2009 statewide BMI data found at www.cdc.gov/obesity/data/trends.html#State. An overweight or obese condition during pregnancy is associated with an increased risk of gestational diabetes, chronic hypertension, large for gestational age infant, and fetal/neonatal death.⁴ Despite these adverse outcomes, another KCUMB study indicated that within the metropolitan area of Kansas City, approximately 50% of women were overweight or obese at the time of conception.⁵

One study compared women who exercised during pregnancy to sedentary non-exercisers. The two groups were not significantly different for the variables of education, employment, age, and parity. Results of this study indicated that the non-exercisers exhibited higher Body Mass Index (BMI) than exercisers.³

Typical physiological responses to pregnancy are

increased resting heart rate, increased sympathetic drive, and decreased heart rate variability (HRV). HRV is related to parasympathetic and sympathetic control. Gestational hypertension and obesity exacerbate these cardiovascular alterations. If exercise has already proved to increase HRV via improved autonomic control, could aerobic exercise be used to maintain cardiovascular health during pregnancy? Paynter, Meacham, Ramar, Gustafson, Suminski, and May⁶ provided evidence that exercise during pregnancy was a plausible intervention to improve maternal cardiovascular health, throughout gestation. Therefore, utilizing exercise intervention may help counterbalance the augmented, sympathetic control of gestational conditions, which is associated with adverse maternal and fetal outcomes.

Keeping these findings in mind, it seems imperative that action must be taken to encourage women to increase their physical activity levels during pregnancy. One of the best ways to achieve this may be to intervene through the health care provider. A study by Smith, Zare-Maivan, and May⁵ established that women whose health care providers encouraged exercise during pregnancy were more likely to participate in physical activities during gestation. Increasing physical activity during pregnancy may help to improve maternal and fetal outcomes.

Maternal Exercise Benefits the Fetus

The most commonly documented neonatal health outcome is birth weight. Several studies have determined that babies born from exercising mothers have normal birth weights.⁷ While exercise during pregnancy is related to healthy birth weights, a lack of exercise is associated with greater frequency of very low birth weight babies.⁸

Another neonatal outcome is morphometric body measurement as an indicator of fetal growth during gestation. Overwhelmingly, research supports that maternal physical activity throughout gestation does not detrimentally effect fetal growth. This is evidenced by similar morphometric parameters for newborns of both active and non-active pregnant women including: birth length, head circumference, abdominal circumference, and ponderal index.⁹

Findings concerning the effects of maternal exercise on fetal growth and development are encouraging. It is still important to determine the response of the baby to acute maternal exercise during and after the exercise

bout. In order to assess fetal distress during and after maternal exercise, measurements of fetal heart rate (FHR), along with fetal breathing have been routinely measured since these measures are the most straightforward measures of fetal well-being during pregnancy. FHR is dependent on duration and intensity of exercise.⁹⁻¹¹ Exercise during pregnancy elicits a FHR response, whether a woman is conditioned or not prior to conception.¹¹ More importantly though, researchers have noted no increase in fetal distress, and a decreased incidence of abnormal fetal heart patterns with maternal exercise.^{7, 9, 10}

Fetal breathing movements are essential for proper lung development and are used as an indicator of fetal well-being; though, the fetus does not practice breathing movements continually. A fetus in distress, for example, will have decreased movements. Marsal, Lofgren, and Gennser¹² and Manders, Sonder, Mulder, and Visser¹³ found an increase in fetal breathing movements immediately following a session of maternal exercise, thus indicating that the fetus was not in distress and was receiving ample oxygen and nutrients. The augmentation of fetal breathing movements suggests maternal exercise may benefit fetal lung development.

A study by Million, Gustafson, and May¹⁴ compared fetuses exposed to exercising and non-exercising maternal cohorts and had two main findings. First, they found there was an “improved maturation of the cardiac autonomic nervous system in fetuses exposed to maternal exercise.” Secondly, they found there was a “higher fetal, cardiac, parasympathetic control during fetal breathing movements for the exercising cohort.”



While exercise during pregnancy is related to healthy birth weights, a lack of exercise is associated with greater frequency of very low birth weight babies.

Maternal Exercise Enhances Fetal Cardiovascular Development: The KCUMB Research Program

Another area of research has begun to examine the effect of chronic exposure of maternal exercise on fetal development. As an adult, regular aerobic exercise leads to a lower resting heart rate, indicative of improved parasympathetic tone. Controlling for gestational age and activity state of the fetus (i.e. active or quiet), fetal heart rate (FHR) is lower with increased heart rate variability (measures of autonomic control) in fetuses exposed to maternal exercise throughout gestation.¹⁵ FHR is lower during fetal breathing in exercise exposed fetuses relative to non-exercise exposed fetuses due to increased parasympathetic control.¹⁴ The development of the fetal, cardiac, autonomic

system appears to be influenced by chronic exposure to maternal exercise.

The developmental origins hypothesis states that the in utero environment influences fetal development and further contends that these differences will have implications for the infants throughout their life span. Further analysis of exercise data by May, Glaros, Gustafson, and Suminski¹⁶ found a dose response relationship between level of maternal leisure time, physical activity and fetal, cardiac, autonomic response. For instance, low levels of maternal exercise produced small changes in FHR and HRV while higher levels of maternal physical activity produced greater changes in FHR. These findings indicated that the level of exposure to maternal exercise in utero influenced the maturation of sympathetic and parasympathetic nervous systems, similar to the adult cardiovascular response to chronic

exercise. Future research is needed to determine if exercise during pregnancy is the earliest intervention to improve cardiovascular health and decrease disease. Considering that heart disease is a leading cause of death in the U.S., such research is necessary and essential.

These findings establish the link between fetal measurements and the developing, autonomic nervous system and suggest that maternal exercise may improve fetal neurodevelopment. Additionally, exercise during gestation may be used as an intervention to improve short and long term outcomes in children, especially those born to women at risk for gestational conditions. Gestational exercise may help reduce or alleviate adverse symptoms and outcomes related to numerous gestational diseases. The findings of current research suggest that exposure to maternal exercise during pregnancy is not only safe, but possibly beneficial. Future research needs to address the question of whether these differences persist after birth and into adulthood.

A study of one-month-old infants of exercising mothers by Meacham and May¹⁷ found that the infants had a lower heart rate (HR) and an increased HRV relative to those not exposed to maternal exercise. The lower HR in exercise exposed infants was due to increased parasympathetic control. Exercise exposed infants had equivalent sympatho-vagal balance, relative to non-exercise exposed infants. These findings suggested that exposure to maternal exercise in utero may influence the maturation of sympathetic and parasympathetic nervous systems. In addition to the cardiovascular system, there are other parameters which have been measured in children exposed to exercise in utero.

Clapp found that by five years of age, the exercise offspring performed significantly better on the Wechsler intelligence scales and tests of oral language skills.¹⁸



When pregnant, low-impact exercise such as walking is the most common and the easiest, since special equipment is not required.

Outcomes for children aged 8-12 years indicate similar growth, significantly better academic and extracurricular performance, and equal or advanced coordination, balance, strength, speed and endurance over children not exposed to maternal exercise. Evenson reported that at 17-20 years youth who were exposed to maternal exercise in utero had significantly better academic and sports performance. In addition, those same youth exhibited no evidence of obesity or cardiovascular disease.¹⁹

All of these findings are extremely informative and suggest that the earliest intervention to improve cardiovascular health, body morphometry, and nervous system development should be during pregnancy. These findings indicate that the in utero environment is enhanced from maternal exercise. As a result, fetal development is influenced in a manner in which offspring have healthier cardiovascular systems than children not exposed to exercise.¹⁷

Ultimately, these data suggest a potentially positive prenatal programming effect, which implies that pregnancy should be the first focus for interventional strategies to help promote health and reduce the risk of cardiovascular disease later in life.

Exercise for Pregnant Women: What kinds, How much?

As heart disease and obesity related conditions continue to elicit concern in our society, it is crucial that health care providers educate pregnant women on safe exercises during pregnancy.⁵ Aspects of exercise which have been studied are factors involving frequency, time, intensity, type of exercise, and environment. For example, the American College of Obstetrics and Gynecology (ACOG) recommend previously sedentary women to exercise three times per week, while previous exercisers can exercise daily.²⁰ Most physicians believe

that three to five exercise sessions per week are ideal.²¹ The amount of time per session may vary from 20 to 60 minutes, or possibly more depending on the activity. For women who have not previously exercised, ACOG recommends starting slowly, and building up to three sessions per week for 30 minutes a session.²⁰ For women who have been active prior to conception, 30 or more minutes every day is safe, as long as the mother remains symptom free.

Non-impact aerobic exercises like swimming or stationary cycling seem to be the safest, based upon research. Unfortunately, these are not the most accessible types of exercise since they require costly equipment, or a gym membership. Low-impact exercise such as walking is the most common and the easiest, since special equipment is not required. Moderate and high intensity exercises such as jogging and running have also been shown to be safe during pregnancy, for healthy women with low risk pregnancies. Studies have also documented the effects of aerobic exercise as well as anaerobic strength and conditioning activities. When these exercises are performed correctly, adverse outcomes have not been reported.

In general, women should focus on an environment that is comfortable (i.e. not too hot or humid) and avoid potentially harmful situations (i.e. falling off a bike, abdominal trauma from racquetball, or laying supine.) Additionally, women must also stay hydrated when exercising. Provided that pregnant women follow ACOG guidelines and consult regularly with their doctors, they should have a safe and healthy pregnancy, while possibly improving the cardiovascular and overall health of their offspring.

Conclusions

In conclusion, research has documented the benefits of maternal exercise to the fetus during pregnancy if all fetal and neonatal measurements are within normal ranges, and there are no indications of fetal distress during or after exercise. More importantly, evidence points to the fact that the fetal cardiovascular system and lungs may benefit from maternal exercise. The changes to the cardiovascular system persist after birth, suggesting that exposure to maternal exercise may have long-term health benefits lasting into childhood and adulthood. Individuals exposed to exercise in utero exhibit improved academic and sports performance, relative to their “non-exposed” counterparts.¹⁹ Further, these exercise exposed individuals show no signs of obesity or cardiovascular disease as

adults. Therefore, health care providers should encourage their pregnant patients to participate in regular exercise throughout their pregnancy. Women who follow ACOG guidelines and the recommendations of their physicians will be more likely to have healthier pregnancy outcomes. Considering the pandemic of obesity and cardiovascular disease in the U.S., these findings suggest that further research about the effects exercise during pregnancy on childhood and adult health outcomes is needed.

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Disclosure

None reported.

