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Full length article

High-intensity exercise during pregnancy – A position paper by the European Board and College of Obstetrics and Gynaecology (EBCOG)

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ABSTRACT

Most guidelines recommend regular physical exercise to all pregnant women. However, because of the anatomical and physiological changes which occur during pregnancy, high-intensity exercise and forms of extreme sports can place the pregnant woman and her fetus at risk of harm.

Introduction

The World Health Organization recommends that all healthy pregnant and puerperal women should undertake regular physical activity of at least 150 min of moderate-to-intense aerobic activity throughout the week, including a variety of aerobic and muscle-strengthening exercises. Women who habitually engage in high-intensity exercise can continue during pregnancy and the puerperium [1]. The WHO recommendations are reflected in a number of country-specific guidelines related to physical activity during pregnancy [2]. Exercise activities which have been extensively studied and shown to be safe and beneficial include walking, stationary cycling, aerobic exercises, dancing, resistance and stretching exercises, and water sports that do not involve diving [3]. With the increasing participation of women in competitive high intensity sports, the issue of the potential effects of such activity during pregnancy has gained increasing relevance.

Because of the physiological and anatomical changes associated with pregnancy, caution must be advocated in particular circumstances and in relation to certain forms of high-intensity exercises such as:

- sport activities that place individuals at risk of direct abdominal trauma or sustaining a significant fall.
- sport activities with risks of indirect trauma, such as those due to sudden accelerations and decelerations.
- sport activities where oxygen supply may be impaired. This criterion is particularly applicable to individuals with cyanotic respiratory or cardiovascular disorders.

High impact intensive exercise compounded by the physiological changes that occur during pregnancy may potentially have an impact on early fetal development during the first trimester mediated through alterations in thermoregulation and hypoxia, whereas exercise-potentiated hypoxia could result in fetal hypoxia during the second and third trimesters.

Physiological changes during pregnancy

Pregnant women undergo a series of physiological changes involving glucometabolic, thermoregulatory and cardiorespiratory alterations that are generally aimed to provide a favourable environment to the developing fetus, to help promote its growth and continued wellbeing. These changes, including the relaxation of connective tissue and smooth muscle, are driven by progressively increasing levels of placental hormones, reaching a plateau in the third trimester. Some of these changes

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have no direct bearing on the exercise tolerance capabilities of the mother, but others may significantly affect them, especially in the third trimester [4].

Risk of thermoregulation (or hyperthermia)

Intense exercise results in physiological responses that carry potential risks of adverse effects on the developing fetus. Sustained exercise, as in distance running, generates an increase in core body temperature. In the first trimester of pregnancy, this is theoretically considered a physical teratogen. However, retrospective questionnaire data has suggested that healthy women accustomed to jogging before pregnancy can continue to do so without harm to the infant [5]. Animal studies have shown a relationship between elevations in core body temperature and the development of birth defects. Chronic exposure during late gestation has also been linked to fetal growth restriction [6,7]. Retrospective studies of human subjects also suggest an increased risk of fetal abnormalities with core body temperatures above 38.9 °C during the first trimester. However, studies evaluating the effects of various combinations of climate and intense physical exercise, have shown no increase in the incidence of fetal abnormalities. It is important to note that exercise-induced core body temperature increases in these studies were 1.1 °C lower than any of those causing increased teratogenic risk in animal studies [6,8].

The thermogenic effects on pregnancy may be heightened by an accompanying dehydration generated during exercise [9]. Pregnant women should be advised to ensure that their exercise regimen does not include a high-intensity period of more than 15 min, alternating with cool-down periods of lower intensity. They should wear light open weave clothing and ensure adequate hydration before, during and after exercise [10,11].

Risk of trauma

The pregnant uterus grows significantly with advancing gestation. It is palpable above the pubic symphysis around the end of the first trimester and reaches the level of the umbilicus at about 20 weeks. Direct trauma delivered to the abdomen after the first trimester of pregnancy can result in the force being transmitted to the placenta and fetus.

Blunt trauma

The leading cause of blunt abdominal trauma in pregnant women is motor vehicle accidents, accounting for about 207 cases per 100,000 births, in high-income countries. Other causes of blunt abdominal injury include falls and physical assaults. In a series of 381 cases of abdominal trauma presenting to a level 1 trauma centre, 74.2 % of cases followed motor vehicle accidents, 15.8 % followed falls, and 6.3 % followed assaults [12]. Blunt abdominal trauma has been shown to contribute to serious obstetric emergencies such as spontaneous miscarriage, placental abruption, preterm labour and delivery, and uterine rupture, all of which are associated with significant mortality and morbidity to both mother and child. Less dramatic complications of partial placental abruption are placental insufficiency and intrauterine growth retardation [13].

Sports injuries

Blunt abdominal trauma may also be caused by sports where participants run the risk of contact with a projectile, e.g., tennis, squash, netball, football, etc. Such sports should be avoided at the competitive level during the second and third trimesters of pregnancy. Sports involving unlimited contact and risk of direct collision on the abdomen, such as kickboxing, judo, rugby, etc, should be completely avoided in the latter two trimesters. Sport activities that place the individual at increased risk of falling and sustaining a blunt abdominal trauma, such as gymnastics, water-skiing, snow-skiing, snowboarding, ice skating, horseback riding, and competitive cycling, should be similarly avoided. The risk of falling is compounded by the fact that pregnancy is associated with greater joint laxity and increased body weight, which can result in an altered sense of balance and gait changes [14].

Risk of indirect trauma

Indirect trauma can be caused by activities involving rapid acceleration and deceleration, and prolonged multi-gravitational (g) force, such as experienced in rollercoaster rides, etc. These have been associated with obstetric complications such as premature rupture of membranes, placental abruption, and fetal-maternal haemorrhage [15,16]. Studies in baboons have demonstrated that rapid deceleration distorts the size and shape of the uterus because of abdominal organ compression [17]. Disruption of myocardial cellular integrity was also noted in pregnant rats exposed to 2G accelerative and decelerative forces [18].

Reduced oxygen availability

It is generally recommended that after the mid-second trimester of pregnancy women should not undertake activities that require them to lie supine on their back for a significant period of time. The increasing size and weight of the uterus at this stage may be sufficient to compress the inferior vena cava in the supine position. This may result in reduced venous return to the heart, decreased cardiac output, orthostatic hypotension, decreased blood flow in the abdominal aorta, decreased placental blood flow, and temporary fetal hypoxemia.

High altitude activities

Travelling to high altitude locations can also reduce the oxygen supply to the fetus. The relative hypoxia of the mother brought on by intensive exercise at high altitudes, compounded by the physiological changes which occur during pregnancy, may potentially contribute towards fetal hypoxia. Such situations are particularly important in women with previous respiratory or cardiac conditions that make them susceptible to cyanosis. Country-specific guidelines recommend that exercise needs to be avoided at altitudes greater than 1800 m, at least until the body physiologically fully adjusts to the altitude.

Scuba diving

Pregnant women should refrain from scuba diving because of the risks of decompression sickness in the fetus. The fetus is poorly protected from developing decompression sickness, because the fetal pulmonary circulation cannot filter bubble formation to the maternal bloodstream. Fetuses of pregnant sheep and goats subjected to air compression equivalent to 49 msw [metre sea water] pressures for 5–15 min were shown to develop decompression gas bubbles even when the mother did not display signs of decompression sickness [19]. Animal studies stimulating decompression sickness in early pregnancy suggest that it may have significant deleterious effects on fetal development [20]. However, anatomical differences in placental circulation between animals and humans may limit the generalisability of these observations to humans [21]. Human studies are naturally observational in nature, and they do not confirm the risks suggested by animal studies. A two-phase retrospective and prospective study, evaluating 157 pregnancies and 1,465 dives showed no adverse fetal effects. However, the vast majority of women ceased diving in the first trimester and therefore the potential adverse effects of diving at a later stage of pregnancy could not be determined. However, it suggests that diving in the first trimester of pregnancy may be relatively safe [22,23].

Recommendations

- Pregnant women should continue to undertake regular moderate physical activity avoiding over-exertion during pregnancy. Safe examples of this include brisk walking, swimming, cycling, mild aerobics, yoga, Pilates, and more depending upon their tolerance levels during pregnancy.
- Pregnant women should avoid intense physical activity during high ambient temperatures and ensure a good hydration during exercise.
- Pregnant women should avoid exercise that involves a high-risk of direct abdominal trauma or sustaining a significant fall. Pregnant women should avoid sport activities with risks of indirect trauma, such as those due to sudden accelerations and decelerations.
- Pregnant women should avoid physical activities associated with reduced oxygenation. This is particularly significant for individuals who have cyanotic respiratory or cardiovascular disease.
- Pregnant women should avoid assuming the supine position for a prolonged period of time after the mid-second trimester.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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