# *Minireview Article*

**Healthy Lifestyles during Pregnancy is Associated with Better Maternal and Fetal Health**


## Abstract

Evidence indicates that healthy lifestyles can significantly improve maternal and fetal outcomes during pregnancy. Several major physiological changes take place during a normal pregnancy, all aimed at keeping the mother and the growing fetus healthy. Five major lifestyles, tobacco smoking, alcohol consumption, obesity, sedentary lifestyle, and inadequate nourishment can deleteriously alter these processes. Several myths, addictions, societal stigmas, and other factors often lie behind the continuance of unhealthy lifestyles. Besides directly impacting the course of a normal pregnancy, fetal development, delivery, and lactation with breastfeeding, these unhealthy lifestyles also impact several chronic diseases that invariably harm the pregnancy. This manuscript briefly reviews the effects of these lifestyles.



**Keywords**: pregnancy, smoking, exercise, alcohol, diet, obesity




## Introduction

Pregnancy usually lasts about 40 weeks (about 9 months) and is usually split into three trimesters[1]. The first trimester is from week one to week 12, the second from week 13 to week 28 and finally the third from week 29 to week 40. Infants born before 37 weeks are considered preterm, those born between the 37th and 38th week of pregnancy are called early term. Those born at 39 weeks or later, are considered full term[2]. Pregnancy is associated with several physiological changes, including an increase in the production of estrogens, progesterone, prolactin, and the placental human chorionic gonadotropin[3]. The gestational body weight increases, mainly due to the additional weight of the fetus, the placenta, enlarging uterus, amniotic fluid, mammary glands, and adipose tissue[4]. Several cardiac and hematological changes also occur. Plasma volume and cardiac output may increase by about 40% - resulting in peripheral vasodilatation and a decrease in systemic vascular resistance. There is a reduction in hemoglobin concentration, hematocrit, red blood cell, and platelet count[5]. Oxygen demand increases by 20 to 30%. There is an increase in respiratory rate and an increase in ventilation. Several other systems are also affected, primarily to adapt to the growing needs of pregnancy[6]. These changes continue to evolve as the pregnancy progresses and start resolving with the birth of the baby and expulsion of the placenta[6]. Lactation and breastfeeding provide the offspring with hydration and nutrients for the first 4–6 months of life[7]. Pregnancy is a complex physiological process. Lifestyles play a significant role during the entire perinatal period. This is briefly discussed in this manuscript.

## Discussion

The five major lifestyles that have a significant impact on human health are smoking, obesity, exercise, alcohol intake, and diet. They play a major role in the pathogenesis of most major

chronic diseases. Li et al. estimated that avoidance of these five unhealthy lifestyles can significantly increase longevity[8]. In their estimate, adherence to healthy lifestyles at age 50, provides women 14.0 years, and men 12.2 years of additional life. These five lifestyles also have a major impact on the health of both the mother and the fetus before conception, during pregnancy, and after childbirth.

**Smoking/Tobacco Use**

Most pregnant smokers are aware that smoking in pregnancy is harmful, although many lack detailed knowledge of the associated risks[9]. However, despite this general awareness, approximately 12% of pregnant women in the United Kingdom and United States smoke throughout pregnancy[10]. Tobacco is the most common substance abused during pregnancy[11]. Its use is associated with increased maternal, fetal, and infant morbidity and mortality[12]. Serious outcomes from tobacco use include ectopic pregnancy, increased risk of miscarriage, placenta previa, premature rupture of membranes[13] , preterm birth[14,15], antepartum and intrapartum stillbirth[16], low birthweight[17,18], decreased head circumference, perinatal death[19], and sudden unexpected infant death[20,21]. Smoking women also tend not to breastfeed, wean offspring earlier, and produce less milk than non-smokers[22]. Waterpipe smoking may also increase the risk of delivering a low birthweight infant as well as other pregnancy complications[23]. Snuff or chewing tobacco is also associated with an increased risk of stillbirth, low birth weight, prematurity, and infant death[24]. Secondhand smoke (SHS) exposure to infants causes an increased risk of sudden infant death (SIDS) and lower respiratory illness[25]. Almost every developing organ system in the fetus, including the lungs, brain, heart, and ears, appears to be affected by prenatal exposure to tobacco[26,27]. The damage is usually long-term and results in future lower respiratory tract infections, asthma, otitis media, dental caries, hearing loss, and metabolic syndrome[28]. Exposure to secondhand smoke is also dangerous for pregnant women – studies have shown that they have a 20% greater chance of giving birth to a low-birth-weight baby than women who are not exposed to SHS during pregnancy[29]. Nicotine and cotinine are known to accumulate in concentrations two- to three-fold higher in breast milk than in plasma, posing an additional risk in breastfeeding infants[30]. Prenatal thirdhand smoke is also dangerous to the lungs in utero of the unborn child[31]. After birth, the newly born child may continue to be exposed to environmental dust with thirdhand smoke particles in a home where smoking is or was present[32]. Studies show that most women who smoked during pregnancy also continue to do so after the birth of the child[33]. Among children exposed to tobacco smoke either prenatally or postnatally, increased rates of behavioral problems are seen very early in life[34]. Newborns exposed in utero have heightened startle responses, tremors, hypertonicity, have more severe reactions to bowel movements and diapering, and tend to be fussier and cry more[34]. By 18 months, children exposed to SHS in utero manifest increased externalizing behaviors, including defiance, not responding to punishment, inattentiveness, and hyperactivity[35]. During early school years, children exposed prenatally to tobacco smoke also demonstrate increased rates of behavior problems. These include hyperactivity, oppositional defiant disorder, delinquency, and both internalizing and externalizing behaviors[36]. An association with ADHD has also been noted[37]. During pre-school years, children prenatally or postnatally exposed (also with SHS) show more behavioral problems than unexposed children[38,39]. These include demanding attention, changes in

mood, emotional instability, arguing, aggression, and destructive behavior[39,40]. These behaviors are often persistent into adolescence[41,42.] E-cigarettes, unlike regular cigarettes[43], expose non-pregnant adults to lower levels of carcinogens and toxins[44]. Exposure to second-hand e-cigarette vapor may pose less risk than exposure to second-hand cigarette smoke[45]. However, although the data on any harm to the pregnant woman or her baby from exposure to vaping is limited[46-48], precautions should be taken to avoid such exposure. And finally, children of women who smoke cigarettes are more likely to take up smoking themselves[49]. There is no safe level of exposure to tobacco smoke during pregnancy.

**Obesity**

Obesity (body mass index or BMI>30) is increasing in pregnant women. It has recently become one of the most important health issues in pregnancy[50]. Current Centers for Disease Control and Prevention (USA) data suggest excessive weight gain is reported in roughly 59% of overweight women and 56% of obese women[51]. Excessive weight gain and obesity impact pregnancy even during the preconception period. Obesity in females is associated with subfertility and with a longer time to achieve pregnancy[52,53]. Observational studies indicate that bariatric surgery improves fertility in women with obesity[54]. Following conception, the complication rates in abnormally overweight pregnant women go up dramataicaly[55]. They are more likely to experience miscarriage[56] – one meta-analysis showed that in women with a BMI>25, the increased risks had an odds ratio (OR) of 1.67[57]. Preeclampsia and gestational hypertension (HTN), usually occurring in the second half of pregnancy or soon after childbirth in obese women, can lead to dangerous cardiovascular complications[58]. A Swedish cohort study of 805,275 pregnancies found that 2.8% of women with a BMI of 29.1–35.0 had preeclampsia compared to 1.4% of women with a BMI of 19.8–26.0 (adjusted OR 2.62)[59]. Duckitt et al. found that there was a 50% increase in the risk of preeclampsia in pregnant women who had an increased BMI at the outset and this risk doubled if the BMI was >35[60]. Gestational diabetes (GD) is also dangerous. It leads to more cesarean sections, offspring born with high body weight, and a higher risk of type 2 diabetes mellitus (T2DM) in both the mother and the child in the future. One study found that almost 42% of mothers developed T2DM over 10 years following GD[61]. Obese pregnant women have a higher incidence of GD. A retrospective UK study of 287,213 pregnancies between 1989 and 1997 showed that after adjusting for confounding factors, women with a BMI ≥30 had a high OR of 3.6 for developing GD than women with a BMI of 20.0–24.9[62]. A subsequent Australian study confirmed this higher risk. In a review of 14,230 pregnancies, Callaway et al. found that the risk of developing GD was 2.95 times higher in obese women (BMI 30.01–40.00) compared with normal-weight (BMI 20.01–25.00) women[58]. Obesity also increases the risk of death from venous thromboembolism (VTE). These women often have reduced mobility, suffer from co-morbid conditions, increased frequency of operative delivery, and possibly higher levels of coagulation factors VIII and IX[63]. In a United Kingdom study, pregnant women with a BMI >30 had an adjusted OR of 2.65 for antenatal pulmonary thromboembolism[64]. Maternal obesity also exposes the offspring being stillborn or preterm[65,66]. Ultrasound examination of the fetus is also often difficult in obese pregnant women. During labor, they experience problems with difficulty with anesthesia, and cesarean delivery. In a systematic review and meta-analyses, Aune et al. determined that the relative risk for each five-

unit increase in BMI in overweight/obese pregnant females was increased: 1.21 for fetal death, 1.24 for stillbirth, 1.16 for perinatal death, 1.15 for neonatal death, and 1.18 for infant death[67]. The BMI is also inversely proportional to the length of labor in nulliparous women[68]. Cesarian delivery is more common: it has an unadjusted OR of 1.46 in overweight and an unadjusted OR of 2.05 in obese women when compared to normal weight women[69]. Anesthesia is more problematic in obese women – epidural failure is more common[70] and endotracheal intubation is sometimes difficult before general anesthesia[71]. Cesarian section is more likely to be complicated by surgical site infections in the overweight (odds ratio 1.6), obese class I (OR=2.4), and obese classes II and III (OR=3.7)[72]. Macrosomia (birth weight of ≥ 4,000 grams regardless of gestational age) is more common. Obese women also experience a higher rate of fetal birth trauma during labor e.g., shoulder dystocia, fracture of the clavicle, damage to the brachial plexus[59,73]. The risk of congenital abnormalities in the offspring is also increased in overweight/obese pregnant women[74]. A systematic review and meta-analysis found a higher risk of congenital anomalies: spina bifida (OR=2.24), neural tube defects (OR=1.87), limb reduction anomalies (OR=1.34), cardiovascular anomalies (OR=1.30), and cleft lip and palate (OR=1.20) – in children born from obese when compared with non-obese pregnant women[75]. The risk increases with increasing levels of obesity[76]. Children born with excess body weight increase their risk of later life obesity[77]. Obese women face several hurdles, such as delayed lactation, embarrassment with body size, larger breasts/nipples, and comorbid medical conditions, that may interfere with breast feeding. This may result in decreased rates of initiating breastfeeding and breastfeeding for shorter durations compared to normal weight women[78]. Obesity during pregnancy also results in postpartum weight retention and continuing obesity[79,80]. They are also prone to future co-morbidities such as T2DM and cardiovascular disease (CVD)[65,77]. According to the Institute of Medicine (IOM) suggests an optimal gestational weight gain of 11 to 20 lbs. (5 to 9 kg) for women who are obese (BMI >30.0 kg/m2) and 15 to 25 lbs. (6.8 to 11.3 kg) for women who are in the overweight (BMI of 25.0-29.9 kg/m2) category[51]. They recommend a weight gain of 25 to 42 lbs. (11 to 19 kilograms) for obese women carrying twins or multiples. For underweight women (BMI <18.5 kg/m2), a weight gain of 28-40 lbs. (12.5-18 kg) and for normal-weight women (BMI of 18.5-24.9 kg/m2), a weight gain of 25-35 lbs. (11.5-16 kg) is considered appropriate[81]. The optimal weight gain recommended may differ for Asian women.

**Alcohol**

It is estimated that globally, 10% of women consume alcohol during pregnancy[82]. Data suggests that in Europe, the percentage is higher and involves about a quarter of the pregnant women. In some specific countries, the consumption of alcohol during pregnancy is even higher - Russia (36.5%), the United Kingdom (41.3%), Denmark (45.8%), Belarus (46.6%), and Ireland (60.4%)[82]. Unfortunately, alcohol use and binge drinking among women of childbearing age has been increasing in most countries globally[83]. In a recent report published in 2018, Denny et al, reported that globally, almost one in nine (11.5%) of pregnant were now drinking alcohol during pregnancy and 3.9% engage in binge drinking during the previous 30 days[84]. Prenatal alcohol exposure can affect multiple aspects of infant health and development[85]. The harm starts preconception, as it adversely affects the quality and quantity of maternal nutrient intake during this period[86]. Since almost one-half of all pregnancies in the United States are unintended, and

often unrecognized early on, alcohol intake often harms a fetus during embryologic (3–8 wk. of pregnancy) development[87]. The teratogenic effects of alcohol are most significant during this stage[88]. Alcohol use in women who are sexually active and in the reproductive age should therefore be (confirming with the current recommendation from the American College of Obstetricians and Gynecologists, Center for Disease Control (CDC), Surgeon General, and medical societies from other countries including the Society of Obstetricians and Gynecologists of Canada) completely avoided[89-91]. Alcohol exposure during the second and third trimesters is also associated with neuronal loss, preterm labor, and preterm birth[92-94]. Other detrimental effects include miscarriage, intrauterine growth restriction, and stillbirth[95,96]. Alcohol consumption during pregnancy may lead to fetal alcohol spectrum disorder (FASD). This includes growth retardation, craniofacial dysmorphisms, central nervous system dysfunction, or neurobehavioral disabilities in the newly born child[97-99]. Its use also detrimentally affects the mother. Pregnant and parenting women who use alcohol often shy away from necessary health care[100]. The related fear of a punitive response is partly responsible for avoiding much-needed health and social services. No safe limit has been established for alcohol consumption during pregnancy[101]. Its use should be avoided during pregnancy and breastfeeding[102]. Alcohol consumption and its harmful effects should be discussed by healthcare providers with pregnant women as early in the pregnancy as possible and during every prenatal visit[103]. WHO also recommends detoxification if addiction is detected in pregnant women[104]. Withdrawal symptoms (visual, auditory, and tactile disturbances, tremors, sweating, agitation, anxiety) may occur and if severe, may require inpatient monitoring during detoxification[105].

**Exercise**

Exercise tends to decrease in many women with pregnancy[106,107]. It is estimated that almost 60% of women are inactive during pregnancy[108], and only 15%–38% of pregnant women follow physical activity (PA) guidelines[109]. The numbers are drastically lower in the 3rd trimester with only 8% meeting the recommended activity guidelines[110]. The decrease in levels of PA during pregnancy often persists up to six months after delivery[111]. Several barriers contribute towards this increase in sedentary behavior, including worries that PA may lead to a miscarriage. Other justifications include nausea and increased body weight and body size[112]. However, PA and physical exercise during pregnancy is not only safe but helps improve maternal and fetal health. It prevents several pregnancy-related complications[113,114]. It deters weight gain[115]. Exercise before and during pregnancy also helps reduce the risk of maternal GD[116] and if present, makes it easier to control[117]. It also helps prevent preeclampsia[118]. Regular exercise may shorten the duration of labor and reduce the risk of Cesarean section and operative-assisted vaginal delivery[119]. Exercise also helps reduce peri-natal depression[120]. PA does not lead to adverse effects on birth weight and does not increase the risk of stillbirth. Fetal benefits include reduced preterm birth and decreased fat mass[121]. There is no detrimental effect on lactation or infant growth[122]. Even non-traditional exercises like yoga reduces pregnancy-related complications[123,124]. Exercise also helps relieve stress, lowers blood pressure, improves blood cholesterol levels, decreases depression, and enhances self-confidence[125,126]. In general, exercise reduces the morbidity and mortality associated with CVD, HTN, T2DM, and many other chronic diseases[127]. Several professional associations, including the American College of Obstetrics and

Gynecology (ACOG) recommend that pregnant women perform at least 30 minutes of moderate exercise, five days per week[128,129]. Aerobic exercise can be safely initiated in the first trimester and continued until delivery[130,131]. Resistance exercises, properly designed, may also help complement aerobic exercises[132,133]. Besides improving cardiorespiratory fitness, exercise also helps decrease weight gain, diminish lower limb edema, and mitigate depression[134,135]. Postpartum exercises also help decrease urinary urge incontinence, reduce lumbopelvic pain, and help strengthen the recti abdominus muscles[136,137]. Certain exercises may, however, cause harm and should be avoided. These include exercise at a higher elevation (above 5250 feet), those increasing the risk of contact, falling, or abdominal trauma, and underwater activities like scuba diving[138]. Hot yoga and hot Pilates may also cause harm. Women should not exercise if they have severe preeclampsia or other comorbid severe diseases. They should not exercise if they suffer from placenta previa, second or third trimester bleeding, vasa previa, intrauterine growth restriction, and preterm labor[139,140]. These women can minimize the risk of venous thromboembolism by ambulating regularly rather than exercising[141]. They should stop exercising and seek immediate medical attention if there are unexplained symptoms – such as dizziness, shortness of breath, chest pain, or calf pain. Exercise should be stopped, and medical advice sought if there are painful contractions, vaginal bleeding, a leak of the amniotic fluid, or rupture of membranes[142,143].

**Diet**

Adherence to the nutritional recommendations is low in pregnant women[144,145]. Most women start avoiding alcohol and caffeine when they find out that they are pregnant[146]. However, diet modification during pregnancy is more complex[147]. The non-pregnancy requirement for protein is generally 0.8g/kg/day. In pregnant women, due to the needs of the growing fetus, this goes up to 1.1g/kg/day[148]. Pregnant women should consume 45-64% of daily calories from carbohydrates and 20-35% of daily calories from fats. The micronutrient intake also goes up – both during pregnancy and during lactation. Three micronutrients are specifically important – folic acid, iron, and vitamin B12. The requirements for folic acid increase 10-20-fold, for iron two- to three-fold, and for B12, about two-fold. Folic acid is necessary to support cell growth and nucleotide synthesis for fetal and placental development. Several studies have shown that folic acid supplementation helps reduce neural tube defects in the offspring. It is recommended that folate consumption should increase from 400 μg/day to 600 μg/day during pregnancy and should be around 500 μg/day during lactation[149]. Another micro-nutrient requirement – iron, nearly doubles during pregnancy. Its requirements go up from 18 mg/day to 27 mg/day. Iron deficiency anemia (ferritin <15 μg/L) is not uncommon in this population and needs to be aggressively treated. Although other micronutrient requirements also go up, these can usually be taken care of by the intake of a daily prenatal multivitamin, both before conception, during pregnancy, and during lactation. An additional 500 kcal/day intake is needed by breastfeeding women beyond what is recommended for non-pregnant women[150] to ensure adequate weight gain by the newborn. Requirements of many micronutrients also continue to be high during this postnatal lactating phase.

## Conclusion

Lifestyles are extremely important in modifying the results of pregnancy. Obesity has a harmful relationship with pregnancy, and this is often unrecognized, overlooked, or ignored. Obesity impacts pregnancy even before conception as it reduces fertility. During pregnancy, excess body weight significantly increases the risk of maternal and fetal complications. It also adversely affects the future of both the mother and the child. The quality of diet also has a significant impact on maternal and fetal health. The increased protein requirement and the critical role played by folic acid and iron in the health of the growing fetus are well recognized. The IOM dietary guidelines are extremely helpful. The deleterious role of smoking and alcohol for both the pregnant mother and the offspring has been well studied. Even a single cigarette or an alcoholic drink is unsafe in pregnancy. And finally, the myth of exercise not being safe during pregnancy has now long been proven false. Most healthy nulliparas are advised 30 minutes of moderate-intensity exercise about 5 days a week. The adoption of healthy lifestyles should begin before pregnancy and continue through the postpartum period.

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