

Tobacco Abuse in Pregnancy

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Full Text: Headnote ABSTRACT: Nicotine Tobacum with its 4,000 additives remains the most injurious addiction to the pregnant woman and her baby. At the discovery of being pregnant 60% of women will quit and 40% will continue throughout the pregnancy. For those 40% tobacco's chemicals will be absorbed into mother's blood, and the baby will be bathed in these toxins. There will be 144,000 spontaneous abortions (approximately 14.6% of all pregnancies), a weight deficit of almost one pound, a loss of 50 I.Q. points in the baby, and affective disorders programmed in the innocent fetus. This article reviews the evidence-based literature regarding findings about tobacco's products and their effect on gestation. KEY WORDS: Tobacco abuse, pregnancy, spontaneous abortion, prematurity. INTRODUCTION There are greater than 1.3 million people who quit smoking in the U.S. each year. That is a remarkable number attempting to reverse the tobacco damage to their health. Unfortunately 50 million continue this dangerous addiction. Of women who smoke, close to 60% percent stop smoking as soon as they find out they are pregnant. Sadly, that means that about 40% continue to abuse tobacco during this critical period. With this percentage then, tobacco ranks as the most commonly abused drug in pregnant women. It is noted that there is an increasing number of women using smokeless tobacco as well (mostly in the Southeastern USA). Even more striking is the projection that between 200-300 million of the world's children will die of tobacco-related disease in their lives. There are estimated to be 1.1 billion people daily using tobacco worldwide (Rotarian, 1999, p. 12). According to the World Health Organization (WHO), 3.5 million people die each year as a result of tobacco abuse. As an obstetrician, for a long time I have tried to discourage smoking during pregnancy. I have always counseled women in their pre-conceptual visits to stop tobacco use before they attempt to conceive. I warn those that are using no contraceptive or inadequate measures like diaphragms and condoms that they should stop tobacco so that the unborn child will not be bathed in all the tobacco chemicals ingested through their lungs and mucus membranes during that most vulnerable, formative time, the first 12 weeks of pregnancy. The early conceptus certainly does not need all the tobacco chemicals that are driven into the blood stream poisoning the new, developing child. There is no question, however, that I have made some patients angry and others have left my office feeling guilty. While it was not my intention to have them feel bad, I wanted them to be informed about the terrible consequences. I have probably gotten about the average number of women to stop the habit. Of those, I have never met a woman who was not completely thrilled to have quit both for herself and her baby. Their pride was worth the effort. This paper is a review of the gathering literature on the subject of the effects of tobacco use and pregnancy. Through this medium I hope to bring an increased awareness of tobacco and its contribution to negative pregnancy outcomes. Much of the information about tobacco abuse is well known and denied by the tobacco companies and people who are addicted. I know, I denied physical damage in my own body for a long time before I quit. This article is written for those women who are pregnant or are contemplating pregnancy and for the professionals who work in childbirth. TOBACCO: WHAT IS IT? Historical Background The culture of tobacco began in the Western Hemisphere and was carried to other countries by mariners. Columbus is thought to have brought tobacco to Europe. North and South American Indians used raw tobacco for spiritual purposes. (This is a totally different product than the manufactured products we consume today.) Apparently, the early voyagers began its use in their travels. Nicotina tabacum (Gruenwald, Brendler, & Jaenicke, 1998) is grown for its leaves, which are known to contain 19 carcinogens. A carcinogen is a chemical that will cause cancerous changes in the tissue to which it is applied. Tobacco is smoked, chewed, dipped (smokeless), and used

ceremonially. As well, tobacco has been used therapeutically as poultice and enema. After manipulation of the leaf by tobacco companies there are known to be over 4,000 additives, many of which are designed to increase the absorption of the addicting nicotine. There are suggestions by other researchers that there are as many as 9,000 additives (James, Steer, Weiner, & Gonik, 1994). In the early 1950's the first research reports indicating that tobacco abuse resulted in disease, especially heart and lung disease, were published (Hammond, 1961). But not until Dr. C. Evert Koop became the Surgeon General was anything done about it. Most of us who smoked noted that our sinuses and lungs seemed affected, even before the scientists identified the risk. More recently, a FDA chairperson tried to get tobacco declared an addictive drug, due to nicotine being as addictive as cocaine, heroine, and morphine. The tobacco lobbyists stopped that effort. The hope was that by declaring tobacco an addictive drug its use could be regulated. Now several states have increased their revenue by placing higher taxes on the products almost \$7 per pack in New York. That increase has forced many to quit smoking. Some of the additives and other chemicals which result from tobacco use and are absorbed into the human blood stream are: acetone, acetylene, ammonia, carbon monoxide, hydrogen cyanide, propane, nitrous oxide, naphthalene, nicotine, nicotine-derived nitroaminoketone (NNK), phenol, toluene, herbicides, various chemical fertilizers, and many more complex chemicals (Excite/Health, Internet, 1999). How does this information relate to pre- and perinates? A current finding is in newborns of smoking mothers: the newborns are found to have unacceptable levels of NNK and other carcinogen in their urine. The implications are frightening. What's in Tobacco That Is Responsible for the Damage? Among the many chemical and by-products of tobacco when entering the human blood stream nicotine, carbon monoxide, Polonium (radioactive element formed while tobacco is burning), NNK, and cyanide do most of the long and short time damage. The implication of the retention of these compounds is the flooding of the baby's system, the placenta, and causing primary tissue damage as well as reducing the oxygenation of the vital tissues. What about second hand smoke? There is increasing evidence that second hand smoke causes all the same problems, though perhaps reducing risk by 50%. However, infants and small children who are exposed to second hand smoke have markedly increased pulmonary, ear, and upper respiratory problems including asthma. Because children are still growing, their sensitive tissues are more vulnerable to second hand smoke, so the damage is greater. I believe that if measured those women who smoke in their cars might be getting even more than their share of tobacco products into their systems. And of course, living with a smoker increases the health complications of the non-smoker. In researching to get current incidence rates for this article I thought the March of Dimes or WHO would have a report of the number women using tobacco during pregnancy. I was disappointed. Of my patients, most did not know there was a danger to their babies by their tobacco abuse and with support they quit. Many, however, look at me and say, "There is no way I will quit." These women doubt the scientific evidence that there is any affect on the baby. They will say as their evidence that "My Ma smoked when she was pregnant with me and I ain't damaged." Tobacco Damage: General Systemic Effects Growth in the fetus is governed by the placenta, which acts as regulator to the supply of oxygen, nutrition, and as a kidney for the developing child. With nutritional deprivation and exposure to nicotine there is shunting of the blood from the skin, gut, liver, pancreas, and kidney to the brain, adrenals, and heart. Circulatory spasm from the effects of nicotine decreases oxygen reaching the placenta. The placental circulation increases in an attempt to compensate for this decreased oxygenated maternal blood. There is a compensatory increase in maternal blood pressure. This begins the "circle of deprivation" (Nathanielszis, 1999). For a short time, hypoxemia will not affect the fetus, however a chronic decrease in oxygen-as in smokers-will result in smaller babies, costs to the liver and pancreas and physical and emotional stress as measured by increased cortisol levels. The pancreas produces less insulin, a cellular growth factor, helping to explain the intrauterine growth retardation of the exposed fetus. Obviously, the unborn is most vulnerable in the first trimester when all its organs are developing. This growth retardation is referred to as symmetrical and unlike asymmetrical changes cannot be reversed in utero. Surprisingly, the starvation of the unborn resets brain hunger regulation and these children grow rapidly after

birth. Tobacco products cause average weight differences of 441 grams which is about one pound. In the Nazi's Dutch Hunger studies the average small-for-dates baby was 235 grams less than those not exposed to starvation, and in that study severe psychological damage in a high percentage was found when the children reached adulthood. Babies born of smoking mothers also expire early in extraordinary numbers. Sudden Infant Death Syndrome (SIDS), remarkable attention deficit/hyperactive disorder (ADHD) children, and diabetes are common sequela of babies exposed to tobacco's harmful products. There is an increase in deep vein thrombosis, which can lead to pulmonary embolism. This is particularly true for women over forty on birth control hormones and estrogen replacement treatment. Women who smoke have a 2.5 times greater risk of fatal coronary heart disease over males. Then there is a negative effect of smoking on ovarian function and in vitro fertilization. Spontaneous abortion is increased 42.1% versus 18.9% for nonsmokers (Hammond, 1961; Williams, Mittendorf, Listern, & Monson, 1991). There are both stimulatory and depressant effects of tobacco abuse: there is increased bowel activity, diarrhea, increased bronchial secretions and cough, central nervous system stimulation and tremors, increased heart rate and blood pressure and decreased respiratory function due to loss of bronchial tube function. There is an increase in sweating and nausea, in infrequent users. Blood sugars will go up and there is an increase in the production of insulin in the blood. There is an increased clumping of the platelets, which is what leads to blood clots. Abuse of tobacco products accelerates the occurrence of heart disease, ulcers, esophageal reflux, hypertension, and delayed wound healing. Tobacco products increase the growth of all cancers especially in the urinary bladder, lung, breast and cervix. There is increasing evidence that there are behavioral problems in smokers, though this is poorly studied. Instead, as you will see, newborns and older children demonstrate behavioral and social problems when they have been exposed to the absorbed chemicals generated from smoking by their mothers while pregnant (Ferguson, 1999). For example, being addicted to tobacco products increases stress. Increased stress increases the adrenal hormone cortisol. Cortisol inhibits cell growth. Smokeless tobaccos affects are: increases in addiction, various oral diseases like decaying gums and teeth, 50 times higher mouth, throat and esophagus cancer; coronary heart disease, increases in angina, hardening of the arteries and increased cerebral vascular accidents (strokes). There is also a marked decrease in sense of taste and smell. Swallowing the juices of smokeless tobacco increases the risk of stomach cancer. Smokeless tobacco is not any safer than cigarettes (Internet: excite/health, 1999). FETAL AND NEONATAL EFFECTS In addition to the general system effects mentioned above, smoking delivers high concentrations of nicotine into the blood stream. The tobacco manufacturers have added ammonia to increase that absorption. The most damaging chemicals to the developing baby are nicotine, carbon monoxide, cyanide and the radioactive isotope, polonium. There is little doubt that there is going to be damage to the cells of the brain and body of the developing baby. The following is a more extensive list of the fetal and neonatal effects:

**Documented Adverse
Outcomes with Cigarette Smoking during Pregnancy**

<i>Maternal</i>	<i>Fetal-Neonatal</i>	<i>Placental</i>
Periodic hypertension	Spontaneous abortion	Abruptio placenta
Respiratory complications	Intrauterine death	Abnormal vascular resistance
Stroke	Premature rupture of the membranes	Placenta previa
Myocardial infarction	Prematurity	Infarction
Uterine hemorrhage	Abnormal adrenal function	
Chronic inflammatory bowel disease	Reduced brain size	
Ectopic pregnancy	Intrauterine growth retardation	
Failed tubal ligation	Reduced intellectual function	
Anorexia and altered bone function	Impaired newborn lung function	
Mediator of stress	Reduced childhood stature	
Failure to reduce ethanol intake	Sudden Infant Death Syndrome-SIDS	

Next to causing a miscarriage, the most common, easily diagnosed result of maternal smoking and exposure to secondary smoke is small for gestational age (SGA), also known as Intrauterine growth retardation (IUGR). This means the baby when born will be underdeveloped, compared to what the child should have been. It is estimated that this weight difference can be almost a pound. Unfortunately, medical professionals are limited in what we can do to change this damage on the developing child. Cessation of tobacco use obviously makes a big difference. I actually had one mother state to me that she was smoking on purpose so that her baby would not be big at birth and labor less painful! Smoking women will say, "I have cut down." Regrettably, as few as 5 cigarettes per day will result in babies that are measured less than 5 pounds 8 oz (Socol, Mennig, Mirata, & Drusin, 1982; Meyer & Tonascia, 1977). Then there is profound chronic hypoxemia (oxygen deficiency to the baby). I do not believe that the hypoxemia alone is the whole story. For example, a mother who smoked heavily and had a little 5 lb. 4 oz. girl at term, continued to deny the smoking had anything to do with it. She said that she smoked with her first baby and, "there was nothing wrong with him." I had to respond, "... that you know of." Her new baby delivered early because of increasing fetal problems, and looked like an anorexic. I have some evidence to support my thoughts about intrauterine growth retardation (IUGR) and smoking. I believe it is caused by a variation in the activity of the insulin growth factor, which is suppressed in smokers. The fetal metabolism of fat is tied to this factor. Nonetheless, we are well aware that there is a marked reduction in the terminal villi of the placenta. These are the fine vessels that assist the fetal uptake of oxygen. SIDS has a relative risk of 2.93 (Dwyer, 1999) for smokers. This means that the risk to a tobacco toxic infant has almost 3 times greater chance of dying in infancy than a similar child of a non-smoking mother. Tobacco toxicity accounts for 30% or more of SIDS deaths. Tobacco is a teratogen, a cancer-causing compound, in the developing fetus. As reported in Science News (1999), women who smoke transmit a potent carcinogen to the fetus called nicotine derived nitroaminoketone (NNK) which is found only in tobacco. So 61% of women who continue to smoke bath their babies in a toxic, cancer-causing soup (Hecht, 1998). There is yet no evidence connecting cancer to tobacco products in the newborn or later in the adult of the exposed fetus (James, et al., 1994). While waiting for the studies to be done, we will have to assume the tender, developing cells of the unborn, especially

in the first three months of gestation, are vulnerable to that disease. Hecht also reported to the meeting of the American Chemical Society that he found tobacco-specific lung carcinogens in the newborn's urine and not in the urine of the non-smoker's babies. The name of that compound is 4-(methy-nitrosamine)-1-(3-pyridil)-1-butanone. Normal fetal behavior is altered in a hostile environment, as proven by many experiments. There is evidence that there is late dissociation of the heart conduction resulting in changes in the heart rate on monitoring (Harmon, 1994). A compromised fetus is more sensitive to other toxic events when labor comes. These compromised babies often must be delivered by Cesarean section because the baby cannot tolerate uterine contractions. This is all too common in the fetuses of tobacco toxic mothers. I have read that epidemiological studies place spontaneous abortions from tobacco abuse at 40-45% compared to 15-19% of pregnancies of women who do not smoke (Stirrat, 1994; Meyer & Tonascia, 1977). Kline (1977) showed an excess of spontaneous abortion in smokers versus non-smokers. We have documented that there is a 1.5 times more frequent abruption of the placenta, or loss of the placenta, early in tobacco abusers. Also hopeful is that there are 50% fewer fetal deaths in nonsmokers if women stop smoking early in pregnancy (Rosh, Andrew, & Kiristal, 1990). There is an increased number of low amniotic fluid indices and premature rupture of the fetal bag of water in the maternal smokers. Meyer and Tonascia (1977) noted that there was a 3-times greater risk of spontaneous, premature rupture of the fetal membranes when compared to non-smokers. This is more than likely due to alteration in protein metabolism of the developing child. Measurement of amino acids, the building blocks of protein, from fetal blood shows marked reduction in every trimester. The fetal outcome is thus dose related. The more mother smokes, the more the damage to this sensitive system. It is shown in this study that five of our essential amino acids were severely depressed but other amino acids were also lower. A heavy smoker in this study was considered to smoke 15 to 25 cigarettes per day. Dr. M. Mascola et al. (1998) wanted to find out what other metabolites could be found in the circulation and placenta of infants born of tobacco-abusing women. He found cotinine, a metabolite of nicotine. It was found that the cotinine would not appear in the fetal blood until the placenta has been saturated. Thus, even slowing down nicotine exposure will not help the baby much because once the placenta is saturated the metabolite passes on through to the baby. Of interest is that metabolite was ten time higher in the urine of breast-fed babies of smokers than in the non-smokers. This implies that women who smoke probably should not breast feed. In a study of antisocial behavior, 70% of exposed newborns showed no antisocial or violent behavior if mother did not breast feed (Mascola et al., 1998). The finding of cotinine suggests the transmission of other metabolites to the baby (Hanrahan, Mascola, McGreevey, Van Yunaicus, Tagar, & Speuizer, 1998). Secondary smoke does not increase blood levels significantly. Behavioral Issues Impaired mental and emotional development, hyperactivity syndromes and attention deficit, and decreased IQ are also evident (Millberger, Biederman, Faraone, Chen & Jones, 1996; Wakschlag, Lahey, Loeber, Green, Gordon, & Leventhal, et al., 1997; Fergusson, Woodard, & Horwood, 1998). Two articles in the Archives of General Psychiatry are of interest to this discussion as well: Maternal smoking during pregnancy and adult criminal behavior and an editorial comment on Prenatal smoking and antisocial behavior. Let me quote from Brennan, Gerkin and Mednick's study (1999): Results (of the study) indicate a dose-response relationship between amounts of maternal smoking and arrests for nonviolent and violent crimes [of 4,169 males born between 1959 and 1961]. Maternal prenatal smoking was particularly related to persistent criminal behavior rather than to arrests confined to adolescence. These relationships remained significant after potential demographic, prenatal, and perinatal risk confounds were controlled for. In a commentary to the above article, David Fergusson (1999) complimented the scholarly study. He went on to cite the many reports about the linkages between maternal smoking and later development of externalizing, antisocial behavior in middle childhood which lasted into later adulthood. This antisocial behavior appears to be unrelated to other mental health and personal adjustments. However, he cautions that it "... would be unwise to draw strong or dogmatic conclusions on the current body of evidence." I must disagree. There is a preponderance of evidence in the scientific literature proving the connection to anti-social behaviors of the tobacco-challenged children. The

unborn will be a smoker early in life-it has tasted the effects. **BENEFITS OF QUITTING** I would be remiss if I did not include the advantage of stopping tobacco abuse. From my own point of view it took a lot more will power to keep smoking than it did to quit. I did not find it hard to do after 43 years of heavy smoking when I finally made to decision to stop. Admittedly, I find many start to stop with determination and when they are faced with their day-to-day trials give up. Most of these folks really did not decide to stop; they tried to stop. Trying will never do it. Said another way, to try means, "I really shouldn't smoke this cigarette. I'll start to stop next time. I really need this one." There are many products and services now to assist the dedicated person to give up the habit, the addiction. Patches, pipes, gum, group therapy, and other supports that help the small number who succeed. I do notice that those who stop, cold turkey, are the most successful long term. The figures of 20-40% are suggested when "stop smoking" is accompanied by progressively reducing nicotine medications and helpful groups. There are also those who are successful with hypnosis with success in the range of 25-30%. Marketers of advertisements claim cold turkey efforts result in 2.5% stopping smoking. Relapse is more common in the medicated group and less common in those getting emotional support. Currently, there is an anti-depressant, which controls the emotional deprivation feeling of not having that cigarette. It works as long as one takes it, but relapse is as high as with the patch. The implication is apparent, namely, that people who smoke are depressed. I found the following in a flyer on cessation of tobacco use recently (Publisher unknown): * Twenty minutes after stopping smoking the blood pressure and pulse decrease; hands and feet warm. * Eight hours later the carbon monoxide levels in the blood return to normal; oxygen increases. * By 24 hours, heart attack risk starts dropping. * Within 48 hours damaged respiratory tree nerve ending begin regeneration; smell and taste improve. * From 2 weeks to 3 months: circulation improves, walking is easier, lung function improves by 30%. * After 1-9 months: energy increases, cough and sinus symptoms disappear, fatigue and shortness of breath decrease, the cilia in the bronchiols return to normal, there is a decrease in the number and severity of upper respiratory infections. Risk of heart attack reduces by 50%. * By 5 years or less, a 50% decrease in risk of mouth, throat, esophagus and lung cancer. * By 10 years the risk of cancer of the lungs and genitourinary tract equals that of never-smokers. * After 15 years of not smoking you are statistically the same as a non-smoker's risk. An interesting finding by Baker and his associates (1999) claims that those who miss the long-lived emotional responses to tobacco can usher those formerly addicted to nicotine back into addiction. He found that those smokers who had intense mood alterations in the first 5 or 6 days after stopping usually return to smoking within the next two weeks. The "welling up of these dark emotions may stem from extended mourning for the loss of pleasure, security, and other elements of the individual's smoking experience." This may be related to the loss of the release of brain dopamine, a pleasure molecule, caused by nicotine, morphine, cocaine, and alcohol and thus they miss the damping effect on those dark emotions. In sum, do not believe that cessation of tobacco abuse is stressed as hard as it should be, faced with the incredible number of miscarriages that will result before many women even guess they were with child. Cigarettes being the most damaging to a pregnancy, pre-pregnancy women could improve chances for a healthy pregnancy and a healthy baby by stopping the addiction. Alcohol is bad and there is much written about the fetal alcohol syndrome, but in my estimation smoking is a far greater risk for more children. After all, the shortterm damage is fetal loss; long term damage has mental, physical and behavioral implications. It is confusing then why there is so much written about the fetal alcohol syndrome and so little comparatively about tobacco. I strongly believe that if a woman does not use excellent birth control, she should not smoke. **THE OTHER SIDE** To be fair I must report that to date there is not a clear causality in many of the fetal effects of tobacco abuse. By that I mean investigators do not know exactly what causes all the changes found in the fetal tissues born of smoking mothers. We can only speculate on what chemicals or combinations exact the damage. There are genetic considerations, which also complicate this connection. Epidemiologically, it goes without saying that we may never know which chemical, how much hypoxemia, or what level of carbon monoxide is necessary to cause IUGR, spontaneous miscarriages, or any of the many clinical damages found. If we only knew all the additives that could be

removed from tobacco, would that make it be safer? I personally believe tobacco use will never be safe. In the meantime, I hope that researchers will continue to find out cause and effect, and women will take more responsibility for their pregnancies. Carol Thompson of Smokers' Rights indicates in "How the Anti-smokers Lie about Neonatal Costs of Smoking" that smoking is not the cause of fetal loss. She concluded, ". . . that no medical costs would be avoided and social problems of poverty, young mothers, and out of wedlock births would be solved by a crusade against maternal smoking." Further she puts the blame on mothers who have no prenatal care, on race and social class, rather than smoking for bad pregnancy outcomes. We already know that these other variables enter the picture in pregnancy outcome studies, however, the preponderance of these groupings abuse tobacco as well. Comparing them to non-smokers in the same group the unsatisfactory outcomes fall heavily on the smoking mothers. Yet, Ms. Thompson insists, "there are no health risks due to smoking or tobacco use." Causality may still be in question, but there are literally hundreds of articles documenting the tobacco damage to mothers and their babies prenatally, intrapartum, and postnatal. This is my bias: I believe that if a woman and her mate desire having a baby they must want the very best for that baby. If they go ahead and get pregnant with that in mind then they will not smoke. As far as I am concerned, smoking by the pregnant woman is the very worst thing they can do to themselves and to their child. And the worst part about smoking while pregnant is the effect may last a child's entire life. That is a terrible legacy for the baby.

CONCLUSION There are no good things to say about tobacco exposure to the fetus and newborn. The tobacco companies have finally been caught in court to have lied about the health risks for years and have had to settle for many billions of dollars over the next twenty years. Yet, there has been no slow up in growing tobacco by tobacco farmers. Admittedly, there are fewer adults smoking than ever before, yet it is disappointing to see increasing numbers of local teenagers starting tobacco use. That is when I started. All I wanted was to be accepted. Instead, I got hooked. I am still very sorry my oldest daughter was exposed to our tobacco smoke before birth and after. She has chronic lung disease as a result. Her mother died at 51 of lung cancer. I ended up with emphysema and a higher risk of heart disease. The goal for this article? I want for others to share it with women who are smoking and who are smoking and pregnant. Isn't it time to really push education about smoking dangers? Wasn't that part of the tobacco company's settlement, to educate our youth about the risk of smoking? Do you believe they are doing a good job?

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