

The Effects of Smoking on Pregnancy and Breastfeeding

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According to the latest Maltese National Obstetric Information System (NOIS) Annual Report of 2020, 8% of expecting mothers were reported to smoke throughout their pregnancy (1). Cigarette smoking during pregnancy as well as lactation is associated with detrimental outcomes for both the mother and baby. However, cigarette smoking is one of the most crucial preventable causes for such outcomes (2). Apart from active smoking by the expecting mother, passive smoking (or second-hand smoking) is also harmful to the baby as it is comprised of the same tobacco smoke toxins found in active cigarette smoking. Furthermore, it has been found that third-hand smoke exposure, which occurs when tobacco components precipitate on surfaces and adhere to dust particles, increases exposure to nicotine especially indoors (3).

CIGARETTE SMOKING AND THE BODY

Tobacco smoke is a complex mixture consisting of more than 4,000 harmful chemicals (4). Some of the components include carbon monoxide, nicotine and carcinogens such as aromatic amines, polycyclic aromatic hydrocarbons and tobacco-specific N-nitrosamines, which have all been associated with adverse effects on foetal life (4). The smaller particles of nicotine are able to infiltrate deeply into the lung tissue, eventually crossing the lung barrier and entering into the blood circulation. Therefore, apart from causing localised injury to the lungs, smoking can also alter the innate and adaptive immunity and consequently increase C-reactive protein, fibrinogen, interleukin-6 levels and white blood cell counts respectively (5,6). Moreover, nicotine has been proven to cross the placenta as high amounts of cotinine, which is a nicotine metabolite, have been seen in the amniotic fluid of pregnant smokers (7,8).

SMOKING AND THE UNBORN BABY

The detrimental effects of maternal smoking during pregnancy may be observed from the first trimester. The basement membrane thickens and consequently increases the changes in placental tissue and morphology (9). This would also lead to a decrease in vascularisation and therefore, less nutrients and oxygen delivery to the foetus (10).

Maternal smoking has also been strongly linked to preterm birth (<32-week gestational age) (11). A dose-response relationship has been observed between the numbers of cigarettes smoked and pregnancy duration (12). A strong association between maternal smoking and birth complications such as premature membrane rupture, has also been reported (13). Preterm babies have been documented

to suffer from long-term decreased lung function values (14,15) throughout their lives and also increased hyper-responsiveness of the airway. Prematurity (16) and corticosteroid exposure (17) to help lung maturation after premature birth is directly linked to asthma.

Smoking during pregnancy is linked to foetal growth restriction and with a decrease in birth weight of around 150-200g (18,19). Maternal smoking during pregnancy is associated with reduced head size and femur length (20). Furthermore, the foetal skeletal growth is also affected as maternal smoking decreases the buildup of foetal bone mass. This occurs due to diminished calcium absorption in the intestines, and oxygen supply and nutrients to the growing foetus (21,22). The influence of maternal smoking has been shown to have a long-lasting effect on the skeletal development of the offspring. This could be due to the intrauterine processing of the growth hormone/insulin-like growth factor-1 axis (23,24). Therefore, smoking during pregnancy could expose the offspring to an increased lifetime risk of defective bone health such as osteoporosis.

One of the adverse effects of maternal smoking is the increased possibility of intrauterine growth retardation (IUGR) (25) and consequently also linked to poor lung function (26). Maternal smoking also increases the risk of morbidity following viral respiratory illnesses (27). Exposure to tobacco increases the chances of respiratory infections and wheezing illnesses (28)

EFFECTS ON BREASTFEEDING

The World Health Organisation (WHO) and the United Nations Children's Fund (UNICEF) both recommend that infants start breastfeeding within the first hour of birth and are solely breastfed for the first 6 months of life (29). Breast milk contains the most important macronutrients (vitamins, proteins, lipids and carbohydrates) needed for the proper development of the newborn. It also contains vital bioactive substances such as antimicrobials, hormones and growth factors, amongst others, that are crucial at this stage.

Cigarette smoking affects the breastfeeding stage of pregnancy as it decreases the levels of prolactin and consequently reduces the milk supply (30,31). It also changes the milk composition and taste. When a woman is breastfeeding, the levels of the hormone somatostatin are decreased. However, in smoking mothers the somatostatin levels are increased which leads to decreased milk production (32). When breast milk is given to the baby, nicotine is taken up by the digestive system and the baby's liver metabolises the nicotine to cotinine (33). These substances in the baby's circulation can lead to increased baseline heart rate (34). Newborn infants of smoking mothers show delayed sucking reflex and decreased sucking pressure whilst breastfeeding. Such differences in breast emptying and stimulation would alter the endocrine hormones which further contribute to decreased milk production in smoking mothers (35).

CHANGE IN BREASTMILK FLAVOUR AND COMPOSITION

Nicotine in breast milk has been reported to diminish the baby's appetite and desire for breastfeeding milk. The total fat concentration in the breast milk of smoking mothers is found to be lower by approximately 19% to 26% (36,37). In normal lactation, the hormone prolactin augments the enzyme activity of lipoprotein lipase which speeds up the production of free fatty acids to the mammary gland (38). In smoking, however, the action of lipoprotein lipase on the liver is inhibited and therefore lipolysis is diminished and triglycerides, low-density lipoproteins and cholesterol levels are increased in maternal blood (36,39). Furthermore, decreased amounts of long chain polyunsaturated fatty acids, such as omega-3 fatty acids, have been observed in women who smoke.

Smoking also increases the levels of certain heavy metals in breast milk (40). The most dangerous is cadmium, which is a toxic metal and which diminishes the metabolism of certain microelements such as iron, magnesium, copper, zinc and selenium (41–43). These microelements are vital for the normal development of the foetus and infant. Moreover, in mothers who smoke even during lactation, iodine levels have been found to decrease in breast milk. Iodine is essential in the development of thyroid hormones and reduced iodine is linked to diminished motor function, poorer cognition and brain damage (44).

Cytokines are important in regulating normal cellular regulation and growth. They bind to specific receptors which are found on immune system cells and play a role in the inflammatory process. In the initial term of lactation, the colostrum and transitional milk have increased levels of specific cytokines such as tumour necrosis factor (TNF) α , TNF β , interleukin (IL)-1 β , IL-2, IL-4 and IL-5 amongst others. These cytokines are vital for organogenesis in early development as the neonates' organs are still not fully developed (45,46). TNF α which plays a crucial role against infection and trauma, was found to be significantly lower in smoking mothers' breast milk. Furthermore, decreased concentrations of IL-1 β and IL-8 in colostrum, and IL-6 in mature milk were observed in lactating smoking women (47).

It has been observed that women who smoke heavily during pregnancy and breastfeeding have an increased rate of their offspring developing early stage leukemia (48). Also, women who breastfeed and smoke run a 50% increased risk of colic in babies (49).

The presence of nicotine in the body promotes the formation of oxygen radicals and concurrently decreases the antioxidant function of the lungs, which contributes to DNA mutations (50,51). This mechanism prevents the correct development of the lungs and leads to structural changes (52–54).

Maternal smoking has been identified as a significant risk factor to sudden infant death syndrome (SIDS) (55) and has also been linked to an increased risk for respiratory infections and allergies in

children. As the child grows older, the adverse effects of maternal smoking may still be felt as the infant has a higher probability of developing upper and lower respiratory tract infections and otitis media (56). A high nicotine level in breast milk has also been linked to a decrease in the child's active sleeping time as compared to those mothers who avoid smoking prior to breastfeeding (53.4 minutes versus 84.5 minutes) (57)

SMOKING CESSATION

Smoking cessation advice in preconception and antenatal care needs to be further reinforced because it has been shown that smoking reduction can lower the risk of impaired foetal growth (18). Cigarettes continue to be the most common used tobacco product even during pregnancy, nonetheless, other forms of tobacco such as vaping, cigars and e-cigarettes are gaining popularity (58). However, data regarding the effects on the maternal population is still very limited. A wrong perception exists that vaping is a safer alternative to cigarette smoking since the smoker is not inhaling the products of tobacco combustion, however, these products still contain nicotine or its salts (59,60)

The National Institute for Health and Care Excellence (NICE) recommends that healthcare practitioners offer cognitive behaviour therapy, motivational interviewing and structured selfhelp and support from professional services for smoking cessation. Nicotine replacement therapy (NRT) risks and benefits should be discussed at length with pregnant women who smoke, especially with those who do not wish to use non-pharmacological therapy. NRT should only be prescribed once the pregnant woman stops smoking and should be started two weeks after smoking has stopped. It is important to advise pregnant women that nicotine patches should be removed prior to going to bed. Also, bupropion and varenicline should not be promoted to pregnant or breastfeeding women (61).

CONCLUSION

In conclusion, healthcare professionals should support both expecting parents to quit smoking in a holistic manner in order to ensure that the baby's health is safeguarded. The expecting mother should be encouraged to reduce the number of cigarettes smoked in order to decrease the dose-response relationship. A smoke-free environment needs to be adopted by the whole family in order to ensure the least exposure possible to tobacco.

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