The impact of second-hand tobacco smoke exposure on pregnancy outcomes, infant health, and the threat of third-hand smoke exposure to our environment and to our children

Smoking during pregnancy is associated with various adverse effects on pregnancy and fetal development, carries a lot of serious complications such as spontaneous abortion, placental abruption, and reduced birth weight of the newborn. Children of smoking mothers have an increased risk of premature birth, low birth weight, sudden infant death syndrome and respiratory diseases during infancy. Smoking also causes long-term risk of maternal health problems such as: heart disease, cancer, emphysema, chronic obstructive pulmonary disease and higher mortality rate. Because women are more likely to quit smoking during pregnancy than at any other time, there are attempts to increase motivation and help them to stop smoking at the procreative phase of their life. The article describes interventions that are carried out in Loma Linda, where the educational program „When You Smoke Your Baby Smokes” reminds parents about the health effects of smoking during pregnancy and harmful impact on child’s health caused by second-hand smoke. Another threat to health and environment of our children, is the nicotine coming from indirect exposure to tobacco smoke. Residual nicotine that persists in high concentrations on the interior surfaces, including clothing, is forming in the reaction of nitric acid carcinogenic compounds of specific nitrosamines. In addition, ozone and related atmospheric oxidants react with nicotine smoke or smoke coming from the second-hand smoke, giving the smallest particles with high risk of asthma. Efforts towards reducing exposure to tobacco smoke coming from the passive and indirect smoking should be placed at a high priority throughout the European Union.

Palenie w trakcie ciąży ma związek z różnymi niekorzystnymi skutkami dla ciąży i rozwoju płodu, niesie za sobą wiele groźnych komplikacji m.in. samoistne poronienia, oddzielenie się łożyska oraz niedobory urodzeniowej masy ciała noworodka. Dzieci matek palących mają zwiększone ryzyko przedwczesnego po rodou, malej urodzeniowej masy dziecka, zespołu naglej śmierci niemowląt oraz chorób układu oddechowego. Palenie tytoniu powoduje również odległe na stępstwa u matek m.in choroby serca, wystąpienie choroby nowotworowej, rozedmy płuc, przewlekłej obruturacyjnej choroby płuc i zwiększonej umiernośc. Ponieważ kobiety są bardziej skłonne do rzucenia palenia w czasie ciąży niż w jakimkolwiek innym momencie ich życia, podejmowane są próby mające na celu zwiększenie motywacji i pomoc w rzuceniu palenia szczególnie młodym rodzicom. Artykuł opisuje interwencje, jakie zaproponowano w programie edukacyjnym „Kiedy palisz Twoje dziecko też pali”, uświadamia rodzicom o skutkach zdrowotnych palenia w trakcie ciąży oraz działaniach szkodliwych dla dziecka, spowodowanych przez biernie palenie tytoniu. Kolejnym zagrożeniem dla zdrowia i środowiska naszych dzieci, pozostaje dym pochodząc z pośredniego narażenia na dym tytoniowy. Pozostałości nikotyny utrzymujące się w dużych stężeniach na powierzchniach wewnętrz pomieszczeń, w tym ubraniach, tworzą w reakcji z kwasem azotowym związki rakotwórcze, nitrozaminy. Dodatkowo ozon i inne utleniacze reagują z dymem nikotynowym lub nikotyną uwalnianą z innych powierzchni co powoduje powstanie substancji szkodliwych dla naszego zdrowia, które mogą wnikać do układu oddechowego. Wysokim priorytetem w Unii Europejskiej, powinny stać się starania w kierunku zmniejszenia ekspozycji na dym tytoniowy pochodzący z biernego i pośredniego palenia.
Tobacco exposure during pregnancy

Although most women stop smoking or significantly reduce tobacco use during pregnancy in the US 10-20% of women continue to smoke, while in Poland upwards of 30% continue smoke cigarettes throughout pregnancy [1,18]. Maternal smoking has been linked to a variety of adverse effects on the mother’s pregnancy and her developing fetus. Pregnancy-associated complications include increased risk of ectopic pregnancy, spontaneous abortion, premature rupture of the membranes, placental abruption, and reduced weight at the time of birth. Among mothers, long-term health risks of smoking include heart disease, cancer, premature death, and other health problems such as emphysema and chronic obstructive lung disease. Infants of smoking mothers have an increased risk of preterm birth, low birth weight, and sudden infant death syndrome (SIDS); they are also more likely to have recurrent wheezing during the first year of life, more frequent otitis media, restless sleep, and colic [10,11,14,22,24,25,27,37,41,42].

Quitting smoking during pregnancy

Women are more likely to quit smoking during pregnancy than at any other time in their lives [14], and most mothers-to-be are highly motivated to do whatever it takes to have a healthy baby. While motivation and confidence to stop smoking are typically high during pregnancy, they are not consistent predictors of remaining tobacco free. Johnson et al [21] reported that approximately 90% of mothers who stopped smoking during pregnancy intended to remain smoke free postpartum, however, approximately 45-70% of women who successfully stop smoking during pregnancy resume tobacco use within 1 year after delivery [7,23,26,36]. Hajek et al reported a direct relationship between mother’s desire to stop smoking and not smoking up to birth, but an inverse relationship between the severity of the pregnant mother’s tobacco addiction and her ability to stop smoking without treatment [16]. A mother’s level of confidence in her ability to control smoking in her home is a significant factor for the patient’s secondhand smoke exposure [43]. Likewise, mother’s level of confidence to remain tobacco free significantly affects relapse rates [8,45]. Without support to remain abstinent after birth, a mother’s level of confidence wanes, and relapse becomes predictable.

Many challenges face new mothers that make them more susceptible to returning to tobacco use. Mothers who relapse back to smoking tend to be from lower socioeconomic background, have less education, and be more resistant to stop tobacco use [13,48]. Women of lower socioeconomic groups are at higher risk for continuing smoking during pregnancy and after birth than those in higher social classes, and the risk is higher among women with less education, and be more resistant to stop smoking because he believed that parents might be open to lifestyle changes to protect their vulnerable infants. However, his intervention was not effective [52]. Another explanation has been as to why mothers continue to smoke around their infants is, that stopping smoking “requires mothers to change their caring routine and behaviors at a time when many mothers feel that they are barely coping with existing responsibilities” [38]. To protect young children from exposure to the harm of a second-hand smoke by motivating their parents to stop smoking has been the aim of several trials. Rosen et al recently compiled the results of 18 trials where stopping smoking programs were started in hospitals, pediatric clinical areas, well baby clinics and family home. Quit rates averaged 23.1% in the intervention group and 18.4% in the control group. The interventions successfully increased the parental quit rate. Studies with the highest intervention benefits were parents of 4-17 years, interventions whose primary goal was cessation, interventions that offered medications, and interventions with high follow-up rates (>80%) [39].

How to support quitting smoking during pregnancy prevent smoking relapse – Loma Linda University

At Loma Linda University Medical Center, Phillips et al [34] and Adams et al [2] developed a multimedia program with incentives called “When You Smoke Your Baby Smokes.” The program is designed to support mothers and fathers during the immediate postpartum period. Trained personnel interview mothers during their prenatal care and postpartum hospitalization regarding their smoking status. Mothers and family members, when present, watch an interactive video presentation that educates them on the harmful effects of smoking and second- and third-hand smoke exposure on their infants regardless of smoking history. Eight weeks of follow-up educational material, including weekly mailings, intermittent visits and telephone calls, were developed to provide education on smoking relapse prevention and normal newborn care. We conducted a prospective randomized study in 2010 where mothers who had a history of smoking within 12 months prior to conception or during pregnancy and who were not currently smoking when they delivered were randomized to receive only the educational video while hospitalized or to watch the educational video and to receive the additional postnatal educational interventions. During the study period, our overall relapse was 20% at 8 weeks postpartum; however, there was no statistical difference between the groups [3]. We found the “When You Smoke Your Baby Smokes” program (A California First 5 funded program), with a program that provided mothers who have a history or currently smoke and/or their partners, into an 8 week program where mothers visit program staff, and if they are confirmed to be nicotine free (measuring using saliva samples) they receive an incentive (coupon for diapers). We enrolled 242 mothers and 124 fathers who were selected during interviews by program staff. A total of 106 mothers (43%) completed the 8-week program, and of those 93% were found to be tobacco free at the completion of the program [2]. Ongoing follow up until one year is currently underway: however the reasons of the other 57% who did not complete the program are complex and remain to be studied. Phillips et al conducted a randomized trial targeting mother with a history of smoking whose infants were admitted to the NICU. She used motivational interviewing during one-on-one counseling and educational video presentations, while focusing on infant cues and development. With these strategies, there was a significant reduction in smoking relapse rates from 81% to 46% and an increase in breastfeeding from 21% to 86% [34].

Methods to support prevention of second-hand nicotine exposure to mothers and children

In Barcelona, Ortega et al is conducting a randomized clustered field trial in which pediatricians have been randomized to conduct survey of mothers and fathers regarding their smoking behaviors, and to test whether a brief intervention within the context of pediatric offices directed at mothers and fathers who smoke can reduce the exposure of their children [31]. Hair samples of their infants and children are taken during first days of life, and at 6 months after the initiation of the trial to test for nicotine. Although laws implemented in 2005 on tobacco control designed to reduce second-hand smoke exposure in the work place and increased public awareness of the hazards of second hand smoke, has made the home environment as one of the few places that people can smoke [29]. This study in Catalonia is designed to test whether enhanced counseling and education both during pregnancy and after birth can reduce nicotine exposure in Spanish children. Although the results of this trial initiated in 2010 are not yet available, this major public health effort within the European Union sets an important standard for testing the value of intensive intervention.

Despite the positive effect of programs employing educational and supportive interventions, tobacco dependency makes it very difficult for most pregnant women to stop smoking especially those with moderate to severe levels of tobacco dependence (Fagerström Test for Nicotine Dependence of 5 or more). To assist clinicians in their efforts, the American College of Chest Physicians created a Tobacco Dependence Treatment Toolkit in 2010 that summarizes current evidence regarding smoking cessation during and after pregnancy [40].

Third-hand tobacco exposure

All of these trials have had as their primary goals not only the reduction in harm to the mother, but the harm to infants and children because second-hand smoke contains more than 4,000 chemicals, many of which are known or suspected contributors to adverse health effects. Second-hand smoke contains ammonia, acrolein, carbon monoxide, formaldehyde, hydrogen cyanide, nicotine, nitrogen oxides, polycyclic aromatic hydrocarbons, and sulfur dioxide, as well as other chemicals that are eye and respiratory irritants, mutagens, carcinogens, and...
cardiovascular and reproductive toxicants [50]. Öberg et al have documented that 56% of children in Central European Countries (including Poland) are exposed daily to secondhand smoke resulting in upper respiratory infections, wheezing, and otitis media in children [30]. Second-hand smoke and what has been termed third-hand smoke exposure coexist, with the tobacco smoke residues remaining after second-hand smoke has been removed by ventilation.

Winickoff described third-hand smoke as the contamination that remains after a cigarette (or other tobacco products) has been extinguished [51]. Even unburned tobacco (such as residual tobacco in a “butt” or filter) can create carcinogenic compounds, tobacco specific nitrosamines (TSN), by reacting with nitrous acid (emitted from gas appliances and vehicles, among other sources). Steiman et al report substantial levels of TSN on surfaces resulting from a 0.4% conversion of nicotine to TSN [47]. Residual nicotine persists in high concentrations on indoor surfaces, including clothes, furniture, drapery, carpets, wall-board, flooring materials (in ceilings), and can be rubbed on to skin, or “degassed” as aerosol particles and gas phase as volatile organic compounds, and semi-volatile organic compounds. Once TSNs are created, they can persist on surfaces for weeks to months. Infants and young children are more likely than adults to be in contact with TSN through skin exposure, dust inhalation, and ingestion as they crawl and explore their homes or within a car in which someone is or has been smoking.

Ozone and related atmospheric oxidants (hydroxyl radical and Hydrogen Peroxide) may generate oxidized products by a reaction with some tobacco smoke components that remained absorbed to indoor surfaces. Indeed, some of respiratory symptoms associated with tobacco smoke may not only originate from tobacco smoke but from volatile by-products that have low thresholds for eye, skin, and upper respiratory tract irritation [9, 46]. Interestingly while ozone levels may usually be low indoors, much higher levels of ozone may be generated using devices containing materials that are often to remove tobacco odors [19]. The reaction of ozone with volatile-organic compounds emitted during smoking has been studied in chambers that approximate the size of a room [44]. Ozone reacts rapidly with unsaturated volatile-organic-compounds producing isoprene, pyrrole, and styrene but few aromatics and alkenes. The main products are volatile aldehydes (formaldehyde, acetaldehyde, and benaldehyde). Petrick et al [33] have documented that amine ozonation can result in absorption of nicotine to indoor surfaces. The reactivity of nicotine absorbed to model surfaces has been studied showing that formaldehyde, N-methyl formamide, 2-methyl ketone, nicotine, benaldehyde, and colnine were formed and were remitted into the gas phase [33]. In addition, ozone reacts with nicotine or second-hand smoke to form ultrafine particles with a high asthma hazard index [20]. Thus the chemistry and physics of tobacco combustion and their residues in indoor environments document that gas and particle phases TSN compounds can remain for extended periods in all indoor environments in which tobacco smoke has been produced. The persistence of third-hand smoke in actual residential settings based on nicotine and 3-EP concentrations in air, dust, and surfaces in the days, weeks, and months after the smoking has taken place [4].

Second and third-hand tobacco exposure – public problem

In Poland the Global Adult Tobacco Survey of 2009-2010 showed more than half of adults either allow smoking in their home (24.3%) or allow it, but with exceptions (25.9%). Current smokers are more likely to allow smoking at their homes (46.6%) compared to nonsmokers (14.6%); and non-smokers are more likely to have a complete ban on smoking at their homes (47%) than non-smokers (16.1%). Fortunately, only 6% of adults reported that they had employment where smoking was allowed everywhere. Current smokers were more likely to work in areas where smoking was permitted everywhere (9.1%) versus nonsmokers (4.3%) [15]. An analysis of more than 6000 non-smokers in New York City, as well as, a national sample (the National Health and Nutrition Examination Survey found that within New York City 23.3% non-smokers were exposed to secondhand smoke in the work place versus 29.7% nationally; however, those within New York City had a higher percentage of those with elevated cotinine levels (56.7% vs 44.9%) [12].

Because of this unacceptable high rate of non-smokers being exposed to second-hand tobacco smoke, significant efforts to reduce this exposure has been the focus of public education and rules or laws within many U.S. states and even more stringent within certain cities such as New York City. For example in Portland, Oregon comprehensive smoke-free policy in multiunit housing (apartments) for low-income tenants within the metropolitan area were enacted. After that the smoking cessation behaviors, knowledge of public laws and policies, and compliance with these laws were monitored. Among 440 apartment dwellers, there was a self-reported annualized quit rate of 14.7% (95% CI 7.9-21.6%) compared with a historical quit rate of 2.6% (95% CI 0.6%-4.5%). Among non-smokers, frequent indoor secondhand smoke exposure decreased significantly from 41% before the laws to 17% after implementation [35]. Reduction in secondhand smoke exposure translates into a decrease in Sudden Infant Death Syndrome (SIDS) rates. Behm et al found that for every 1% absolute increase in the prevalence of smoke-free homes with infants, SIDS rates decreased 0.4% from 1995 to 2006 continuing for supine sleep position. Thus in the U.S. it is possible that 20% of the 1326 total SIDS cases were attributable to childhood second-hand smoke exposure in the home in 2006 with potentially 534 fewer infant deaths attributable to less second-hand smoke exposure in 2006 compared to 1995. These authors calculated that between 4403-6406 SIDS cases in the U.S. were attributable to exposure to secondhand smoke within their homes [5]. Further studies are underway to assess the improvement in childhood respiratory illnesses associated with a reduction in second-hand and third-hand smoke exposure are underway.

The automobile is another closed microenvironment where absorption of tobacco pollutants may lead to long-term contamination and substantial exposure of non-smokers. Further, when children are in cars with a smoker they are exposed to high levels of nicotine and other toxins. In a recent study, cars of smokers who did not impose smoking bans had very high levels of nicotine on dashboards, in car dust, and in the air within the cabin. These values were measured several hours or days after smoking took place and were significantly higher than those from cars where smoking was banned [32]. While bans on in car smoking are in place in many U.S. states, this ban is not currently in place in Poland. Efforts towards reducing second and third-hand smoke exposure in cars should be placed at a high priority throughout the European Union.

There are several challenges to better understand the health effects attributable to third-hand smoke. Future studies are required to further understand both the in vitro and in vivo metabolism, toxicology, and genotoxic potential of third-hand smoke products and especially those formed through reactions with oxidants such as ozone. Studies are needed to evaluate the toxicology of different exposure pathways (dermal transfer, ingestion, and inhalation) and the exposure profiles (acute, chronic, and cumulative) of such exposures especially during pregnancy and infancy. Furthermore, more effective ways to decontaminate surfaces or substances previously contaminated with these toxins need to be developed to “clean up” homes and cars where smoking occurred.

One major goal for all health care professionals is the “denormalization” of tobacco use in our society [6]. Public awareness, attitudes, and social norms about smoking and the adverse effect of smoking on pregnant women and our children is crucial in order to protect the most vulnerable fraction of our society children. We must be committed to the protection of children and young women from the hazards of tobacco-smoke exposure and those of its residues permeating our environment throughout fetal development, infancy, and childhood. To dismiss this vital role as health care professionals is intolerable in a society that values women and their pregnancies that produce our future generations of children.

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Pismieńcwo:


