

### Smoking: the gender gap

In 2015 it was estimated that globally more than 1.1 billion people were tobacco smokers<sup>1</sup>. Each year the product is responsible for the deaths of approximately seven million people, a figure which includes around 890,000 individuals who die as a result of second-hand smoke (also called environmental tobacco smoke, this type of smoke is made up of smoke that is exhaled by a smoker, and smoke from the lighted end of a tobacco product<sup>2</sup>). Around the world, the prevalence of smoking is much lower among women than it is among men (the share of men who are smokers is more than five times that of women according to the most recent WHO estimates<sup>3</sup>), however the size of the gender gap in tobacco use is at its smallest in high-income countries where the share of male smokers is less than twice that of female smokers. Of course, even within these high-income countries, there are substantial differences in tobacco consumption between men and women.

Figure 1 presents WHO estimates for the percentage of smokers aged 15 and over in the European Union by gender in 2012<sup>4</sup> (data is not available for Cyprus). Tobacco consumption is at its lowest in Denmark and at its highest in Greece. The gender gap in smoking that is in evidence around the world is also present within the EU. We can see that in only one Member State, Sweden, is the prevalence of smoking higher among women than it is among men, though the share of people who smoke in Sweden is among one of the lowest in the EU. Countries with the largest gap between men and women tend also to be the countries where smoking is most widespread (e.g. Latvia, Greece, Estonia). The prevalence of smoking is predicted to fall for both men and women across Member States by 2025, but even with this decrease smokers will still make up somewhere between 10 and 47% of the population of these countries, something which represents an important public health challenge.

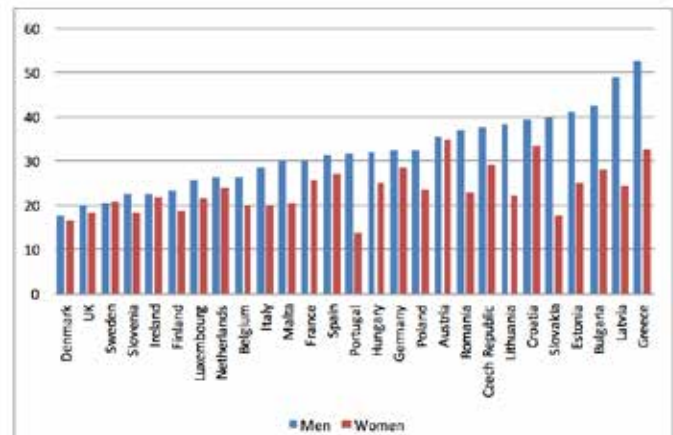


Figure 1. Percentage of smokers aged 15 and over in EU Member States by gender (where available), 2012

### The problem of smoking and pregnancy

Despite the fact that women are much less likely to be smokers than men, tobacco use among women represents a particular challenge to maternal and foetal health. Smoking increases the level of carbon monoxide (CO) in the blood stream of the mother, which passes to the foetus through the placenta, reducing foetal oxygen supply. In addition, tobacco products contain harmful compounds such as nicotine which are also transmitted by the mother to the baby in utero. Nicotine and elevated levels of CO have been linked to negative outcomes for both mothers and their babies, such as spontaneous abortion, placental abruption, low birth weight, and Sudden Infant Death Syndrome (SIDS).<sup>5,6</sup> It is critical therefore that policymakers, healthcare professionals, and relevant stakeholders work together to develop strategies to reduce the prevalence of smoking among women, particularly those women who are expectant mothers or who are planning to conceive, in order to improve maternal and foetal health.

### Smoking and conception

Smoking has the potential to impact the fertility of both men and women. It appears to have a negative effect on each of the systems involved in the reproductive process.<sup>7,8</sup> In men, some studies have found that smoking impacts the mobility of sperm and the quality of the seminal fluid<sup>9</sup> while others find that it reduces semen volume<sup>10</sup> and decreases the quality of the DNA contained in the nucleus of the sperm cells<sup>11,12</sup>, all of which can make conception more difficult. In women, active smoking depletes their ovarian reserve (the supply of eggs present in the ovaries)<sup>13,14</sup> as well as disrupting their endocrine function (the production and secretion of hormones, including sex hormones)<sup>15</sup> both of which can lead to adverse reproductive outcomes such as infertility.<sup>15</sup> In addition, smoking in women has been found to result in changes to the morphology of the Fallopian tubes, which likely explains the increased risk of ectopic pregnancy (whereby the embryo implants outside of the uterus, usually in one of the Fallopian tubes) in women who smoke.<sup>16</sup>

The negative impact that smoking has on individuals' ability conceive is also present in assisted reproduction, where fertility treatments such as in vitro fertilisation (IVF) are employed<sup>17,18</sup> and there is some evidence that it is particularly pronounced in such cases. One meta-analysis from 1997 found that twice as many cycles of IVF were required for smokers to conceive than for non-smokers.<sup>19</sup> There is evidence that this negative impact on the success of fertility treatments of this kind can result even where smoking has taken place years prior to undergoing the treatment.<sup>20</sup>

Overall, in heterosexual couples where the male partner smokes and the female partner either engages in active or passive smoking, conception is delayed.<sup>21</sup> There is no amount of cigarettes that can be smoked without adversely impacting on the health of the smoker, but the negative impact of smoking with respect to conception increases as the number of cigarettes smoked rises. It is important when couples are planning to conceive that both partners – not just women – should give up smoking in order to increase their chances of getting pregnant and to avoid the negative effects that both active and second-hand smoking can have on the health of the mother and baby. These effects are discussed below.

## Smoking while pregnant

### Impact of smoking on maternal health

Women who smoke while pregnant are at an elevated risk of a number of complications during the pregnancy. The most common are listed below.<sup>22</sup>

- Ectopic pregnancy (where implantation of the embryo occurs outside of the uterus, usually in the Fallopian tubes)<sup>23,24,25,26,27</sup>
- Stillbirth<sup>28,29,30,31,32</sup>
- Spontaneous abortion (miscarriage)<sup>33,34</sup>
- Placenta previa (where the placenta partially or totally covers the mother's cervix which can cause severe bleeding throughout the pregnancy and during delivery<sup>35</sup>), placental abruption (where the placenta partially or completely separates from the uterine wall, causing bleeding in the mother and deprivation of nutrients and oxygen for the foetus<sup>36</sup>), and other problems with the placenta<sup>37,38,39,40</sup>
- Premature labour<sup>41,42,43</sup>

The elevated risk of women who smoke during pregnancy experiencing the complications listed above is substantial. One meta-analysis found that the likelihood of experiencing a stillbirth is increased by 47% on average for women who smoke during pregnancy compared with women who do not smoke.<sup>44</sup> And in high income countries, between 4 and 7% of all stillbirths are estimated to be attributable to maternal smoking.<sup>45</sup> The odds of women who smoke during pregnancy of experiencing an ectopic pregnancy are estimated to be as high as 1.77 times those of women who do not smoke.<sup>46</sup> In addition, any active smoking by women who are pregnant has been found to be associated with a risk of miscarriage that is 1.23 times that of women who do not smoke during pregnancy.<sup>47</sup> Indeed, any active smoking at all increases the risk of miscarriage but this risk increases with the amount smoked: each additional cigarette smoked per day is estimated to lead to a 1% increase in the relative risk of miscarriage.<sup>48</sup>

What the existing research indicates is that smoking during pregnancy represents a serious threat to maternal health. However, as is discussed below, tobacco consumption is also associated with a range of threats to foetal health.

### Impact of smoking on foetal health

Babies born to mothers who smoke during the course of the pregnancy are at risk of a range of negative health outcomes, including the following:<sup>49,50</sup>

- Pre- and post-natal growth retardation<sup>51,52,53</sup>
- Low birth weight<sup>54,55</sup>
- Birth defects (including cardiovascular, musculoskeletal, and facial defects)<sup>56</sup>
- Childhood obesity<sup>57,58,59</sup>
- Learning and intellectual disabilities<sup>60,61,62</sup>
- Behavioural disturbances and disorders<sup>63,64</sup> (for example, ADHD<sup>65,66</sup>)
- Asthma, weak lungs, and chest infections<sup>67,68,69,70</sup>
- Sudden Infant Death Syndrome (SIDS)<sup>71,72,73</sup>
- Childhood cancers (such as leukaemia and lymphoma)<sup>74,75,76</sup>
- Reduced fertility (in male adults whose mothers smoked while pregnant)<sup>77</sup>
- Elevated risk of tobacco dependence later in life<sup>78,79</sup>

The increased risk of these outcomes emerging in children whose mothers smoked during pregnancy is again very substantial. For example, in the US state of Georgia, it is estimated that 21% of all SIDS cases are attributable to maternal smoking<sup>80</sup> and for mothers who engaged in prenatal smoking the risk of their babies dying of SIDS is twice that of mothers

who did not smoke during their pregnancy.<sup>81</sup> The odds of children born to mothers who smoked while pregnant being overweight (between the ages of 3 and 33) have been estimated at 1.5 times those of children whose mothers did not smoke.<sup>82</sup> In addition, maternal smoking during pregnancy is also associated with an increased risk of a baby developing conditions such as infant colic<sup>83</sup> a range of infections,<sup>84</sup> and diseases such as meningitis.<sup>85</sup>

### **Passive smoking and pregnancy**

While there are important challenges associated with accurately measuring passive smoking<sup>86</sup> it is important to note that women and their foetuses can be at risk of the negative health outcomes listed above even if they do not smoke themselves but are exposed to smoke in the home or outside it. For example, maternal exposure to second-hand smoke has been found to impact negatively on infant neurobehavioural development irrespective of other factors like socio-demographics;<sup>87</sup> babies whose mothers engaged in passive smoking while pregnant have worse sensory, motor, and attention responses in comparison with those whose mothers were not exposed to smoke in this way.

Pregnant women who engage in passive smoking are estimated to be twice as likely to experience a stillbirth<sup>88</sup> and 1.5 times more likely to give birth to an infant of low birthweight<sup>89</sup> than those women who did not. Exposure to second-hand smoke has also been found to be associated with an increased risk of congenital malformation.<sup>90</sup>

### **Third-hand smoke and pregnancy**

The residual nicotine and other chemicals left by tobacco smoke and remaining on indoor surfaces constitute third-hand smoke (THS).<sup>91</sup> These compounds cling to clothing, hair, car interiors, furniture, and carpets for a long time after someone has finished smoking a cigarette.<sup>92</sup>

Research on the public health implications of exposure to THS is still in its infancy but animal studies suggest that exposure to these toxins contained in tobacco products in this way have the potential to cause serious damage to infant lung development, and that this exposure could lead to the development of asthma and other serious respiratory ailments later in life.<sup>93</sup>

While parents generally recognise the dangers associated with THS to the health of babies and children, fathers and heavier smokers are less likely than other parents to hold beliefs about the dangers of exposure to THS.<sup>94</sup> This suggests that there is a role for medical professionals and informational campaigns in persuading individuals who are planning a pregnancy or expecting a baby of the necessity of providing an entirely smoke-free environment.

More extensive research on the impact of third-hand smoke is necessary to understand the cumulative impact of tobacco use on both mortality and morbidity.<sup>95</sup> Such research will have important implications for both foetal and maternal health.

### **Smoking and breastfeeding**

For mothers who choose to breastfeed their babies, breast milk can provide infants with additional protection from infections as well as important nutrients.<sup>96</sup> The CDC and the NHS encourage mothers who breastfeed their children to quit smoking if they have not already done so since it is possible for nicotine and other ingredients found in tobacco products to be passed to the infant through the mother's breast milk.<sup>97,98,99</sup> However, both organisations still recommend that where possible mothers breastfeed their babies even if they smoke.

While extensive research on the impact of breast milk intake from mothers who smoke on long-term health outcomes for infants should be conducted as a matter of urgency, there is some limited evidence of a short-term effect. One experimental study found that infants who had breast milk intake in the hours immediately after their mother smoked had a disrupted sleep pattern compared with those infants whose mothers abstained from smoking prior to feeding<sup>100</sup>.

### **Risk factors for maternal smoking**

Existing research has identified a number of risk factors that increase the likelihood that a woman will smoke during her pregnancy. Across economically developed countries, women with lower levels of education (or who are of a lower socio-economic status) are consistently found to be more likely to smoke while pregnant.<sup>101,102,103</sup>

Pregnant smokers are more likely to be single or in a relationship with a partner who smokes,<sup>104,105</sup> to be younger<sup>106,107</sup>, to have more than one child,<sup>108,109</sup> to suffer from psychosocial stress<sup>110,111</sup> and to be a smoker prior to becoming pregnant.<sup>112</sup> In addition, women who smoke during pregnancy are more likely to be negligent during prenatal care (attending clinic late or irregularly).<sup>113</sup> Studies originating in the United States find evidence that race is also a predictor of maternal smoking: Caucasian women tend to be more likely than African American women to smoke while pregnant.<sup>114</sup>

Many of these characteristics make pregnant smokers difficult to effectively target through smoking cessation programmes which represents an important challenge for medical professionals and policymakers.

### Smoking cessation during pregnancy

Due to the range of negative health outcomes that can arise from smoking during pregnancy for both women and their babies, quitting smoking is highly recommended for women who are planning to conceive. Studies illustrate that women who quit smoking early in their pregnancy have reduced rates of pre-term births and the birth weight of their babies is more similar to that of babies born to mothers who have never smoked.<sup>115</sup> Smoking cessation after conception can therefore be beneficial for maternal and foetal health even if the mother has smoked early on in the pregnancy. Spouses or partners are also encouraged to quit smoking in order to shield expectant mothers from second- and third-hand smoke.

To aid women in quitting smoking during pregnancy, nicotine replacement therapy (NRT) has often been recommended to women. NRT consists of medically-approved consumption of nicotine that does not involve tobacco consumption. Common types of NRT are chewing gum, lozenges, and adhesive patches that are applied to the skin.

While research using human and animal subjects has indicated that the risk of cigarette smoking during pregnancy is much greater than the risk associated with exposure to nicotine only, the use of NRT during pregnancy should not be considered to be without risk.<sup>116</sup> In addition, there is no definitive evidence that NRT actually increases smoking cessation in pregnant women or reduces the adverse pregnancy and birth outcomes associated with the use of tobacco products during pregnancy.<sup>117,118,119,120</sup> Further research on the effectiveness of these aids is required, as well as a consideration of the impact that the consumption of nicotine in this way can have on maternal and foetal health.

### The challenge of e-cigarettes

Electronic cigarettes (or e-cigarettes) were first patented in China in 2003, and launched in the global market the following year.<sup>121</sup> They are small handheld devices that deliver nicotine to the user by heating a liquid contained in the device so that it turns to vapour that can be inhaled. Since their introduction to the global mass market, use of e-cigarettes has rapidly increased. In Great Britain, for example, 2.3 million people (or 4% of the population) identify themselves as e-cigarette users.<sup>122</sup> In the US, that number was estimated by the CDC at 9 million adult users in 2014 (3.7% of the population).<sup>123</sup>

While e-cigarettes are commonly used as aids to support smoking cessation (in line with other NRT types), e-cigarette manufacturers do not make therapeutic claims about their products which means that they are unregulated by organisations like the America's FDA.<sup>124</sup> Many view these devices as an attempt by the tobacco industry to make smoking acceptable by other means.<sup>125</sup> In particular, sceptics have been sharply critical of the marketing of flavoured liquids for the devices which might be appealing to children and adolescents (the nearly 8000 types currently being manufactured include fruit and candy flavours).<sup>126</sup> While the use of these devices is increasing, there is little clarity around the associated short- and long-term effects.<sup>127</sup>

With respect to the use of these devices during pregnancy, we do not yet have evidence about their impact on maternal and foetal health. However, since "no amount of nicotine is known to be safe in pregnancy"<sup>128</sup> it is important to address perceptions that expectant mothers may have about the safety of such devices. Indeed, there is concern that a belief that these devices are safer to use during pregnancy than tobacco products may induce pregnant women to use e-cigarettes more freely, which could have the kind of deleterious effects for the health of mothers and their babies discussed above.<sup>129</sup> These devices should be labelled as potentially harmful to pregnant women, and medical professionals should advise expectant mothers and women who are planning to conceive of the risks that may be associated with using these products.

### European and national strategies tackling smoking during pregnancy

The European Union and its Member States take the issue of smoking seriously.<sup>130</sup> The contents, packaging, and labelling of tobacco products is regulated at EU-level and the Tobacco Advertising Directive (2003/33/EC) places strict limits on advertising or sponsorship which promotes a tobacco product. The EU has also run several anti-tobacco campaigns targeting different age groups (the HELP campaign targeted young people aged 15 to 25, while Ex-Smokers are Unstoppable focused on 25 to 34 year olds).<sup>131</sup>

Some Member States have gone further in implementing legislation aimed at curbing tobacco consumption and protecting their citizens from passive smoke. In 2003, Ireland was the first EU country to implement a complete prohibition on smoking in the workplace, with other countries following suit with smoke-free provisions of their own (Greece, Hungary, Spain, Bulgaria, the UK).<sup>132</sup> Ireland has also passed legislation standardising the packaging of tobacco products. All such products will have to remove all branding, and packing will consist of a neutral colour with a large and graphic health warning.<sup>133</sup> Only Australia, the UK, and France have implemented similar measures so far.

Given the negative maternal and foetal health outcomes that smoking prior to and during pregnancy can have, initiatives around smoking cessation should be targeted at women of reproductive age and pregnant women in particular as a matter of urgency. Designing such initiatives represents a particular challenge since women who are most likely to smoke during pregnancy are those who are most likely to be overlooked by them (women with lower levels of education, low

health literacy, sporadic prenatal care, and whose pregnancies are unplanned).<sup>134</sup> The European Commission's *Together* project pilot which began in 2015 aimed to gather data on pregnant, postnatal, and vulnerable women in 6 European cities (in the UK, Spain, Denmark, Bulgaria, and the Czech Republic) in order to examine the differences in their eating and exercise habits, as well as their health literacy. The goal of the project is to develop activities within each of the participating cities, including relevant stakeholders (educators, nutritionists, midwives etc.), to promote health and well-being among these women. The core aim of the project is not smoking cessation, but this pilot has generated important insights on the smoking habits of women across these three groups. Despite projects of this kind, more data about the prevalence of smoking during pregnancy is needed, and in particular it is important to gather information about the level of tobacco consumption among those who do smoke.

Currently, most initiatives in Member States with respect to smoking cessation in pregnancy are health-care-provider-based, relying on messages regarding the risks associated with smoking to be delivered by a nurse or doctor in a health-care setting.<sup>135</sup> It is worth considering how policymakers and healthcare professionals can work together to improve health literacy and promote smoking cessation in other settings. Reaching women who are more likely to be negligent in their prenatal care (attending the clinic late in their pregnancy or attending irregularly) is a particular challenge to the relevant stakeholders but should have positive implications for foetal and maternal health.

## Steps for Policy Action

### 1. Increase awareness of the harms of smoking exposure prior to and during pregnancy.

Exposure to smoking during pregnancy is one of the largest and avoidable causes of mortality and morbidity in both mother and infant. At the same time, smoking among young women, women in their prime childbearing years, is increasing. Increased awareness throughout the EU of these dangers is need, particularly among high-risk groups.

### 2. Improve existing EU data collection on pregnancy and smoking.

Currently, little data collection occurs at EU level examining pregnancy smoking and exposure prevalence and its impact on maternal and infant health across the 27 Member States. Data should be collected annually at the national and EU levels on smoking prevalence and exposure during pregnancy as well as on its health impacts. The data will enable the effective combatting of smoking throughout pregnancy and monitor the effectiveness of intervention programmes across the EU.

### 3. Examine the effect of social determinants on smoking exposure and smoking cessation effectiveness during pregnancy.

Exposure to smoking and effectiveness smoking cessation during pregnancy appear to be linked to various factors including education and income. Further research on these social determinants is needed to determine how to be design policy and programming to reduce pregnant women's exposure to smoking and encourage smoking cessation.

### 4. Encourage more research and development of policy and programming to effectively encourage smoking exposure and smoking cessation.

Smoking exposure during pregnancy has large impacts on maternal and infant health. Smoking cessation during pregnancy can be highly effective. Policies and programmes that effectively target pregnant women and support women to continue smoking cessation after pregnancy should be research and developed. The effectiveness and safety of existing techniques in pregnant women needs to be studied.

### 5. Provide effective supports to women who are pregnant or plan on becoming pregnant that smoke to help them quit for their health and for the health of their foetus.

Many women in Europe smoke or are exposed to smoke during their pregnancy. The healthcare systems and communities more broadly need to develop programming and support structures targeted specifically at women who are pregnant or plan on becoming pregnant that smoke. Women and their partners need to be educated about the risks of smoking and need support them throughout their pregnancies to initiate and maintain smoking

### 6. Investigate the long- and short-term consequences of the use of e-cigarettes on the health of pregnant women and their foetuses.

As a new technology, existing research regarding the consequences for the health of users of electronic cigarettes in general is scant. Of particular concern is the lack of regulation of these devices and the lack of consensus among Member States as to how these products should be treated. Women who are pregnant should be minded that there is no safe level of nicotine consumption and warned that e-cigarettes do not represent a 'safe' alternative to tobacco products. It is important that research enable healthcare professionals to clarify the risks associated with the use of these devises for their patients.

## A warm thank you to our expert reviewer:

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December 2017

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