

# Interventions for smoking cessation during pregnancy

Andriani N. Loukopoulou<sup>1</sup>,  
Miltos P. Vasiliou<sup>1</sup>,  
Panagiotis K. Behrakis<sup>1,2</sup>

<sup>1</sup>Hellenic Cancer Society, Research Centre of Smoking and Lung Cancer, Donation of G.D. Behrakis, Laboratory of Experimental Physiology, Medical School, National and Kapodistrian University of Athens

<sup>2</sup>Department of Environmental Health, School of Public Health, Harvard University

**Key words:**

- smoking,
- pregnancy,
- smoking cessation,
- quit,
- intensive interventions,
- low-intensity interventions,
- strategies

**Correspondence to:**

Andriani Loukopoulou  
V. Othonos 65. Kifisia.  
ZC 14561. Attiki.  
Tel: 2108010248  
E-mail: aloukopoulou@msn.com

**SUMMARY.**

Maternal smoking during pregnancy has been shown to be the most significant risk factor for the foetus and it is associated with complications during pregnancy, unfavourable results in childbirth and a variety of health problems in newborn infants and children. Most of these negative effects are reversible if smoking cessation is achieved during the first trimester of gestation. Smoking cessation has been found to contribute to a decrease in low birth weight and prematurity rates and reduced needs for health care in childhood. Successful interventions for smoking cessation can be considered cost effective because, regardless of their intensity, their cost is minimal compared with the beneficial results. The interventions that are considered to be the most effective are the intensive, cognitive-behavioural type, which involve face-to-face contact, more and longer sessions, and the use of a self-help manual, and accompanied with sessions after childbirth to prevent a post-partum smoking relapse. There is some debate in the international scientific community on the issue of use of medication for smoking cessation during pregnancy. Recently, the use of nicotine replacement products has been suggested, for highly dependent smokers only, after careful assessment and with close supervision, and provided that the pregnant woman is determined to stop smoking. The effectiveness and safety of these products, however, have not been sufficiently evaluated. *Pneumon 2011, 24(1):66-76.*

## INTRODUCTION

Smoking during pregnancy is the most significant cause of preventable complications of pregnancy. Recognizing its importance, researchers in the US have been studying this issue for more than 30 years in attempts to identify the most suitable interventions for achieving smoking cessation in pregnancy.<sup>1</sup> The first research documenting a decrease in low birth weight from maternal smoking cessation via an intensive smoking cessation intervention programme was published 26 years ago.<sup>2</sup>

Although 40% of pregnant women smokers stop smoking spontaneously

before their first visit to the obstetrician,<sup>3</sup> the remainder persist in smoking. Smoking cessation programmes during pregnancy target those pregnant women, with significant success in quitting smoking,<sup>4,5</sup> but 20-30% of pregnant women continue to smoke during pregnancy, as is evident from the research of Coleman and Joyce in ten states in the US.<sup>6</sup>

The increasing awareness of pregnant smokers about pregnancy outcomes and of their new social role as mothers renders pregnancy a "teachable moment", as their receptivity toward smoking cessation messages is heightened.<sup>7</sup>

## INTERVENTIONS: GENERAL CHARACTERISTICS

The European Strategy for Smoking Cessation of the World Health Organization (WHO) suggests employment of more sensitivity towards women and proposes more research on how to prevent smoking during pregnancy and post-partum relapse.<sup>8</sup>

This review includes only randomized control trials (RCTs) of interventions targeting smoking cessation during pregnancy.<sup>9</sup> The studies presented here focussed on one type of intervention in comparison with standard care, mostly intensive intervention compared with standard care or low-intensity intervention.<sup>10</sup>

All the interventions studied converge on providing information about the effects of tobacco smoking on the foetus and the pregnancy, emphasizing the advantages of quitting smoking. The interventions vary, however, depending on their intensity: whether they simply involve standard care without provision of any other description,<sup>11,12</sup> whether they provide informative booklets or personal advice combined with a self-help manual for smoking cessation during pregnancy.<sup>12,13</sup> Personal advice can be provided in many ways, for example by video<sup>14</sup>, software programmes<sup>15</sup> or telephone.<sup>16</sup>

The use of the Internet in smoking cessation during pregnancy is of particular interest; it is not seen as just another form of intervention, but because of the rapidly increasing use of the Internet it represents a new and promising category of smoking cessation tools.<sup>17</sup> As early as 2005 in the US more than 8,600 smokers reported that they had used the Internet in the past year in their efforts to quit smoking.<sup>18</sup> The use of the Internet in smoking cessation is considered to be eminently cost effective, because the same programme can be used by multiple users at the same cost.<sup>17</sup>

Not all the programmes available on the Internet are reliable, easy to use and effective, and they have not yet been evaluated by research methodology to establish their validity, functionality and effectiveness. Some of these websites are very complex; others contain too much non-secure information in a format that can be printed and that is not significantly different from the self-help manuals for smoking cessation.<sup>17</sup>

## COUNSELLING IN SMOKING CESSATION

### i. The "5 As" in smoking cessation during pregnancy

In many studies, as reviewed in the meta-analysis of Melvin et al, counselling is based on the "5 As" (Ask, Advise, Assess, Assist, Arrange)<sup>19</sup> (see Table 1). The "four steps" by Glynn and Manley<sup>20</sup> recommended by the National Cancer Institute (NCI) of the US include the advice to "estimate" the desire of smokers to quit smoking. The "5 As" are considered so important in counselling that their implementation is recommended in instructions to health professionals by the US Department of Public Health.<sup>21</sup>

In line with these steps, smokers are first asked about their smoking status. If they have already quit smoking before or just after they found out they were pregnant, they are congratulated about their success in quitting and encouraged to stay smoke free. If they still smoke, their smoking status is recorded and the next steps follow. The pregnant women who smoke receive brief, personal advice about smoking cessation and how it affects not only the foetus but also themselves.<sup>19</sup>

The willingness of the pregnant smokers to quit smoking is then assessed within a month, and if they express the will to quit smoking, they receive help. A self-help manual is given to them, encouraging them to use practical solutions for various difficulties and to seek help from their family and social network. At the last stage of intervention, follow-up visits are arranged to encourage them to quit smoking if they are still smokers.<sup>19</sup> In 2010 the American College of Obstetricians and Gynaecologists (ACOG) suggested the "5 As" as the intervention of choice for smoking cessation and recommended its systematic implementation for each pregnant smoker as it is considered short and easy to use.<sup>22</sup>

### ii. The "stages of change"

Another smoking cessation counselling technique is the "stages of change" provided in the transtheoretical model developed by Prochaska and DiClemente.<sup>23</sup>

### Five A's of smoking cessation during pregnancy (Ask, Advise, Assess, Assist, Arrange)

1. **ASK** the pregnant woman about smoking status at the first prenatal visit and follow-up with her at subsequent visits.

**The pregnant woman should choose the statement that best describes her smoking status:**

- A. I have NEVER smoked or have smoked LESS THAN 100 cigarettes in my lifetime.
- B. I stopped smoking BEFORE I found out I was pregnant, and I am not smoking now.
- C. I stopped smoking AFTER I found out I was pregnant and I am not smoking now.
- D. I smoke some now, but I have cut down on the number of cigarettes I smoke SINCE I found out I was pregnant.
- E. I smoke regularly now, about the same as BEFORE I found out I was pregnant.

If the pregnant woman stopped smoking before or after she found out she was pregnant (B or C), reinforce her decision to quit, congratulate her on success in quitting, and encourage her to stay smoke free throughout pregnancy and postpartum.

If the pregnant woman is **still smoking (D or E)**, proceed to Advise, Assess, Assist, and Arrange.

2. **ADVISE** the pregnant woman who smokes to stop by providing strong advice to quit as soon as possible. Smoking cessation at the beginning of the pregnancy can be really beneficial for the foetus.

3. **ASSESS** the pregnant woman's willingness to quit smoking in 30 days.

4. **ASSIST** the pregnant woman who is interested in quitting by providing pregnancy-specific, self-help smoking cessation materials.

5. **ARRANGE** follow-up visits to track the progress of the pregnant woman's attempt to quit smoking, reinforce steps taken towards quitting.

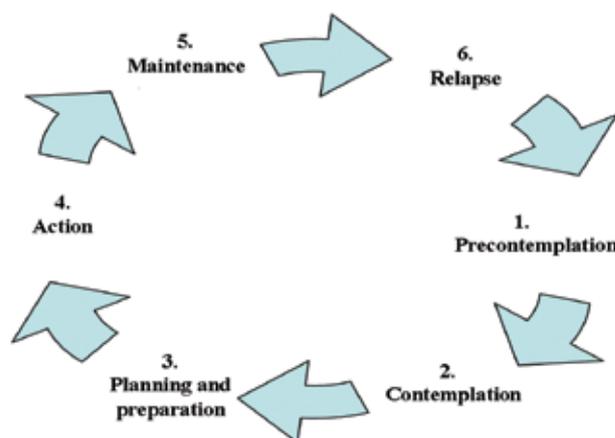
**Table 1.** The "5 As" in smoking cessation during pregnancy according to Fiore et al<sup>5</sup> as adapted by the American College of Obstetricians and Gynaecologists.<sup>22</sup>

Analytically, in the first stage, "precontemplation," it is determined whether there is indifference about quitting smoking and the subsequent intervention focusses on this information. In the second stage, "contemplation", the medical professional investigates whether there is a concern about smoking cessation that needs to be strengthened. The third stage is the stage of "planning and preparation", which determines whether there are a desire to quit smoking and a need for support. The fourth stage is called "action" because during this stage the decision for smoking cessation is implemented. At

this stage, smoking cessation is a fact and efforts are made to prevent smoking relapse. The final stage is called "maintenance" because its objective is the maintenance of abstinence from smoking without the occurrence of relapse, which in any case is not regarded as failure. Focus on the reason for relapse prepares the patient for a better outcome in the next attempt to quit smoking (see Figure 1). According to the stages of change strategy, the intervention should be proportional to the stage in which each smoker finds herself.<sup>23</sup>

The "stages of change" counselling strategy for smoking cessation has been applied in several research projects. Hajek et al focussed their intervention on the provision of advice based on "stages of change" to investigate the effectiveness of a brief intervention (10-15 minutes) for smoking cessation in pregnancy provided by hospital staff under routine conditions. Pregnant women who did not want to quit smoking received brief intervention with a view to motivate them. Those who did want to quit smoking received proportionate help, and those who had already quit smoking received intervention to help them avoid a smoking relapse. The above interventions were found to be ineffective, as 7.8% of the intervention group and 5.8% of a control group quit smoking.<sup>11</sup>

The RCT of Lawrence et al compared the effectiveness of interventions based on the "stages of change" with those provided under standard care. This study involved 918 pregnant women who were smokers, divided into three groups. The first group received routine care, the second group were given self-help manuals based on the transtheoretical model of "stages of change", while the third group received the same manuals as the second group,



**FIGURE 1.** The "Stages of Change" strategy of smoking cessation counselling.

along with a computer-based educational programme with personalized advice on smoking cessation. Ten days after childbirth 3.5% of the first group, 4.7% of the second group and 8.1% of the third group had stopped smoking.<sup>15</sup> The combination of educational methods in intervention proved to be most effective.

### iii. Cognitive –Behavioural Interventions

Intervention based on the cognitive-behavioural model consists of a combination of cognitive and behavioural techniques aimed at behaviour modification. This is a short, goal-oriented, energetic approach focussed on a person seeking help on a specific topic.<sup>24</sup> The cognitive-behavioural model has evolved rapidly and has been shown to have positive effects. The cognitive dimension holds that the mental reflection of the outside world exerts a decisive influence on human behaviour.<sup>25</sup>

Various studies have used cognitive-behavioural interventions for smoking cessation with positive results,<sup>16,26-29</sup> including the RCT carried out by Hegaard et al, in which interventions in both groups were of the cognitive-behavioural type, accompanied by the additional option of nicotine replacement therapy in one group.<sup>28</sup>

Cognitive-behavioural intervention was also used in the RCT conducted by Windsor et al to assess the impact of health education methods on behaviour. The survey included 814 pregnant smokers from 4 public maternity clinics, whose smoking status was confirmed biochemically by a saliva cotinine test at the beginning, middle and end of pregnancy. According to the research findings, 14.3% of the experimental group and 8.5% of the control group quit smoking, demonstrating that health education methods for smoking cessation are effective, but this study also showed that, economically the intervention was cost-effective.<sup>26</sup>

Walsh et al also used cognitive-behavioural strategies in their RCT, using a control group with no statistically significant difference in demographic data from the intervention group. According to the biochemical measurements smoking abstinence was significantly higher in the experimental group (9%) for which more time (mean, 7.15 minutes) had been spent on intervention. The brief intervention (2 minutes) given to the women in the control group was ineffective, as their smoking cessation rate was 0%.<sup>27</sup>

The interventions in the research project of Rigotti et al, involving 442 subjects, were conducted by phone. The intervention group received five phone calls with a total average conversation time of 68 minutes, while the control

group received one phone call of five minutes. According to biochemical validation, 10% of the intervention group stopped smoking, compared with 7.5% of the control group. Three months later, however, the control group revealed higher rates of abstinence from smoking (7.1%) than the intervention group (6.7%), which led the researchers to conclude that a short practical communication was effective for the less dependent smokers and those who had already tried to quit smoking in early pregnancy.<sup>16</sup>

### SELF-HELP MANUAL

Along with counselling, many studies based their interventions on the use of a self-help manual. Lancaster and Stead's systematic research review<sup>30</sup> provides a useful definition for a self-help manual: it provides structured materials (printed or audio-visual) that assist the individual in making an attempt to quit and sustaining abstinence without significant assistance from health professionals. For instance, self-help can be provided by written, video, telephone (recorded messages) or computer-based materials.<sup>29</sup> In most studies the self-help manual used is an informative booklet; after it has been presented and explained, the pregnant woman takes it with her and can read it as many times as she wishes and refer to it whenever necessary.<sup>15,27,29,31-35</sup>

A self-help manual is not limited to information about the effects of smoking on the foetus, the potential complications during pregnancy and adverse outcomes in childbirth, but also includes the effects of smoking on the woman's own health, in order to prevent a smoking relapse post-partum.<sup>36</sup> Such a manual, which was used initially by Windsor in 1985, in combination with brief interpersonal communication, to intervene to help pregnant women quit smoking, has been discovered to be twice as effective as an intervention consisting of brief interpersonal communication and a general guide on how to stop smoking.<sup>31</sup>

#### i. The usefulness and effectiveness of a self-help manual

The usefulness of a self-help guide lies in its immediacy, the global information it provides, the solution to any possible questions pregnant women may have, and especially in the gradual preparation for quitting, giving practical solutions and advice on handling specific situations.<sup>29</sup> In an assessment of the most famous self-help manual after twenty years of its use, this manual was found to be not only a highly successful tool for smoking cessation in pregnancy, but also cost-effective.<sup>35</sup>

This does not mean that the self-help manual is a panacea: where it is adopted without adaptation to the targeted population or without the necessary training of the personnel providing the intervention, it can have effects similar to those of the RCT of Gielen et al in Baltimore.<sup>32</sup> This trial involved low-income African-Americans; the intervention group received a self-help manual that had been particularly successful in Birmingham and the control group received only routine intervention. There was little difference in the outcome in the two groups, as the rate of smoking cessation was 6.2% in the intervention group and 5.6% in the control group.<sup>32</sup>

### THE EFFECTIVENESS OF SMOKING CESSATION INTERVENTIONS IN PROPORTION TO THEIR INTENSITY

In most studies an intensive intervention lasting more than 15 minutes was found to be more effective<sup>27,28,31</sup> than shorter and less individualized interventions, which are described in some studies as "low intensive intervention" and in others as "usual care" (<5 minutes).<sup>27,28,33,37,38</sup> This may also be due to the fact that some studies included communication for a time interval after childbirth and final biochemical measurements after 2-6 months<sup>11</sup> or final measurements even after 12 months as in the study of Hughes et al.<sup>39</sup> In their systematic review and meta-analysis to investigate which is the most effective and shortest counselling intervention for smoking cessation during pregnancy, Melvin et al suggest that more intensive intervention is more effective. They propose that for maximum impact the duration of this intervention should be about 15 minutes, and that it should be cognitive-behavioural in approach and accompanied by printed material.<sup>19</sup>

The effectiveness of a manual of clinical guidelines for smoking cessation during pregnancy and patient education methods was evaluated in the study of Windsor et al, in which a control group received routine care, while the intervention group received intensive intervention for smoking cessation, including a self-help manual, a videotape on smoking cessation and brief counselling intervention. The resulting rate of smoking cessation was significantly higher in the experimental group (17.3%) than in the control group (8.8%).<sup>38</sup>

The cluster randomized control trial of Moore et al assessed the effectiveness of self-help manuals in helping women quit smoking during pregnancy (1,527n). The intervention was carried out by health professionals

as part of their daily routine, giving pregnant women a series of five self-help booklets for themselves and their families and friends, to increase their motivation to quit smoking, but without spending more than five minutes for their explanation. Even though these interventions achieved high rates of smoking cessation, they proved ineffective in terms of intensity because the frequency of smoking cessation was lower in the intervention group (18.8%) than in the control or usual care group (20.7%). This demonstrated that booklets alone are insufficient if they are not accompanied by face-to-face communication of longer duration.<sup>12</sup>

Ferreira-Borges evaluated the effectiveness of brief counselling and behavioural intervention for smoking cessation during pregnancy. Intensive intervention of no longer than twelve minutes was shown to be more effective (33%) than standard care (8.3%). This brief, intensive intervention was cognitive-behavioural, and the results were biochemically confirmed by expired air carbon monoxide (CO), but the small sample size (58n) does not allow generalization of the results.<sup>29</sup>

Some of the studies not only explored the results of the interventions in terms of smoking cessation, but also recorded the infants' birth weight<sup>11,12</sup> and premature births.<sup>12,37</sup> The systematic research review carried out by Lumley et al demonstrates that interventions for smoking cessation increase the mean birth weight of infants by 33 g (95% CI 11 g to 55 g) and simultaneously reduce preterm birth (pooled RR 0.84, 95% CI 0.72 to 0.98) in pregnant women who quit smoking.<sup>40</sup>

In conclusion, the more individualized and specialized the intervention, the more beneficial it proved to be, not only for smoking cessation of highly dependent smokers, but also for the maintenance of smoking cessation after pregnancy. When more time is spent on advice on smoking cessation, the rates of smoking abstinence are increased. To be considered reliable, reported smoking cessation should be biochemically confirmed.

### BIOCHEMICAL VALIDATION OF SMOKING CESSATION

#### i. Types of Biochemical Tests: Differences-Weaknesses

The claim of pregnant smokers to have quit smoking was biochemically confirmed in most studies. This was done by measuring either cotinine levels in salivary samples<sup>14,32,34,38</sup> or in urine samples,<sup>1,16,28,42</sup> or expired CO,<sup>11,28,29,39</sup> or by hair analysis to detect nicotine and cotinine.<sup>42</sup>

Expired CO is a convenient, low-cost measurement, providing immediate results for the evaluation of smoking status.<sup>43</sup> However, its short half-life (3-6 hours) can lead to false negatives<sup>44</sup> as it is not able to detect smokers who have abstained from smoking for several hours.<sup>43</sup> Therefore it cannot be considered the most reliable biochemical marker for confirming the validity of smoking cessation.

The same applies to with nicotine, which has a half-life of only 2-3 hours in the blood.<sup>45</sup> Due to its short half-life, nicotine levels can only provide information about recent exposure to tobacco smoke.<sup>46</sup> Dempsay et al, in their study of the metabolism of nicotine during pregnancy, assumed that both nicotine and cotinine are metabolized faster in the second and third trimesters of pregnancy. The extremely small sample size of this study (10 women) limits generalization, while motivating further research.<sup>47</sup>

Cotinine is the major metabolite of nicotine and as a biomarker it determines the exposure to smoke for a longer time, because compared with that of nicotine (2-3 hours), its half-life is 15-19 hours in different body fluids (plasma, urine and saliva).<sup>48</sup> Cotinine is therefore the biomarker of choice for both active and passive smoking exposure.<sup>46</sup> Because of its longer half-life, cotinine levels accumulate during the day and because it is eliminated over a longer time than is nicotine, levels of cotinine remain relatively stable throughout the day.<sup>46</sup>

The concentration of cotinine in the body fluids of pregnant women, however, differs from that of the normal adult population.<sup>45,49,50</sup> Rebagliato et al claim to have found significant differences between prenatal and postnatal cotinine concentrations in smokers after controlled smoking consumption.<sup>50</sup> It is concluded that the metabolism and distribution of nicotine and cotinine is modified during pregnancy, with higher rates of clearance of cotinine compared with non-pregnant smokers.<sup>45</sup>

A new method of biochemical validation uses hair analysis; depending on the length of the hair, this method gives us information about the smoking status during the last six months, as hair grows approximately 1 cm per month.<sup>51</sup> Klein et al analyzed hair samples from the scalps of 28 pregnant women, who reported that they smoked the same amount during all three trimesters of pregnancy, and found that indeed there is an increase in nicotine metabolism in pregnancy, while cotinine remained steady throughout pregnancy. For this reason the levels of cotinine should be examined as they provide a more reliable history of exposure to active smoking. On the other hand, a decreased concentration of nicotine should be treated with caution, taking into account its

increase in metabolism during pregnancy.<sup>42</sup>

A strong correlation between the average number of cigarettes smoked per day and the levels of nicotine and cotinine in hair from the scalp in all three trimesters of pregnancy was observed by Koren et al.<sup>53</sup> A significant decrease in hair nicotine was observed in consistent smokers from the first to the third trimester, along with a significant increase in hair cotinine. This phenomenon may explain why many pregnant women feel the need to continue smoking and why nicotine replacement therapy has not been effective in reducing smoking during pregnancy in various clinical trials.<sup>52</sup>

## ii. The reliability of self-reported smoking cessation

Despite the availability of biochemical tests, some studies continue to accept smoking cessation reported by smokers without biochemical validation.<sup>53</sup> Therefore, the statement that a number of smokers quit smoking may be untrue, as several studies have refuted the claims of pregnant women through biochemical tests.<sup>27,41</sup>

In the study of Walsh et al, biochemical testing showed the rate of false declaration of abstinence from smoking to be higher in the control group than in the experimental group. Only biochemically confirmed smoking cessation can therefore be considered a reliable index of smoking cessation.<sup>28</sup> This phenomenon was also seen in the study of Webb et al, where 48% of pregnant women who reported being non-smokers were discovered to have a mean urine cotinine level of more than 100 ng/mL.<sup>41</sup>

The importance of biochemical validation of smoking cessation during pregnancy is summarized in the conclusion of the systematic literature review of Lumley et al,<sup>54</sup> which covers 72 RCTs conducted from 1975 to 2008 and involving more than 25,000 pregnant smokers. According to that review, studies that did not validate the smoking status of pregnant women in order to confirm the reported smoking cessation almost certainly had substantial measurement errors and therefore should be considered unreliable.<sup>54</sup>

## PROVISION OF PHARMACOTHERAPY FOR SMOKING CESSATION DURING PREGNANCY

### i. Nicotine replacement therapy (NRT)

In the international literature there is a marked division on the subject of provision of drugs for smoking cessation in pregnancy. According some researchers, highly dependent smokers cannot quit smoking without nicotine

replacement therapy (NRT) during pregnancy; they thus recommend the use of NRT products in the belief that these products, even though by no means harmless, are less dangerous than cigarettes themselves.<sup>55,56</sup> They may have been influenced by studies of non-pregnant women that show that NRT approximately doubles smoking cessation rates compared with the administration of a placebo.<sup>21</sup> However, considering that women metabolize nicotine and cotinine faster in pregnancy, it is unclear whether NRT is equally effective for pregnant women.<sup>57</sup>

Particularly pertinent to this issue is the research of Wisborg et al, which explored the usefulness of transdermal administration of nicotine for smoking cessation during pregnancy. The pregnant smokers were randomly divided into two groups: the intervention group, which along with information was administered transdermal nicotine; and the control group, which was administered a placebo. After 18 weeks, 26% had stopped smoking and one year later, 14% continued to abstain from smoking. However, there was no statistically significant difference between the two groups, indicating that the transdermal administration of nicotine had no effect on smoking cessation during pregnancy.<sup>34</sup>

In the study of Hegaard et al the intervention in two groups, "intensive" and "standard care", was cognitive-behavioural. As an additional option, the women were given the choice of NRT. The rates of abstinence from smoking were higher in the intensive intervention group (14%) than in the standard care group (5%).<sup>28</sup>

These results are not confirmed by the recent double-blind, placebo-controlled trial of Oncken et al, which studied the effectiveness of NRT for smoking cessation during pregnancy. The intervention group was given gum with 2 mg of nicotine, while the control group received placebo gum, but there was no statistically significant difference in the quit rates of the groups. Specifically, the quit rates reported between the 32nd and 34th weeks of pregnancy were 13% in the group given NRT gum and 9.6% in the control group. This observation suggests that nicotine gum substitution may reduce overall tobacco exposure during pregnancy, resulting in an increase in infants' birth weight to a level similar to that of non-smokers and a reduction in premature births, which are very important factors for neonatal health and quality of life.<sup>58</sup>

Despite their positive findings, Oncken et al do not recommend widespread prenatal administration of nicotine chewing gum, taking into consideration the reported side effects of its use in animals.<sup>58</sup> Nicotine has been found to cause abnormal proliferation and differentiation of cells,

leading to a reduced number of neurons and ultimately to a change in synaptic activity, suggesting a link with the Sudden Infant Death Syndrome.<sup>59</sup>

As the available research results regarding the safety and effectiveness of the use of NRT products are debatable,<sup>34</sup> the use of these products for smoking cessation in pregnancy should either be avoided or be optional.<sup>1</sup> The US Preventive Services Task Force stated that the use of NRT products or other pharmaceuticals to enhance smoking cessation during pregnancy and lactation have not been sufficiently evaluated to determine their efficacy and safety.<sup>60</sup>

The ACOG recently concluded that NRT during pregnancy should be undertaken only after careful consideration and always with close supervision, provided that the pregnant woman is determined to stop smoking. The awareness of pregnant women about the known risks of continuing smoking during pregnancy and the possible risks of NRT is paramount in any such course of action.<sup>22</sup>

## ii. Bupropion Hydrochloride and Varenicline

The only drug for use for smoking cessation without nicotine that has been suggested to be acceptable during pregnancy, according to other researchers, is bupropion hydrochloride (bupropion), because it has been used for many years as an antidepressant without reported teratogenesis in animals. Data regarding its effects in humans are limited,<sup>61</sup> however, and the use of antidepressants, including bupropion hydrochloride, for smoking cessation is not recommended during pregnancy, despite the research published by the manufacturer of bupropion. Although that research involved pregnant women, the sample size was too small for the findings to be generalized, and the use of bupropion hydrochloride cannot be considered perfectly safe.<sup>62</sup>

Finally, varenicline (Chantix) is a drug that acts on brain nicotine receptors by blocking them to reduce the effects of pleasure caused by smoking while relieving withdrawal symptoms caused by nicotine cessation.<sup>63</sup> However, so far there is no knowledge regarding the safety of varenicline use in pregnancy.<sup>64</sup>

## BARRIERS TO SMOKING CESSATION DURING PREGNANCY

Socio-economic level and age directly influence the decision of pregnant women to quit smoking: low-income women, single women and women with social problems

tend to continue to smoke without even trying to reduce smoking.<sup>65</sup>

The psychological state is a very important factor that can impede smoking cessation. In particular, the likelihood of continuing to smoke during pregnancy is particularly high in women with occupational stress, family violence, depression and lack of practical help.<sup>66,67</sup>

The presence of smokers in a pregnant woman's social network and the existence of a supportive environment for smoking cessation each have a strong impact on smoking cessation. Usually women who smoke during pregnancy have husbands who smoke and little support from their family environment to quit.<sup>3</sup> The support from the family and female friends of a pregnant woman is argued to be more influential than that of her husband, as they are perceived as more convincing.<sup>68</sup>

This is supported by Mohsin et al who found that smokers who had higher rates of continuing smoking during pregnancy were teenagers, unemployed, single, with less education and unable to manage their stress. In addition, those who had little knowledge about the effects of smoking were more likely to continue smoking (73%), while those concerned about the risks of continuing smoking during pregnancy were less likely to continue smoking. Informing pregnant women appropriately about the potential risks of continuing to smoke during pregnancy can help them quit smoking, regardless of their social, economic and psychological situation.<sup>69</sup>

Recognizing these factors, Donatelle et al tried to reduce their effect. In a study where the control group intervention included counselling and a self-help manual, while the intensive intervention group combined the above intervention with social support and financial incentives. The research findings showed that the intensive intervention was highly effective, demonstrating that positive encouragement and social support may have beneficial results.<sup>33</sup>

The psychological changes of pregnant women should not be neglected: their psychological state changes with every trimester of pregnancy, as they go through three different stages that correspond roughly to the relevant trimesters of pregnancy.<sup>70</sup> The first psychological stage begins when a woman learns that she is pregnant and lasts until she recognizes the first foetal movements around the middle of the fourth month. During this stage a pregnant woman accepts her pregnancy; usually a pregnant woman experiences some ambivalence in relation to her pregnancy. This stage very often involves an intense fear of miscarriage.<sup>71</sup>

In the middle of the second trimester, when the pregnant woman begins to recognize the first foetal movements, she is moving to the second psychological stage, where the realization that there is another life inside her is undeniable. The emotional bond with the baby begins at this stage: now the pregnant woman begins to perceive the foetus as a separate person. This stage lasts until the seventh month of pregnancy.<sup>71</sup> The third and last psychological stage of pregnancy includes three main issues of concern for pregnant women: anxiety about childbirth, physical complaints that appear again in 50% of pregnant women<sup>72</sup> and the preparation for the arrival of the baby.<sup>73</sup> Along with their fear of gaining weight or even their stress about caring for a newborn, pregnant smokers also feel social pressure from their environment not to smoke during pregnancy.<sup>29</sup>

There is a category of women called "spontaneous quitters" who stop smoking more easily during pregnancy than at any other time in their lives. Spontaneous quitters usually smoke less, they may not have partners who smoke, and they are more aware of the risks caused by smoking.<sup>7</sup> However, only one-third of these women still abstain from smoking one year after the birth.<sup>74</sup> Thus, the easier smoking cessation is achieved by this category of smokers, the easier it is for them to relapse to smoking after pregnancy.

## CONCLUSION

The worldwide epidemiological data on the effects of smoking during pregnancy indicate that smoking cessation in pregnancy is more important than ever. To achieve this goal it is necessary to enhance the awareness and continuing education of all health professionals, who should systematically identify pregnant smokers in order to provide them with appropriate advice and counselling.

The most beneficial and effective interventions for smoking cessation during pregnancy have been found to be intensive cognitive-behavioural interventions, with sufficiently long sessions, provision of a printed self-help manual and meetings after childbirth to prevent post-partum smoking relapse. For smokers rated highly dependent by the Fragestorm Dependence Test,<sup>75</sup> it is recommended that smoking cessation be achieved before pregnancy. This recommendation is made because the use of NRT products during pregnancy is considered suitable for highly dependent smokers only after careful assessment, with close supervision and provided that the pregnant woman is determined to stop smoking.<sup>22</sup>

Smoking cessation during pregnancy is also doubly beneficial, because along with improving maternal health, it has a direct impact on improving infant health indices, as it leads to fewer premature births, decrease in the number of low birth weight infants and reduction in perinatal morbidity and mortality, with enormous economic benefit.<sup>76</sup>

The benefits of quitting smoking during pregnancy are almost directly related to the birth weight of newborn infants. Once pregnant women quit smoking during the first 3-4 months of pregnancy, their infants will have a birth weight similar to that of those whose mothers never smoked.<sup>77</sup> A reduction in the number of cigarettes smoked instead of quitting smoking is not associated with an increase in birth weight.<sup>78,79</sup> The children of women who have quit smoking have less need for health care, suffer less from chronic diseases and have fewer learning difficulties.<sup>80,81</sup> It has been estimated that if all pregnant women who smoke 15 or more cigarettes per day stopped smoking, 5% of hospital admissions for children aged less than 8 months could be avoided.<sup>82</sup>

Consequently, the minimal cost invested in successful smoking cessation programmes during pregnancy would result in an incomparably greater benefit<sup>83</sup> related to better health and quality of life of citizens, quite apart from the positive financial and social impact of this cessation.

## REFERENCES

- Ershoff DH, Ashford TH, Goldenberg RL. Helping pregnant women quit smoking: An overview. *Nicotine Tob Res* 2004;6:101-105.
- Sexton M, Hebel JR. A clinical trial of change in maternal smoking and its effect on birth weight. *JAMA* 1984;251:911-5.
- Solomon LJ, Quinn VP. Spontaneous quitting: Self-initiated smoking cessation in early pregnancy. *Nicotine Tob Res* 2004;6:S203-S216.
- Lumley J, Oliver SS, Chamberlain C, Oakley L. Interventions for promoting smoking cessation during pregnancy. *Cochrane Database Syst Rev* 2004 Oct 18;(4):CD001055. Review. John Wiley & Sons Ltd, Chichester, UK.
- Fiore MC, Jaén CR, Baker TB, et al. Treating Tobacco Use and Dependence: 2008 Update. Clinical Practice Guideline. Rockville, MD: U.S. Department of Health and Human Services. A Public Health Service Report [http://www.surgeongeneral.gov/tobacco/treating\\_tobacco\\_use08.pdf](http://www.surgeongeneral.gov/tobacco/treating_tobacco_use08.pdf)
- Coleman GJ, Joyce T. Trends before, during and after pregnancy in ten states *Am J Prev Med* 2003;24:29-35.
- McBride CM, Emmons KM, Lipkus IM. Understanding the potential of teachable moments: the case of smoking cessation. *Health Educ Res* 2003;18:156-70.
- World Health Organization. WHO European Strategy for smoking Cessation Policy 2004, European Tobacco Control Policy Series No 1. World Health Organization Regional Office for Europe Copenhagen <http://www.euro.who.int>
- Parahoo K. *Nursing Research, Principles, Process and Issues*. Macmillan, Houndmills, New York, 1997.
- Albrecht S, Stone CA, Payne L, et al. A preliminary study of the use of peer support in smoking cessation programs for pregnant adolescents. *Jour Am Acad Nurs Pract* 1998;10:119-25.
- Hajek P, West R, Lee A, et al. Randomized controlled trial of a midwife-delivered brief smoking cessation intervention in pregnancy. *Addiction* 2001;96:485-494.
- Moore LO, Campbell R, Whelan A et al. Self help smoking cessation in pregnancy: cluster randomised controlled trial. *B M J* 2002;325:1383-6.
- Bakker M. Pregnancy: a window of opportunity to quit smoking!! The development, implementation and evaluation of a minimal intervention strategy for pregnant women and partners (thesis) Maastricht Health Research Institute for Prevention and Care, 2001, Netherlands.
- Cinciripini PM, McClure JB, Wetter DW, et al. An evaluation of videotaped vignettes for smoking cessation and relapse prevention during pregnancy: The Very Important Pregnant Smokers (VIPS) Program. *Tobacco Control* 2000;9(Suppl III):61-63.
- Lawrence T, Aveyard P, Evans O, et al. A cluster randomised controlled trial of smoking cessation in pregnant women comparing interventions based on the transtheoretical (stages of change) model to standard care. *Tobacco Control* 2003;12:168-177.
- Rigotti NA, Park ER, Regan S et al. Efficacy of telephone counseling for pregnant smokers: A randomized controlled trial. *Obstet and Gynecol* 2006;108:83-92.
- Strecher VJ. The Internet: Just Another Smoking Cessation Tool? *Addiction* 2008;103:485-486
- HINTS. Health Information National Trends Survey. National Cancer Institute; 2005. U.S. National Institutes of Health <http://hints.cancer.gov>
- Melvin CL, Dolan-Mullen P, Windsor RA, et al. Recommended cessation counselling for pregnant woman who smoke: a review of the evidence. *Tobacco Control* 2000;9(Sup III): 80-84.
- Glynn TJ, Manley MW, Pechacek TF. Physician-initiated smoking cessation program: the National Cancer Institute trials. *Prog Clin Biol Res* 1990;339:11-25.
- Fiore MC, Bailey WC, Cohen SJ. Treating Tobacco Use and Dependence: A Clinical Practice Guideline; 2000. U.S. Department of Health and Human Services, A Public Health Service Report [http://www.surgeongeneral.gov/tobacco/treating\\_tobacco\\_use.pdf](http://www.surgeongeneral.gov/tobacco/treating_tobacco_use.pdf)
- American College of Obstetricians and Gynecologists Committee, Opinion No. 471. Smoking cessation during pregnancy. *Obstet Gynecol* 2010;116:1241-4.
- Prochaska JO, Norcross JK, DiClemente CC. *Changing for Good*. William Morrow and Company; 1994. New York.
- Beck JS. *Cognitive therapy: Basics and beyond*. The Guilford

- Press;1995. New York.
25. Kalatzi-Azizi A. Self-knowledge and self management: A Cognitive behavioral approach. Greek Letters, Athens; 2002.
  26. Windsor RA, Lowe JB, Perkins LL, et al. Health education for pregnant smokers: its behavioral impact and cost benefit, *Am J Public Health* 1993;83:201–206.
  27. Walsh RA, Redman S, Brinsmead MW, et al. A smoking cessation program at a public antenatal clinic. *Am J Public Health* 1997;87:1201-4.
  28. Hegaard H, Hjaergaard H, Moller L, et al. Multimodel intervention raises smoking cessation rate during pregnancy. *Acta Obstetrica et Gynecologica Scandinavica* 2003;82:813-819.
  29. Ferreira-Borges C. Effectiveness of a brief counseling and behavioral intervention for smoking cessation in pregnant women. *Preventive Medicine* 2005;41:295-302.
  30. Lancaster T, Stead L. Self-help interventions for smoking cessation. *Cochrane Database Syst Rev* 2005; Issue 3:CD001118.
  31. Windsor R. A pregnant woman's guide to quit smoking. 5<sup>th</sup> ed Society for Public Health Education. Washington;1985.
  32. Gielen AC, Windsor R, Faden RR, et al. Evaluation of a smoking cessation intervention for pregnant women in an urban prenatal clinic, *Health Education Research* 1997;12:247-254.
  33. Donatelle RJ, Prows SL, Champeau D, et al. Randomised controlled trial using social support and financial incentives for high risk pregnant smokers: Significant Other Supporter (SOS) program. *Tobacco Control* 2000;9:67-9.
  34. Wisborg K, Henriksen TB, Jespersen LB, et al. Nicotine patches for pregnant smokers: A randomized controlled study. *Obstetrics and Gynaecology* 2000;96:967–971.
  35. Windsor R, Woodby L, Crawford M, et al. Effectiveness and cost benefit of the smoking cessation or reduction in pregnancy treatment model in Medicaid maternity care. *Am J Public Health* 2001;129:246–289.
  36. Greaves L, Barr V. Filtered policy: Women and tobacco in Canada. 2000. Retrieved January 20, 2010 from [www.cwhn.ca/cewhp-pcesf/filtered-policy/summary.html](http://www.cwhn.ca/cewhp-pcesf/filtered-policy/summary.html)
  37. Thornton L. Smoking and pregnancy: feasibility and effectiveness of a smoking intervention programme among pregnant women; Dept of Public Health, Dublin; 1997.
  38. Windsor RA, Woodby L, Miller T, et al. Effectiveness of agency for health care policy and research clinical practice guideline and patient education methods for pregnant smokers in medicaid maternity care. *Am J Obstetrics and Gynecology* 2000;182:68-75.
  39. Hughes E, Lamont D, Beecroft M, et al. Randomized trial of a "stage-of-change" orientated smoking cessation intervention in infertile and pregnant women, *Fertility and Sterility* 2000;74:498-503.
  40. Lumley J, Chamberlain C, Dowswell T, et al. Interventions for promoting smoking cessation during pregnancy (CohraneR-view).The Cochrane Library 2009; 3; John Wiley & Sons Ltd, Chichester, UK.
  41. Webb DA, Boyd NR, Messina D, et al. The discrepancy between selfreported smoking status and urine cotinine levels among women enrolled in prenatal care at four publicly funded clinical sites. *J Public Health Manag Pract* 2003;9:322–325.
  42. Klein J, Blanchette P, Koren G. Assessing nicotine metabolism in pregnancy--a novel approach using hair analysis. *Forensic Sci Int* 2004;29:145:191-4.
  43. Acosta M, Buchhalter A, Breland A, et al. Urine cotinine as an index of smoking status in smokers during 96-hr abstinence: comparison between gas chromatography/mass spectrometry and immunoassay test strips. *Nicotine Tob Res* 2004;6:615–620.
  44. Binnie VS, McHugh S, Macpherson L, et al. The validation of self-reported smoking status by analysing cotinine levels in stimulated and unstimulated saliva, serum and urine *Oral Diseases* 2004;10:287-293.
  45. EPA California. Proposed Identification of Environmental Tobacco Smoke as a Toxic Air Contaminant. Sacramento, CA: 2004.
  46. Benowitz NL. Cotinine as a biomarker of environmental tobacco smoke exposure. *Epidemiol Rev* 1996;18:188–204.
  47. Dempsey DA, Jacob P III, Benowitz NL. Accelerated Metabolism of Nicotine and Cotinine in Pregnant Smokers, *J Pharmacol Exp Ther* 2002;301:594-8.
  48. Poppe WA, Peeters R, Daenens P, et al. Tobacco smoking and the uterine cervix: cotinine in blood, urine and cervical fluid. *Gynecol Obstet Invest* 1995;39:110–114.
  49. Haddow JE, Knight GJ, Palomaki GE, et al. Second-trimester serum cotinine levels in nonsmokers in relation to birth weight. *Am J Obstet Gynecol* 1988;159:481–484.
  50. Rebagliato M, Bolumar F, Florey Cdu V, et al. Variations in cotinine levels in smokers during and after pregnancy. *Am J Obstet Gynecol* 1998;178:568–571.
  51. Nakahara Y. Hair analysis for abused and therapeutic drugs. *J Chromatogr B Biomed Appl* 1999;733:161–180.
  52. Koren G, Blanchette P, Lubetzky A, et al. Hair nicotine:cotinine metabolic ratio in pregnant women: a new method to study metabolism in late pregnancy. *Ther Drug Monit* 2008;30:246-8.
  53. Dunkley J. Training midwives to help pregnant women stop smoking. *Nursing Times* 1997;93:64-66.
  54. Lumley J, Chamberlain C, Dowswell T, et al. Interventions for promoting smoking cessation during pregnancy (Cohrane Review). The Cochrane Library 2009; (3) John Wiley & Sons Ltd, Chichester, UK.
  55. Dempsey DA, Benowitz NL. Risks and benefits of nicotine to aid smoking cessation in pregnancy. *Drug Safety* 2001;24:277-322.
  56. Petersen R, Garrett JM, Melvin CL, et al. Hartmann KE Medicaid reimbursement prenatal smoking intervention influences quitting and cessation *Tobacco Control* 2006;15:30-34
  57. Coleman T, Thornton J, Britton J, et al. Protocol for the Smoking, Nicotine and Pregnancy (SNAP) trial: double-blind, placebo-randomised, controlled trial of nicotine replacement therapy in pregnancy, *BioMedCentral Health Services Research* 2007;7:2.
  58. Oncken C, Dornelas E, Greene J, et al. Nicotine Gum for Pregnant Smokers A Randomized Controlled Trial. *Obstetrics & Gynecology* 2008;112:859-867.
  59. Slotkin TA. Fetal nicotine or cocaine exposure: Which one is worse? *J Pharmacol Exp Ther* 1998;285:931–45.

60. U.S. Preventive Services Task Force. Ann Intern Med 2009; 150:551-5. Counseling and interventions to prevent tobacco use and tobacco-caused disease in adults and pregnant women: U.S. Preventive Services Task Force reaffirmation recommendation statement.
61. Benowitz NL, Dempsey DA. Pharmacotherapy for smoking cessation during pregnancy. Nicotine Tob Res 2004;6:189-202
62. Walsh RA, Lowe JB, Hopkins PJ. Quitting smoking in pregnancy. The Medical Journal of Australia 2001;175:320-32.
63. Oncken C, Gonzales D, Nides M, et al. Efficacy and safety of the novel selective nicotinic acetylcholine receptor partial agonist, varenicline, for smoking cessation. Arch Intern Med 2006;166:1571-7.
64. Chantix® (varenicline) tablets: highlights of prescribing information. New York (NY): Pfizer Labs; 2010. Available at: [http://media.pfizer.com/files/products/uspi\\_chantix.pdf](http://media.pfizer.com/files/products/uspi_chantix.pdf). Retrieved 10/9/10.
65. Graham H. Smoking prevalence among women in the European community 1950-1990. Social Science and Medicine 1996;43:243-54.
66. Dejin-Karlsson E, Hanson BS, Ostergren PO, et al. Psychosocial resources and persistent smoking in early pregnancy: a population study of women in their first pregnancy in Sweden. J Epidemiol Community Health 1996;50:33-39.
67. Wergeland E, Strand K, Bjerkedal T. Smoking in pregnancy A way to cope with excessive workload. Scandinavian J Primary Health Care, 1996;14:21-28.
68. Dunn CL, Pirie PL, Hellerstedt WL. The advice-giving role of female friends and relatives during pregnancy. Health Ed Res 2003;18:352-62.
69. Mohsin M, Forero R, Berthelsen A, et al. Social influences for smoking in pregnancy in South Western Sydney antenatal clinic attendees. Gynaecology 2007;47:207-212
70. Sandelowski M, Black PB. The epistemology of expectant parenthood. Western J Nurs Res 1994;16:601-622.
71. Fleming AS, Ruble D, Krieger H, et al. Hormonal and experiential correlates of maternal responsiveness during pregnancy and the puerperium in human mothers. Horm Behav 1997;31:145-158.
72. Berk B. Body image and pregnancy: bridging the mind-body connection. J Perinatol 1993;3:300-304.
73. Cohen RL. Maladaptation to pregnancy. Semin Perinatol 1979;3:15-24.
74. Centers for Disease Control and Prevention. Women and smoking: a report of the Surgeon General (Executive Summary). Morbidity and Mortality Weekly Report 51, 2002 (No. RR-12).
75. Fagerstrom KO. How to measure nicotine dependence IN: Wilhelmsen L editor Smoking as a cardiovascular risk factor -New strategies for smoking cessation Hogrefe and Huber Publishers New York, 1991.
76. Lumley J, Oliver SS, Chamberlain C, et al. Interventions for promoting smoking cessation during pregnancy (Cohrane Review). The Cochrane Library 2005 (4) John Wiley & Sons Ltd, Chichester, UK.
77. Centers for Disease Control and Prevention. Cigarette Smoking-Attributable Mortality and Years of Potential Life Lost—United States. Morbidity and Mortality Weekly Report 1993;42:645-649. Available from: <http://www.cdc.gov/mmwr/preview/mmwrhtml/00021441.htm>.
78. U.S. Department of Health and Human Services. The Health Benefits of Smoking Cessation. A report of the Surgeon General. Atlanta, Georgia: Centers for Disease Control, Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health, 1990. Available from: [http://www.cdc.gov/tobacco/data\\_statistics/sgr/previous\\_sgr.htm](http://www.cdc.gov/tobacco/data_statistics/sgr/previous_sgr.htm)
79. Pitsiou GG, Argyropoulou-Pataka P. Woman and smoking. Pneumon 2007;20:27-34.
80. Marks JS, Koplan JP, Hogue CJ, et al. cost-benefit/cost-effectiveness analysis of smoking cessation for pregnant women. AJPM 1990;6:282-9.
81. Lightwood JM, Phibbs C, Glantz SA. Short-term health and economic benefits of smoking cessation: low birth weight. Pediatrics 1999;104:1312-20.
82. Wisborg K, Henriksen TB, Obel C, et al. Smoking during pregnancy and hospitalization of the child. Pediatrics 1999;104:e46.
83. Rovina N, Gratziou Ch. Smoking Cessation strategies. Pneumon 2005;18:245-62.