A Cost-Benefit Analysis of Smoking Cessation Programs During the First Trimester of Pregnancy for the Prevention of Low Birthweight

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Background. The frequency of low birthweight decreases when women quit smoking in the first trimester of pregnancy. This analysis examines the cost-effectiveness of smoking-cessation programs during pregnancy for the prevention of low birthweight.

Methods. Using data from the 1988 National Health Interview Survey and estimated costs of care for low birthweight and normal birthweight infants, a decision tree was constructed to estimate break-even costs for smoking-cessation programs, assuming a success rate of 18%. Sensitivity analyses were performed to determine how program effectiveness and changes in the population affected the break-even costs.

Results. For a population similar to that which participated in the 1988 National Health Interview Survey, smoking-cessation programs would be cost-effective if the program cost $80 or less. In general, to be cost-effective, a smoking-cessation program has to decrease smoking rates by 2.15% to justify every $10 in program costs. Sensitivity analyses showed that as the baseline spontaneous quit rate in the smoking population decreases, smoking-cessation programs of higher cost become more cost-effective.

Conclusions. Smoking cessation programs during pregnancy may be cost-effective for preventing low birthweight if their cost is $80 or less and they achieve success rates of at least 18%.

Key words. Smoking cessation; behavior therapy; infant, low birthweight; cost-benefit analysis.
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Table 1. Effect of the Spontaneous Smoking Cessation Rate on Break-even Costs of Programs with Differing Smoking-Cessation Effectiveness Rates

<table>
<thead>
<tr>
<th>Baseline Quit Rate</th>
<th>Program Costs ($) by Program Effectiveness Rate</th>
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<tbody>
<tr>
<td>6%</td>
<td>21 124 201</td>
</tr>
<tr>
<td>15%</td>
<td>19 113 182</td>
</tr>
<tr>
<td>37%</td>
<td>14 84 135</td>
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</tbody>
</table>

*Maximum cost possible for program to be considered cost-effective. Note that the lower the baseline quit rate, the more a program can cost to achieve a given effectiveness rate.

approximately 2.15% for every $10 per participant spent for a smoking-cessation program.

Finally, we examined how the baseline rate of smoking cessation among smokers who presented in the first trimester affected the break-even costs. Using 6% as the minimal spontaneous smoking-cessation rate in the population and varying this estimate up to the 37% spontaneous quit rate used in the initial analysis, we found that as the baseline spontaneous smoking-cessation rate decreased, the break-even costs for programs of equal effectiveness increased (Table 1). The increase in the break-even cost is most noticeable with programs achieving higher effectiveness. Programs that are less effective in increasing the smoking-cessation rates among pregnant women had relatively little increase in the break-even point in their cost-benefit analysis.

Discussion

Our analysis of smoking-cessation programs in pregnancy shows that programs costing $80 or less will be cost-effective when the impact of smoking cessation on the frequency of low birthweight is considered as the primary outcome. This cost value for the break-even point of smoking-cessation programs is considerably higher than what others have estimated. The primary reason for the higher break-even costs estimated in this study as compared with prior studies is the higher incidence of low birthweight seen in the infants of smokers in the 1988 National Health Interview Survey and a larger difference in low birthweight risks among smokers, quitters, and nonsmokers.

This study also shows that the cost-to-benefit ratio of a smoking-cessation program is highly dependent on the effectiveness of the intervention and the percentage of women who will spontaneously quit without an intervention. For populations in which the spontaneous quit rate is fairly high, programs with minimal effectiveness, such as discussing smoking cessation during a routine office visit, must cost less than $14 to be cost-effective. Intensive programs that can achieve quit rates in the 25% to 30% range will be cost-effective only if they cost less than $15. For populations in which the spontaneous quit rate is low, more expensive programs can be justified.

Estimates of the costs of various smoking-cessation interventions are shown in Table 2. Based on our analysis, many of these programs must be highly effective to justify their cost when the reduction in low birthweight costs the desired outcome. However, in populations where women spontaneously stop smoking early in their pregnancy, these programs may still be cost-effective even though they are not extremely efficacious.

While this analysis may be useful in estimating the cost-to-benefit ratio of smoking-cessation programs during pregnancy for the prevention of low birthweight, there are limitations to the analysis that need to be stressed. First, only a single outcome, ie, prevention of low birthweight and its associated costs, was considered. Smoking cessation may have other advantages during pregnancy. Increases in placental abnormalities, maternal hemorrhage, and preeclampsia have been noted among smokers. However, the issue of causality for smoking and these other pregnancy outcomes is less clear. For example, there have been no data that demonstrate that these complications are reversible with the discontinuation of smoking during pregnancy. Based on the questionable causal link between smoking and less common outcomes, we chose not to include these in our analysis. Had we included these, the cost-effectiveness of smoking-cessation programs would have been increased, albeit only slightly since these outcomes occur less frequently than low birthweight and are associated with a smaller additional cost.

Second, the costs and complication rates used for this study were averages and not adjusted for potential effect modifiers. Other variables related to the rate of low birthweight, such as socioeconomic status or race, could interact with cigarette smoking to influence the effects of smoking on birthweight. If further research identifies populations in whom smoking has a greater adverse effect, a greater benefit would be achieved at higher costs and in calculations in this study would need to be modified.

Additionally, this study focused only on the short-term cost savings of smoking cessation, and it is important to consider the long-term benefits of smoking cessation. For example, smoking cessation may lead to a reduction in the risk of future cardiovascular disease, which could result in long-term cost savings for individuals and society.

Table 2. Estimated Costs of Smoking Cessation Intervention

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Estimated cost ($)</th>
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<tbody>
<tr>
<td>Brief advice during visit*</td>
<td>10</td>
</tr>
<tr>
<td>Acupuncture</td>
<td>50</td>
</tr>
<tr>
<td>Organized support groups†</td>
<td>50-225</td>
</tr>
<tr>
<td>Nicotine gum</td>
<td>100-600</td>
</tr>
<tr>
<td>Nicotine patches†</td>
<td>350</td>
</tr>
</tbody>
</table>

term positive effect of smoking cessation on pregnancy outcomes. Long-term benefits of smoking cessation were not considered. In general, smoking-cessation advice, while minimally effective, has been identified as one of the most cost-effective preventive practices. Since the spontaneous quit rate during pregnancy is high, it is likely that pregnancy is a time when women may be particularly receptive to smoking-cessation interventions. Thus, by not considering the long-term benefits, this analysis may underestimate the true cost-effectiveness of smoking-cessation programs. However, the consideration of long-term benefits from smoking cessation during pregnancy is complicated by unknown rates of recidivism after birth.

Finally, our model is limited to smoking cessation achieved only in the first trimester. Since evidence suggests that smoking cessation during later stages of pregnancy is not as effective in reducing low birthweight rates, we believe that this model is most appropriate. However, should future evidence show that smoking cessation later in pregnancy reduces the frequency of low birthweight or that it results in similar rates of low birthweight infants who are less ill and whose care is therefore less costly, then re-analyses should be performed to determine cost-benefit levels for programs targeting women in the latter two trimesters of pregnancy.

Maternal cigarette smoking is a modifiable risk factor for low birthweight infants. Consequently, as with the results of all cost-benefit analyses, the practitioner must decide if the benefit-to-cost ratio is favorable for a particular program before implementing such a program. In this case, considering that the cost of having a low birthweight infant is high and that many risk factors for low birthweight, such as race and age, are not modifiable, the benefit for implementing a smoking-cessation program in early pregnancy seems worthwhile if programs can demonstrate a reasonable effectiveness at increasing the rate of women who discontinue smoking early in pregnancy. Physicians should also be cautioned that up to one third of all pregnant smokers may stop smoking without any intervention. When evaluating smoking-cessation programs for pregnant women, physicians should focus on the increase over this baseline rate and not rely on the overall quit rate that is inflated by the high spontaneous quit rate.

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References