Transtheoretical model-based passive smoking prevention programme among pregnant women and mothers of young children

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Background: We evaluated the effectiveness of a transtheoretical model (TTM)-based passive smoking prevention programme developed to enhance passive smoking avoidance among pregnant women and young children in Taiwan. Methods: Subjects were pregnant women recruited from the obstetrics/gynaecology department and women with children younger than age 3 recruited from the paediatrics department of four hospitals in Taiwan. Participants were randomly assigned to a group receiving a TTM-based intervention programme or a comparison group receiving routine care. The intervention programme consisted of educational materials and phone counselling. Baseline assessment and post-test data were collected from both groups using a self-reported questionnaire developed based on stages of change related to readiness for passive smoking avoidance. Results: Determinants of change, post-test scores of knowledge, experiential and behavioural processes and self-efficacy were significantly different between the intervention group and comparison group among both pregnant women and mothers. Among pregnant women, the intervention group had significantly higher post-test scores than the comparison group. The distribution of percentages in three stages of change (Precontemplation, Contemplation/Preparation and Action/Maintenance) was significantly different between the two groups among both pregnant women and mothers. However, a higher percentage of mothers made progress in stages of change compared with pregnant women. Conclusion: A TTM-based intervention programme was potentially effective in passive smoking prevention by improving knowledge, experiential and behavioural processes and self-efficacy among pregnant women and women with young children. A higher percentage of mothers with young children had progressed in stages of change post-intervention compared with pregnant women.

Introduction

Passive smoking is a threat to public health. Secondhand exposure to tobacco smoke may cause heart disease and lung cancer in non-smoking adults and sudden infant death syndrome, acute respiratory infections, middle ear disease, exacerbated asthma, respiratory symptoms and decreased lung function in children. However, the knowledge and actions of non-smoking women against environmental tobacco smoke, especially in public spaces, may not have been adequately emphasized to pregnant women and mothers of young children. Therefore, a need emerges for intervention programmes designed to protect non-smoking women and children from the health hazards of passive smoking.

Interventions have been shown to reduce passive smoke exposure in mothers and children. Parental education on passive smoking reduced the prevalence of passive infant smoking from 41% to 18%. Similarly, a theory-driven intervention called ‘Keeping Infants Safe from Smoke’ reduced objective measures of passive smoke exposure among ethnically diverse low-income families with high smoke exposure and disease burden. In China, a simple education intervention by nurses to mothers of sick children motivated the mothers to take actions to protect their children from exposure to passive smoking produced by fathers. Also in China, simple advice by obstetricians to non-smoking pregnant women with husbands who smoked influenced more husbands in the intervention group to stop or reduce smoking than among those in the control group.

The transtheoretical model (TTM) is an integrated model that recognizes various degrees of motivation to change. The TTM postulates specific factors and mechanisms associated with accelerating changes by individuals. The integrated TTM offers a series of determinants of change, including a set of psychological constructs: stages of change, experiential and behavioural processes of change, pros and cons of decisional balance and self-efficacy. TTM defines behaviour change as a progressive process through a series of five stages: precontemplation (unawareness of problem, not considering change), contemplation (considering change), preparation (intending to change), action (taking initial steps) and maintenance (sustaining the new behaviour). Various TTM-based programmes have been effectively designed to change behaviour or to evaluate behavioural changes, including programmes supporting smoking cessation.

In this study, we hypothesized that using TTM and its stages of change as a framework for an educational intervention to help individuals avoid passive smoking might increase the motivation of a given population to act against being exposed to passive smoking, increase the understanding of passive smoking prevention and increase knowledge of designing effective passive smoking prevention programmes. Thus, this study aimed to develop a motivationally matched passive smoking prevention programme for
pregnant women and women with young children in Taiwan, and prospectively evaluate the outcomes of a TTM-based intervention.

Methods

Study design

This was a controlled study including pregnant women and women with young children. All subjects were randomly assigned to two groups based on alternating dates (odd days for one group, even days for the other) of participants’ out-patient visits to their respective hospitals: an intervention group receiving an educational intervention and a comparison group receiving routine care without any intervention.

Sample and setting

Eligible participants were pregnant women from the obstetrics/gynaecology department and women with young children from the paediatrics department of four hospitals in Taiwan. Inclusion criteria were as follows: currently pregnant women or women with children younger than age 3; absence of any clinical disease; at least 20 years old. Pregnant participants with a known complicated pregnancy were excluded, as well as those who had a history of smoking and those who were not ever exposed to passive smoking. This study was approved by the Taipei Veterans General Hospital institutional review board, and participants signed informed consent.

A total of 355 mothers agreed to participate, 177 were allocated to the intervention group and 178 to the comparison group. Forty-eight percent and 45% of participants were currently pregnant in the intervention and comparison groups, respectively. The intervention was conducted for 1 month. Baseline assessment and post-test data were collected in both groups before and after intervention completion. Of the original 355 women, 41 withdrew and 136 completed the questionnaire in the intervention group, whereas 22 withdrew and 158 completed the questionnaire in the comparison group. The causes of withdrawal included lost to phone contact, inability to complete post-test and refusing twice to accept phone counselling. Because data could not be collected from subjects who withdrew during and after the intervention, collected and complete data were analysed on the basis of ‘per protocol analysis’ rather than ‘intent to treat’ analysis, meaning that analysis was restricted to that of participants who met the requirements of eligibility, interventions and outcomes assessment.

A final sample of 294 women completing all assessments was used for final analysis, including 65 pregnant women and 71 women with children in the intervention group, and 70 pregnant women and 88 women with children in the comparison group.

Definition of TTM stages

All materials for the intervention applied in this study were designed based on the TTM stages. The TTM stages of change include precontemplation stage (not thinking about adopting preventive behaviours); contemplation stage (thinking of taking preventive behaviours in next 6 months); preparation stage (not taking preventive behaviours currently but seriously thinking of taking preventive behaviours in next month); action stage (performing preventive behaviours for >6 months); and maintenance stage (performed for >6 months). To work with intervention strategies, we modified the TTM by condensing the original five stages of change into three stages based on previous studies.8,13 The three categories of change include: 1) precontemplation, 2) contemplation/preparation (C/PR) and 3) action/maintenance (A/M). TTM theoretical constructs and interventional strategies/activities are presented in a supplementary table (See supplementary table in Appendix).

Ten processes of change are classified as experiential and behavioural processes. Experiential processes involve consciousness raising (increasing awareness), dramatic relief (emotional arousal), environmental reevaluation (social reappraisal), social liberation (environmental opportunities) and self-reevaluation (self-reappraisal). Behavioural processes include stimulus control (re-engineering), helping relationship (supporting), counter conditioning (substituting), reinforcement management (rewarding) and self-liberation (committing).3,8 The decisional balance construct reflects the individual’s relative weighting of the pros and cons of change. Self-efficacy construct represents an individual’s confidence engaging in a target behaviour across a series of situations.3,8

Intervention programme overview and application of TTM

The intervention programme applied TTM constructs by using stages of change, decisional balance and self-efficacy related to women protecting themselves and their children from passive smoking exposure as the determinants of change. Knowledge has been suggested to affect individuals’ perceptions and influence behaviour,9 and was also included as a determinant of change. The intervention focused on providing appropriate strategies based on mothers’ motivation to change. In addition to inducing changes in motivation and the determinants of change using stage-targeted intervention, we also designed individually tailored intervention (the phone counselling session) to support behaviour initiation and maintenance based on the concept of tailoring proposed by Kreuter and Skinner.14 The phone counselling sessions were conducted after the intervention began to individually tailor the intervention based on the participants’ stages of change and level of difficulty.

The intervention programme components included the following:

DVD: A Story of Three Mothers in three sections, as follows: Section A—How passive smoking affects your life, which was demonstrated by mothers at precontemplation stage; Section B—Practical strategies to avoid passive smoking in public places, which was demonstrated by mothers who were not living with smokers; and Section C—Practical strategies to avoid passive smoking at home, which was demonstrated by mothers who were living with smokers and were at the contemplation/preparation, action/maintenance stage.

Booklet: A 31-page coloured booklet was designed specifically for mothers, using the title ‘Mommy Says No to Passive Smoking’. It instructs mothers about stages of change so they can stage themselves and then provides information appropriate to the stages of change. Education is provided related to mothers protecting themselves and their children from passive smoking at the pre-contemplation, contemplation/preparation and action/maintenance stages. Quizzes and exercises reinforce the information.

Accessory tools: Supportive tools that function as stimulus control to support desired changes, include stickers, bibs and door hangers that reinforce the concepts of the intervention. They combine a logo—‘Valuable life. No smoke’.—that suggests a forbidden feeling to reinforce the concepts of the intervention. They combine a logo—‘Valuable life. No smoke’.—that suggests a forbidden feeling and increases feeling of protection. Information is imprinted on the tools emphasizing the health effects of passive smoking.

Intervention: passive smoking prevention programme

The intervention group was assessed to identify participants’ stages of change. Participants were shown the video and afterward received educational materials to reinforce video information. Research staff explained the materials and guided mothers to focus on the part of the booklet that corresponded to their own stages of change. Participants received two follow-up telephone calls: the first at 2 weeks after the intervention, and the second 1 week after the first call. During the calls, research nurses discussed with the women any difficulty regarding passive smoking prevention and suggested resolutions and offered encouragement.

All participants in both groups completed a structured questionnaire before the intervention to gather baseline data. At the end of
the intervention, both groups received questionnaires by mail. Reminder calls encouraged participants to fill out and return the questionnaire.

Measures
A questionnaire was developed and modified based on a comprehensive literature review. Measures used included demographic information, self-reported assessments of readiness for passive smoking avoidance (stages of change), TTM psychological constructs associated with passive smoking avoidance (decisional balance pros and cons, self-efficacy and use of experiential and behavioural strategies for behavioural change) and questions about knowledge of adverse health effects of passive smoking. The questionnaire was reviewed for content validity by seven health professionals. The content validity index was 0.89.

Stages of change
Participants selected one of five statements best representing their current intentions of taking preventive behaviours against passive smoking. Discrete stages (precontemplation, contemplation/准备 or action/maintenance) were determined by an algorithm based on response options.

Decisional balance
Decisional balance pros and cons were measured using an 8-item inventory assessing perceived benefits and barriers to avoid passive smoking. Participants rated statements on a 5-point Likert-type scale as to the level of influence each statement had on their decision to engage in preventive behaviour or deciding to take action on avoiding passive smoking. The scale ranged from 1 = 'little influence' to 5 = 'great influence'. Internal consistency was pros = .73 and cons = .90.

Processes of change
Experiential and behavioural processes of change were assessed by 20 items regarding frequency of avoiding passive smoking. Participants indicated frequency of use for each process within the past month on a 5-point Likert-type scale ranging from 1 = 'never' to 5 = 'always'. Internal consistency coefficients for process scales were .80 to .87.

Self-efficacy
Self-efficacy in avoiding passive smoking was measured using a 4-item instrument. Participants endorsed each item using a 5-point Likert scale ranging from 1 'no confidence at all' to 5 'complete confidence'. Internal consistency coefficients for the process scales were .68.

Knowledge
Knowledge related to adverse health effects of passive smoking was measured with 16 yes/no items. Internal consistency of the knowledge scale assessed by Kuder–Richardson 20 was 0.62.

Power consideration
Average effect size for t-test situations was .35 based on previous analysis of nursing publications. Assumed effect size of 0.35 was used to estimate sample size needs. Using a general power analysis programme (G*Power 2 software) with a power of .80 and alpha of .05, sample size requirement was 260, allowing group differences to be detected by t-test in our sample of 292 women.

Data analysis
All data were analysed using the Statistical Product and Service Solution (SPSS) 15.0 (SPSS Inc., Chicago, IL, USA). Background variables were described by percentages, means and standard deviations. Student t-test and chi-squared test were used to evaluate differences in background characteristics and in baseline TTM measures between the intervention and comparison groups and between mothers with children and pregnant women within the two groups. Differences between the two groups in indicators of programme effectiveness were examined with either analysis of covariance (ANCOVA) or McNemar test. ANCOVA used pre-test scores as a covariate, and mean ages of participants were treated as controlling variables owing to significant differences between the two groups. Model included intervention status, pre-test scores and any baseline variables for which conditions differed.

Results
Characteristics of study subjects
Background characteristics of study subjects are summarized in table 1. The mean ages of pregnant women in the intervention group were significantly higher than those of pregnant women in the comparison group (31.29 years vs. 29.45 years, respectively; \( P = 0.021 \)).

Determinants of change: knowledge
No significant differences were found between the two groups and both types of participants in mean knowledge scores at pre-test (table 2). There were no significant differences in the post-test scores between mothers and pregnant women within both intervention and comparison groups after adjusting for pre-test scores and age (table 3). ANCOVA results showed that the differences between the intervention group and comparison group were statistically significant (\( P < .001 \)) for both mother with child and pregnant women.

Determinants of change: processes of change
No significant differences were found between the two groups or between both types of participants in experiential and behavioural processes scores at baseline (table 2). There were significant differences in the post-test scores of experiential processes between mothers and pregnant women in the comparison group after adjusting for pre-test scores and age (\( F = 5.115, P = .025 \)). After adjusting for pre-test scores and age, the ANCOVA results showed that the adjusted post-test scores for experiential and behavioural processes were significantly higher in the intervention group than in the comparison group both in mothers and pregnant women (table 3).

Determinants of change: decisional balance
The pre-test scores for decisional balance pros and cons were not significantly different between the two groups and both types of participants (table 2). There were no significant differences in the post-test scores between mothers and pregnant women within both the intervention and comparison groups after adjusting for pre-test scores and age. After adjusting for pre-test scores and age, the ANCOVA results showed that pregnant women in the intervention group had significantly higher post-test scores of pros than pregnant women in the comparison group (adjusted post-test scores = 19.27 and 18.27, respectively; table 3).

Determinants of change: self-efficacy
The pre-test scores for self-efficacy were not significantly different between the two groups and both types of participants (table 2). There were no significant differences in the post-test scores between mothers and pregnant women within both intervention
Table 1 Background characteristics of the intervention and comparison groups

<table>
<thead>
<tr>
<th>Background characteristics</th>
<th>Intervention group (n=136)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Mothers with children (n=71)</td>
<td>Pregnant women (n=65)</td>
<td>t or ( \chi^2 ) value</td>
<td>P-value</td>
<td></td>
</tr>
<tr>
<td>Age( ^a )</td>
<td>Mothers (years)</td>
<td>32.03±3.59</td>
<td>31.29±4.16</td>
<td>1.108</td>
<td>0.270</td>
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<tr>
<td></td>
<td>Children (days)</td>
<td>514.43±313.20</td>
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<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>Gestational age (weeks)</td>
<td>–</td>
<td>25.06±9.67</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>Mothers’ education( ^b )</td>
<td>–</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Less than senior high school, n (%)</td>
<td>3 (4.2)</td>
<td>3 (4.6)</td>
<td>0.012</td>
<td>1.000</td>
</tr>
<tr>
<td></td>
<td>Senior high school or above, n (%)</td>
<td>68 (95.8)</td>
<td>62 (94.5)</td>
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<td>–</td>
</tr>
<tr>
<td></td>
<td>Employed mothers (%)( ^b )</td>
<td>51 (71.8)</td>
<td>45 (69.2)</td>
<td>0.111</td>
<td>0.740</td>
</tr>
<tr>
<td></td>
<td>Marital status ( ^b )</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Married (%)</td>
<td>69 (97.2)</td>
<td>65 (100.0)</td>
<td>1.858</td>
<td>0.173</td>
</tr>
<tr>
<td></td>
<td>Other (%)</td>
<td>2 (2.8)</td>
<td>0 (0.0)</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>Live with smokers (%)( ^b )</td>
<td>42 (59.2)</td>
<td>30 (46.2)</td>
<td>2.302</td>
<td>0.129</td>
</tr>
</tbody>
</table>

Data are displayed as \( ^a \)mean±SD and \( ^b \)percentage.

\*Indicates a significant difference between mothers with children and pregnant women, \( P<0.05 \).

\( ^1 \)Indicates a significant difference between intervention and comparison groups.

Table 2 Comparison of pre-test scores of TTM measures between intervention and comparison groups

<table>
<thead>
<tr>
<th>TTM measures</th>
<th>Intervention group (n=136)</th>
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<tbody>
<tr>
<td></td>
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<td>Pregnant women (n=65)</td>
<td>t or ( \chi^2 ) value</td>
<td>P-value</td>
<td></td>
</tr>
<tr>
<td>Stages of change, n (%)( ^a )</td>
<td>Precontemplation</td>
<td>15 (21.1)</td>
<td>8 (12.3)</td>
<td>1.990</td>
<td>0.377</td>
</tr>
<tr>
<td></td>
<td>Contemplation/preparation</td>
<td>4 (5.6)</td>
<td>5 (7.7)</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>Action/maintenance</td>
<td>52 (73.2)</td>
<td>52 (80.0)</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Determinants of change( ^b )</td>
<td>Knowledge</td>
<td>11.76±2.49</td>
<td>11.54±2.19</td>
<td>0.550</td>
<td>0.583</td>
</tr>
<tr>
<td></td>
<td>Processes of change</td>
<td>42.04±5.27</td>
<td>42.03±5.73</td>
<td>0.012</td>
<td>0.990</td>
</tr>
<tr>
<td></td>
<td>Behavioural process</td>
<td>33.28±9.40</td>
<td>32.25±7.87</td>
<td>0.687</td>
<td>0.493</td>
</tr>
<tr>
<td></td>
<td>Decisional balance</td>
<td>–</td>
<td>–</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pros</td>
<td>18.76±1.84</td>
<td>18.94±1.72</td>
<td>–0.576</td>
<td>0.566</td>
</tr>
<tr>
<td></td>
<td>Cons</td>
<td>12.25±4.38</td>
<td>12.83±4.61</td>
<td>–0.749</td>
<td>0.455</td>
</tr>
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<td></td>
<td>Self-efficacy</td>
<td>13.46±4.41</td>
<td>12.03±4.66</td>
<td>1.843</td>
<td>0.067</td>
</tr>
</tbody>
</table>

Data are displayed as \( ^a \)number (percentage) and \( ^b \)mean±SD.

Table 3 Comparison of post-test scores of TTM measures for intervention and comparison groups

<table>
<thead>
<tr>
<th>TTM measures</th>
<th>Intervention group (n=136)</th>
<th></th>
<th></th>
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<td></td>
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<td>Pregnant women (n=65)</td>
<td>F or ( \chi^2 ) value</td>
<td>P-value</td>
<td></td>
</tr>
<tr>
<td>Stages of change, n (%)( ^a )</td>
<td>Precontemplation</td>
<td>1 (1.4)</td>
<td>3 (4.6)</td>
<td>0.031</td>
<td>1.000</td>
</tr>
<tr>
<td></td>
<td>Contemplation/preparation</td>
<td>8 (11.3)</td>
<td>4 (6.2)</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>Action/maintenance</td>
<td>62 (87.3)</td>
<td>58 (89.2)</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Determinants of change( ^b )</td>
<td>Knowledge</td>
<td>15.09±0.18</td>
<td>15.04±0.18</td>
<td>0.042</td>
<td>0.838</td>
</tr>
<tr>
<td></td>
<td>Processes of change</td>
<td>44.69±0.41</td>
<td>44.32±0.43</td>
<td>0.390</td>
<td>0.533</td>
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<tr>
<td></td>
<td>Behavioural process</td>
<td>38.09±0.70</td>
<td>38.86±0.74</td>
<td>0.572</td>
<td>0.451</td>
</tr>
<tr>
<td></td>
<td>Decisional balance</td>
<td>–</td>
<td>–</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pros</td>
<td>19.05±0.17</td>
<td>19.27±0.18</td>
<td>0.781</td>
<td>0.379</td>
</tr>
<tr>
<td></td>
<td>Cons</td>
<td>12.84±0.49</td>
<td>12.02±0.51</td>
<td>1.313</td>
<td>0.254</td>
</tr>
<tr>
<td></td>
<td>Self-efficacy</td>
<td>15.89±0.34</td>
<td>16.28±0.38</td>
<td>0.548</td>
<td>0.461</td>
</tr>
</tbody>
</table>

\*Data are displayed as number (percentage).

\( ^1 \)Data are displayed as adjusted M±SE.

\*Indicates a significant difference between mothers with children and pregnant women, \( P<0.05 \).

\( ^1 \)Indicates a significant difference between intervention and comparison groups.
and comparison groups after adjusting for pre-test scores and age. After adjusting for pre-test scores and age, the adjusted post-test scores were 15.89 and 16.28 for mothers and pregnant women, respectively, in the intervention group, and 13.49 and 13.29 for mothers and pregnant women, respectively, in the comparison group (table 3). The ANCOVA results showed that the differences between groups in self-efficacy were statistically significant (mothers: $F = 12.285, P < .001$; pregnant women: $F = 24.682, P < .001$).

### Stages of change

No differences were found between intervention and comparison groups and both types of participants (mothers and pregnant women) on the baseline distribution percentages of the TTM stages of change described as precontemplation, contemplation/preparation and action/maintenance (table 2). No differences were found between mothers and pregnant women in the percentage distribution among the TTM stages of change within the two groups (table 3). However, the ANCOVA results showed that the percentage distribution among the stages of change after intervention were statistically significant between participant groups (mothers with children: $F = 11.978, P = 0.003$; pregnant women: $F = 6.689, P = 0.035$).

The changes of stage were categorized as progress (advancing stages), stationary (no progress) and regression (regressing stages) (table 4). Most participants remained in the same stages (stationary). Less than 30% of women changed their TTM stage during the study period. A statistically significant difference was found between mothers with children, but not for pregnant women, in the intervention group in percentage of participants who had changed TTM stages ($\text{McNemar test} = 13.400, P = 0.004$). There were a higher percentage of mothers in the intervention group (25.4%) who progressed in stages of change than mothers in the comparison group (12.8%).

### Discussion

Our intervention programme adapted stages of change proposed by the TTM and included educational materials and phone counselling. Using a TTM-based questionnaire, we demonstrated that the intervention programme was effective in improving post-test scores for knowledge, experiential and behavioural processes and self-efficacy in the target population. A higher percentage of subjects in the intervention group were in the action/maintenance stage than those in the comparison group. Women with young children in the intervention group were more likely to progress from lower to higher TTM stages than women with young children in the comparison group, that is, although many subjects in the present study were in an advanced stage of change according to the TTM (e.g., action, maintenance), more participants in the intervention group moved from lower to higher stages compared with those in the comparison group, which demonstrates programme effectiveness. It is also of note that although 73% of study subjects were already in the target behaviour stage of behaviour change (action/maintenance), at post-test, fewer women in the intervention group (n = 6; 4.4%) had regressed in stage of behaviour change compared with women in the control group (n = 18; 11.5%). This suggests that the TTM-based intervention helps to maintain the stage of behaviour change.

Passive smoking prevention programmes vary, and results are inconsistent and not always maintained, Wakefield et al. indicated that simple intervention such as informing parents of the presence of cotinine in their children’s urine samples did not significantly or sustainably reduce exposure of children to passive smoking. However, providing behavioural counselling to smoking mothers on their children’s exposure to passive smoking effectively reduced exposure of their children to passive smoking. An educational intervention delivered by healthcare workers to parents about preventing passive smoke exposure for their children reduced prevalence of passive infant smoking from 41% to 18%. Outcomes of our study were consistent with previous reports that more women were in action/maintenance stage after participating in intervention programmes, and the TTM-based programme in the present study did promote behaviour change to avoid passive smoking among women with young children.

It is intriguing that the pregnant women, but not women with children, in the intervention group had significantly higher post-test scores of pros (positive attitudes towards passive smoking avoidance) than the comparison group in the present study. However, we did not find an increased percentage of pregnant women who had made progress. Armitage acknowledged that the TTM was the dominant model of health behaviour change, but the author also suggested that the pros and cons of smoking may not actually be able to predict progressive movement between stages of precontemplation, contemplation and preparation. A previous study had evaluated the effectiveness of the Smoke Free Families intervention in pregnant low-income black women forwards in the stages of change towards avoidance of secondhand smoke. The author found no statistically significant differences between treatment and control groups in movement forwards in the TTM stages of change, raising questions about the conceptual fit of the TTM with pregnant women.

Participating in an intervention providing education on environmental smoke exposure may be an intervention in itself. However, we found no major differences between the two groups in pre-test scores of TTM measures, which were done after the allocation. Our data (table 2) indeed suggested that the participation itself may not have influenced the status of passive smoke prevention in terms of stages of change and determinants of change.

We noted during phone interviews that mothers performed protective measures to avoid passive smoking that involved other people. Therapeutic interventions designed to promote smoking cessation should extend to family and friends. A study on avoidance of environmental tobacco smoke among pregnant Taiwanese women found that avoidance of passive tobacco smoke was associated with self-efficacy, no smoking policies at home and educational levels of the women and their partners.

### Table 4 Stage movement from pre-test to post-test in intervention and comparison groups

<table>
<thead>
<tr>
<th>Stage movement</th>
<th>Intervention Group (n = 136)</th>
<th>Comparison Group (n = 156)</th>
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<tbody>
<tr>
<td></td>
<td>Mothers with children (n = 71)</td>
<td>Pregnant women (n = 65)</td>
</tr>
<tr>
<td>Stage movement, n (%)</td>
<td>Progress 18 (25.4) 11 (16.9)</td>
<td>11 (12.8) 12 (17.1)</td>
</tr>
<tr>
<td>McNemar test</td>
<td>13.400, P = 0.004</td>
<td>4.167, P = 0.244</td>
</tr>
</tbody>
</table>

*Data are displayed as number (percentage).

$^{b}$P-values are based on McNemar test.
Among earlier reports of robust results of TTM interventions in various populations, Prochaska noted a ‘magnitude of abstinence’ of 22% to 26% of adult smokers at long-term follow-up.\(^2\) However, adding more telephone counsellors or doubling the number of TTM-tailored communications did not increase intervention efficacy in these studies.\(^2\),\(^2^3\) A meta-analysis by Priest et al.\(^2^4\) reported evidence of relative success among several types of interventions to reduce children’s exposure to environmental tobacco smoke, including a school-based curriculum-based approach; intensive home visiting programme for at-risk mothers with education about preventive child health; smoking cessation telephone counselling to mothers recruited through ‘well child’ clinics; brief educational information provided to parents of sick children in a clinical setting; education provided by nurses to mothers attending ‘well child’ visits; and health advice provided to mothers of sick children. The author suggested that interventions for smoking control could achieve more significant differences between intervention and control group outcomes by using intensive counselling rather than brief counselling by physicians; however, evidence was lacking to support this among parents in child healthcare settings.\(^2^4\) More study may be needed to investigate whether stage-matching or ‘tailoring’ may reduce robust results.

Certain limitations may have affected some results of this study. Firstly, because biochemical results (urine or saliva cotinine results) were not included as outcome measures, the significance of results is limited by the nature of self-report. Secondly, individuals may regress to a lower stage of behaviour change when they encounter new difficulties or barriers. Thus, long-term follow-up may be needed to track the maintenance of passive smoking avoidance behaviour.

**Conclusions**

TTM is an applicable model for designing passive smoking prevention programmes and is able to improve knowledge, experimental and behavioural processes and self-efficacy among pregnant women and women with young children. Results of this study showed that our TTM-based programme was potentially effective in passive smoking prevention among pregnant women and women with young children and may encourage more women with young children to make progress in avoiding passive smoking.

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**Conflict of Interest:** None declared.

**Key points**

- A TTM-based intervention programme focused on stages of change may improve the knowledge and self-efficacy about prevention of passive smoking among the pregnant women and women with young children.
- A higher percentage of mothers with young children had progressed in stages of change post-intervention compared with pregnant women.
- The study provided an intervention programme designed to protect non-smoking women and children from the health hazards of passive smoking.

**References**