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Factors Characterizing Stages of Change for Smoking during Pregnancy: General Risk Knowledge, Personal Risk Perceptions, Motives, Reasons and Decisional Balance

by

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Abstract

A secondary analysis of data from a sample of pregnant smokers is described in this thesis, which focuses on examining knowledge, attitudes and beliefs related to women's decision to continue smoking during pregnancy. Based on theoretical concepts from the Transtheoretical Model (TTM), the Health Belief Model, Meichenbaum and Fong's hierarchy of reasons, and Ikard et al.'s smoking motives, patterns of risk knowledge, risk perceptions, motives, reasons, and pros and cons of smoking among pregnant women are examined at each of the first three stages of change: women not considering quitting in the next six months (Precontemplation), women considering cessation in this time frame (Contemplation), and women planning on stopping smoking in the next 30 days (Preparation).

Stages of change and their correlates have not been examined in a sample of pregnant smokers in the published literature; therefore, this thesis represents a unique contribution to both the application of the Transtheoretical Model to a new population, and to the examination of determinants of smoking behaviour in pregnant women.

Design Pregnant women (N = 2641) were surveyed in a cross-sectional convenience sample of prenatal clinic attendees in a city of approximately 350,000 people, over a one-year period. Respondents answered a one-page questionnaire on stages of change, smoking history, demographic factors, and maternal history. Current smokers (n = 371, 14%) were invited to participate in the second phase of the study, and 151 women (41%) elected to take part. In the second phase, participants completed the Smoking Attitudes Questionnaire (SAQ), which inquired about "decision-making variables" (risk knowledge, personal risk perceptions, motives, reasons, and the pros and cons of smoking), and stages of change.

Analysis Univariate and bivariate analyses were conducted in order to describe the sample for comparison with similar samples in the published literature on the variables of interest. Multivariate analysis of variance (MANOVA) was conducted in order to ascertain whether there

were any differences by stage on these decision-making variables. Post hoc ANOVAs and Tukey's test were conducted for those variables which contributed to the significant MANOVA.

Results Participants in the second phase were remarkably similar to current smokers in the Intake sample on demographic and smoking history variables, and in the distribution of stages of change.

Sample characteristics: The typical participant completing the SAQ was age 28, had completed high school, and was a first-time mother at 21 weeks' gestation. Average self-reported smoking consumption had dropped from about a pa a day before pregnancy to about a half a pack at the time of this study. Over half of participants reported reducing consumption, while a third said they had tried to quit smoking while pregnant, and 6% had neither reduced nor tried to quit. Of those women who had tried to quit or who had cut down, about half said they intended for the change to be permanent, while the remainder said it was just for the pregnancy, or they didn't know. Most women had partners who smoked, and/or were exposed to smoke at work, indicating persistent risk of exposure from other sources.

Stages of change: 32% of pregnant smokers were in the Precontemplation stage, 35% in Contemplation, and 33% in Preparation.

Patterns of decision-making variables: In general, participants' level of knowledge was high about maternal and fetal risks of smoking during pregnancy. However, similar items assessing personal perceptions of risk showed that many women thought their personal risk was lower than pregnant smokers in general. Negative affect was the dominant motive, and Level 1 reasons (doubting the evidence of harm) were cited as being most important factors related to continued smoking. Overall, participants gave higher ratings to the cons of smoking than to the pros.

Multivariate analysis: There were no serious violations of the assumptions of independence, linearity, or homogeneity of the variance-covariance matrices. The multivariate statistic was significant (Wilks'

Λ = .6586, F (2, 233 df) = 1.84, p = .0067), indicating an overall difference by stage on these variables. Follow-up ANOVAs and Tukey's test on the variables which contributed significantly to the overall statistic indicated that women in Preparation had significantly higher knowledge of risks from smoking during pregnancy than Contemplators, but did not differ significantly from Precontemplators, while Precontemplators did not differ significantly from Contemplators on this variable. Women in Preparation had a significantly higher personal perception of risk for the fetus of smoking during pregnancy than women in the other two stages. As expected, Precontemplators perceived significantly lower Cons of smoking than women in the other two stages, who did not differ significantly from each other. This finding is consistent with that of Prochaska et al.[1]

Conclusions Based on this study's data, knowledge of the risks of smoking while pregnant, personal risk perceptions, and the cons of smoking could be helpful additions to the stages of change framework in describing the characteristics of pregnant women who continue to smoke. The lack of significant differences by stage on smoking motives, reasons, and pros can possibly be attributed to small sample size per stage-variable stratum, to instrumentation problems, or to a uniformity among pregnant smokers on these variables. In general, there were similarities in the patterns of responses on these scales for the total sample compared with those of other studies. As these variables are theory-derived, their relationship to stages of change should be tested in a larger sample before any conclusions are drawn about their value to the model. Future research should further investigate the relationship of decision-making variables to stages of change in a longitudinal, prospective design.

Program implications As this sample has indicated, pregnant women already know about health risks and other disadvantages of their smoking. So pregrams need not seek to increase pregnant women's knowledge levels, but should focus on addression women's disbelief in personal susceptibility and on their discounting of the evidence of harm. Pregnant

smokers' motives and reasons for continuing to smoke should be solicited and respected, as these can guide program elements by suggesting substitutions for acknowledged needs (e.g. alternative stress management techniques). Time periods which separate the stages may need to be adjusted in order to represent more pertinent benchmarks (such as prenatal check-ups) during the course of pregnancy.

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Thank you to Dana Edge and to Sharon Buehler for first captivating my interest in epidemiology and launching me on my new career.

Warm thoughts of gratitude go to my husband, Mark Allston, and to my parents, Beverley Healy and John O'Hollaren, for their understanding and loving support during the hair-wrenching, but rewarding experience of graduate studies and thesis research.

This work is dedicated to all pregnant women who are caught in the powerful grip of the need to smoke: may this research help them to find other ways to meet their very real needs, for their future health and the health of their children.

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CHAPTER 1 - INTRODUCTION

Smoking during Pregnancy: Scope of the Problem

The health hazards of smoking are well-publicized, and yet some thirty percent of Canadians continue to smoke; among them are pregnant women. The potentially harmful effects of maternal smoking on the fetus have been extensively studied. These include higher incidences of low birth weight and prematurity, miscarriage, fetal and infant death, complications of pregnancy, congenital anomalies, and respiratory ailments.[2] Yet, efforts to promote smoking cessation among pregnant women have met with generally poor results. Despite knowledge of the risks to their babies, some 70-80% of female smokers continue to smoke while pregnant.[3]

While pharmacological addiction is an important factor in continued smoking, social cognitions and attributions have also been shown to be significant correlates of smoking behaviour.[4] The social and behavioural sciences have a significant and historical place in the development of epidemiologic theory and research, and their preventive health applications, as Kleinbaum et al. have remarked: "Indeed, productive epidemiologic research borrows from and, to a certain extent, integrates the theories of several disciplines, including the biomedical sciences..., the social sciences (psychology, sociology, anthropology, economics, and political science), and quantitative disciplines..."[5]

This study, a secondary analysis of data, was undertaken to explore the attitudinal determinants of smoking behaviour among pregnant women. Pregnant women, even more than the general population, are frequently confronted with how their behaviour affects a dependent other. Therefore, they must make decisions about their smoking - whether to continue or to quit. While this decision-making process may not always constitute a "rational" weighing of the advantages and disadvantages of continued smoking, pregnant women who wish to smoke likely must find some reasons which justify in their own minds why they should continue.

The focus of this thesis was to identify and test the relationships among some variables shown in the literature to be related to women's smoking. The variables that were considered to contribute to this decision-making process were: general risk knowledge of the effects of smoking on the fetus for pregnant women, perceived personal risk of of harm to one's own baby and oneself from smoking while pregnant, smoking motives, reasons for smoking, and decisional balance (assessments of the pros and cons of smoking). These variables were examined as they related to the first three stages in the process of decision-making about quitting: not contemplating quitting (Precontemplation), considering it (Contemplation), and planning cessation (Preparation). Demographic, pregnancy-related, and smoking history variables

commonly studied as correlates of smoking behaviour among women were described for comparative purposes.

While virtually all pregnant smokers have been smoking for some time before their pregnancies, there are a number of pregnancy-specific factors which make examination of this behaviour of particular interest. In many ways, pregnancy constitutes a unique period in a woman's life. Her awareness of and perceived control over her body (or lack thereof) are heightened. The salience of health concerns is generally higher, and thus health promotion efforts and smoking interventions should meet with greater acceptance. Increased contact with the health care system, including prenatal care, provides an opportunity for health care providers to intervene.

However, while it is known that smoking during pregnancy is a risk factor for low birth weight and other adverse pregnancy and birth outcomes, little is known about how to successfully modify that risk factor in order to prevent its harmful effects. While some smokers quit or cut down when they find out they are pregnant, three-quarters continue to smoke; moreover, the relapse rate is high during pregnancy, and even higher in the postpartum. Clearly, present efforts to prevent smoking-related pregnancy outcomes are not as effective as they need to be. Little research has been done into why this is so. This study will elucidate women's reasons for continued smoking during pregnancy. Insights

about these beliefs and attitudes can guide the development of health promotion efforts which reflect an understanding of the role smoking has in the lives of pregnant smokers, and thus be more relevant and effective in modifing this important risk factor for adverse pregnancy outcomes.

Purpose of this Study

The purpose of this study is to investigate attitudinal factors related to women's continued smoking during pregnancy, through an examination of their knowledge of the association between smoking and fetal and maternal harm, their perception of their personal risk, their motives and reasons for smoking, and their assessments of the pros and cons ("decisional balance") of smoking, at each stage of change for current smokers (Precontemplation, Contemplation and Preparation).

The goal is to inform health researchers and practitioners about why some pregnant women continue to smoke, and to guide the development of programs sensitive to the needs pregnant smokers have that are currently being met by smoking.

Study Questions

1. At each stage of change:
    a. What is pregnant smokers' knowledge about the risks of smoking to the fetus?

b. To what extent do study participants perceive that the risks relate to themselves and their own babies?

c. To what extent do pregnant women endorse certain motives for smoking? What is the relative strength of the following motives: habit, addiction, the suppression of negative affect, the promotion of positive affect, stimulation, or enjoyment of the sensorimotor ("handling") aspects of smoking?

d. To what extent do participants endorse certain reasons for continuing to smoke during pregnancy? To what extent are these endorsements based on disbelief of the evidence of harm, perceived barriers to quitting, or inability or refusal to consider changing?

e. To what extent do pregnant smokers endorse the pros and cons (decisional balance) of smoking? What is the ratio of pros to cons?

2. a. Is there an <u>overall</u> difference among the stages on level of knowledge, perceptions of personal risk, motives, reasons, and decisional balance?

b. If an overall difference by stage does exist, which variables account for this difference?

c. Which stages are distinguished by the differences on these variables?

The following chapter will investigate the background for the development of these questions from the published literature.

CHAPTER 2 - LITERATURE REVIEW

Method

In order to develop an understanding of the background and scope of the problem of smoking in pregnancy, on-line searches of computerized databases of journal articles including Medline, Psychlit, and Sociofile were conducted, as well as manual searches of current issues of relevant journals and Current Contents. The reference list was expanded via "snowballing" (searching bibliographies of relevant studies), which also confirmed the importance of key articles. Contact with health researchers and with agencies in the focus area confirmed the search strategy.

The Impact of Smoking during Pregnancy

Prevalence and trends

While the general rate of smoking has been declining in recent decades, there are still nearly a third of Canadians who smoke. A summary of studies[6] of smoking trends from 1965 to 1990 estimated that 31% of Canadian men and 28% of women over 15 years old were regular smokers in 1990 (down 30% from the 1965 rate for men, and 10% for women). However, the prevalence for women of child-bearing age (20-44 years old) at 34% was higher than the population prevalence, and over two-thirds of these women were moderate to heavy users, smoking 11 to 25 cigarettes a day. Both Quebec and Nova Scotia had

exceptionally high rates for women aged 25 to 44, where 40% were current smokers. A disturbing trend that has developed since 1983 is the higher smoking rates among young women (29% of women aged 15-24 in 1994), compared to young men (26%),[7,8] a pattern that is likely to continue while these women enter their childbearing years.

The prevalence of smoking among pregnant women has not yet been assessed in a national Canadian sample, or even in large, population-based surveys such as the 1994 surveys of Canadians' smoking habits by Health Canada. In the United States, the smoking status of pregnant women has been calculated from information on birth records and from record matching of large databases such as the Behavior Risk Factor Surveillance System. In most studies, smoking prevalence among pregnant women ranged between 25% and 40%, although there were differences by sociodemographic strata.[9,10,11] Williamson et al.[12] reported 21% of their sample of pregnant women were current smokers, compared with 30% of nonpregnant women. While the number of women who had ever smoked were close in both groups (43% and 45% respectively), more pregnant than nonpregnant women had quit (22% vs 15%). In other countries, estimated smoking prevalence during pregnancy ranged from 25% to 40%[13]

Estimates of smoking prevalence during pregnancy vary according to which trimester women are surveyed.[14] Of the approximately 30% of women who smoke before pregnancy, about

15% to 30% quit before the first prenatal visit. However, some of these women will relapse before the end of pregnancy. Some women (perhaps an additional 10% to 20%) may quit later in pregnancy. Thus, 50% to 75% of women who smoked before pregnancy continue to smoke throughout pregnancy. While 30% to 65% may cut down consumption, 10% actually increase the number of cigarettes smoked daily, and postpartum relapse rates are high. Many smokers who quit do so on their own, rather than following a program.[15]

Stewart et al.[16] examined changes in smoking prevalence among pregnant women over a ten-year period in the Ottawa-Carleton region, where the present research also took place. Eighty-five percent to 95% of the women giving birth were surveyed in the postpartum units of area hospitals in a population-based sample over six months in 1983 and 12 months in 1992. Of 3296 new mothers in 1983 and 7940 women in 1992, the prevalence of self-reported smoking after the first trimester of pregnancy dropped from 28.5% to 18.7% in the ten-year period. The authors attributed this decline to the significantly smaller number of women smoking before pregnancy (37.4% in 1983 vs 26.4% in 1992) and to the significantly increased number of women quitting in early pregnancy (up from 23.9% in 1983 to 29.2% in 1992). These decreases for the Ottawa region were greater than those found in national surveys. However, there were still one-fifth to one-quarter of new mothers who had smoked after the first trimester of

pregnancy, putting their babies at risk of low birth weight and other negative outcomes. Although smoking status was retrospectively reported and was not biochemically validated, Stewart et al.'s study provides a benchmark to which studies in similar populations can be compared.

Sociodemographic differences in smoking behaviour

Sociodemographic factors such as age, sex, race, income or occupational level, educational level, and marital status have been studied for their relationship to women's smoking patterns and cessation rates. In most studies, higher rates of smoking are linked to lower educational attainment, lower income, non-professional occupation or unemployment, and separated or divorced marital status.[17] [18] [19] [20] [21] [22] [23] [24] Women disadvantaged in these ways are also more likely to have smoked for longer, with fewer quit attempts.[25] A study using a community-based sample[26] found that women with higher income and educational attainment had more successful cessation attempts, and that they were also more likely to try again after a failed quit attempt. In Greaves' Background Paper on Women and Tobacco (1987) and Update (1990),[27] as well as in the most recent Health Canada smoking survey cycle (1994), many of these sociodemographic patterns were confirmed.[28]

The pattern is repeated among pregnant women. Several studies[29] [30] [31] have shown that, although smoking rates were

generally lower among pregnant women than in nonpregnant women, pregnant women who were teenagers and/or unmarried were more often smokers than their nonpregnant counterparts. In their study, Davis et al.[32] found that 32% of married pregnant teenagers smoked, compared with 43% of unmarried pregnant teens. Williamson et al.[33] estimated that while pregnant women were 70% as likely to smoke as nonpregnant women, unmarried pregnant women were 40% more likely to smoke than similar samples of unmarried women who were not pregnant.

Stewart et al.[34] found that in their 1992 sample, there was an inverse relationship of age to smoking prevalence: 64% of teenaged women (age 15-19) reported smoking daily before pregnancy, and 48.3% continued to do so after the first trimester, compared with 18.9% and 13.1%, respectively, of women aged 30 or older. Unmarried pregnant women were more likely to have smoked daily in the month before pregnancy than married women (54.9% vs 19.5%), and to have smoked daily after the first trimester (43.5% vs 12.8%). Pregnant women with a Grade 13 education or less were also much more likely than women with some post-secondary education to have smoked before pregnancy (51.0% vs 16.5%), to have smoked daily after the first trimester (41.6% vs 9.5%).

Maternal and Fetal Health Effects

Physiologic process

The deleterious effects of smoking while pregnant have been known since the 1930s,[35] [36] [37] [38] [39] and warnings have appeared on cigarette packs and in advertisements since the 1960s.[40] It is now known that the placenta acts not as a barrier, but more like a sieve. The toxins in cigarette smoke (especially nicotine, carbon monoxide, and cyanide) act both directly and indirectly to impair the fetal cardiovascular system by lowering uterine and umbilical artery blood flow velocity and oxygenation.[41] [42] [43] Thus, the chemicals in cigarette smoke lead to a higher probability of low birth weight or intrauterine growth retardation by restricting blood flow and inducing hypoxia (oxygen debt) in the fetus. The mechanisms of this process include the displacement of blood oxygen with carbon monoxide, decrease in maternal blood pressure, and damage to the vascular structure of the placenta.[44] [45] [46] [47] Another mode of action is that nicotine, or the hypoxic state it produces, alters maternal levels of prostaglandins, norepinephrine and its metabolites (as demonstrated by their increased levels in amniotic fluids)[48] and increases placental vascular resistance.[49] [50]

Adverse outcomes of maternal smoking

The most commonly studied outcome of smoking in pregnancy is low birth weight (LBW) and the related problems: premature

birth, small for gestational age (SGA), intrauterine growth retardation (IUGR) or fetal growth retardation (FGR).[51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66] The term "low birth weight" is generally applied to infants whose birth weight is less than 2500 grams (5.5 pounds), regardless of gestational age. Premature infants (those born before 36 completed weeks of pregnancy) generally have LBW, and maternal smoking is related to both problems. The U.S. Surgeon Generals' reports and other studies have reported that smokers' babies have a mean birth weight 150-200 g less than nonsmokers' babies.[67 68 69 70 71 72 73 74 75 76] This deficit may be doubled for heavy smokers. Prevalence of LBW has been found to be 54% to 130% higher for heavy smokers' babies[77].

McIntosh, in a review of the literature on health risks of pre- and postnatal smoking, calculated relative risks, attributable risks, and population attributable risks for 25 adverse outcomes. Attributable risk of smoking for low birth weight ranges from 11% to 42%, depending on the prevalence of smoking in the pregnant population sampled.[78 79 80 81 82 83] Smoking during pregnancy has also produced an approximate relative risk of 1.41 for prematurity (accounting for 14% of all cases, in populations where smoking prevalence is around 40%), to 2.42 for intrauterine growth retardation, compared to mothers who did not smoke (attributable risk for IUGR is 36%, with smoking prevalence of 40%). The influence of smoking on birth weight has been demonstrated since the 1950s.[84]

Smoking remains the largest predictor of LBW, even after controlling for potential confounders such as maternal age, prepregnant weight, parity, length of gestation, maternal stature, SES indicators, previous pregnancy outcomes, and infant sex.[85] [86] McIntosh's calculation of the attributable risk proportion, that is, the extent to which adverse outcomes can be said to be due to smoking, ranged from 15% to 45%[87]

Interventions and birth weight effects

The effect of smoking on birth weight and other adverse pregnancy outcomes has been studied in several randomized controlled trials of cessation interventions. In a prospective, randomized controlled trial by Sexton and Hebel[80], 935 pregnant women were randomly assigned to receive a smoking intervention with biweekly contacts (treatment group), or no contact until the eighth month (control group). Self-reported smoking status was biochemically confirmed (by saliva thiocyanate) at the time of randomization (< 18 weeks' gestation) and in the eighth month of pregnancy, for both groups. The two groups were similar in sociodemographic, obstetric, and cigarette consumption characteristics at baseline. At the eight-month follow-up, twice as many women in the treatment group compared with the control group had quit (43% vs 20%), and those who continued to smoke consumed half as many cigarettes per day (6.4 ± 8.7, vs 12.8 ± 11.5, respectively). Babies born to women in the control group were

significantly smaller, with an average birth weight deficit of 92g.

An earlier controlled trial[89] did not find a significant difference in birth weight according to maternal smoking status. Self-reported pregnancy smoking rates were collected at baseline, and retrospectively in the postpartum. Smoking status was not biochemically confirmed. The treatment group's reported rate of smoking during pregnancy was similar to the control group's, until late pregnancy, where the treatment group smoked an average of seven fewer cigarettes per day than the control group (9.2 vs 16.4). The control group received some anti-smoking advice provided in prenatal clinics, while a note was put in the treatment group's charts for their doctors to speak to them specifically about smoking. No information about the nature, frequency, or consistency of doctors' advice was reported. Therefore, the lack of a significant difference in birth weight could have been due to misreporting of smoking rate, and/or lack of control over the quality and quantity of the advice the treatment group received; i.e. it may not have differed much from what the control group received.

A meta-analysis of randomized trials by Dolan-Mullen et al.[90] included three studies[91 92 93] which assessed effects of interventions on birth weight and related outcomes. Because of differences in sample size and methodology, no summary figure could be calculated. Babies of women who

continued to smoke had a risk ratio for low birth weight of 0.6 to 1.1, compared with women who quit. Preterm risk ratios were calculated for two of the studies (Ershoff et al., and Hjalmarson et al.), and were 0.9 (95% CI 0.3-2.6) and 0.8 (0.3-1.8).

Carbon monoxide, tar and nicotine intake have been shown to have a dose-related effect on adverse outcomes both for number of cigarettes smoked per day, and duration of smoking in pregnancy.[94] [95] [96] [97] [98] [99] [100] [101] Studies have found that smoking after the first trimester results in greater birth weight deficits,[102] [103] and that quitting can alleviate some of that loss.[104] [105] [106] [107] [108] [109] [110] [111] [112] In a Canadian study, birth weight deficits of 181 g were observed for babies of women still smoking in the third trimester, compared with birth weight decreases of 131 g in women who quit after the first trimester.[113] As fetal weight gain is significant in the third trimester, maternal smoking during this time appears to have the greatest effect. Also, the relationship between each cigarette and the incremental decline in birth weight may not be linear; that is, there may be some threshold after which each additional cigarette smoked increases risk exponentially.[114]

Whereas quitting smoking during pregnancy has a positive effect on birthweight, reduction has had an inconsistent relationship to birth weight.[115] [116] In a meta-analysis of studies on fetal effects of maternal smoking, Kramer

calculated a 11.1 g deficit in birth weight for every cigarette smoked per day.[117] However, while total cessation is preferable, reduction in consumption may be a more feasible goal for some women,[118] though it may not alleviate the risk of low birth weight.

Passive (second-hand) smoke may also negatively affect infant size.[119] [120] [121] [122] [123] One study among 906 nonsmoking women exposed to at least two hours daily of passive smoke found a crude relative risk of 1.30 (95% confidence intervals = 0.85-1.98) for low birth weight. After adjusting for length of gestation, maternal age, parity, and race, the relative risk increased to 2.17 (95% CI 1.05-4.50).[124]

Other fetal risks

Smoking during pregnancy is also associated with higher rates of miscarriage, fetal death, abruptio placentae, placenta previa, toxemia, and other complications of pregnancy, as well as congenital anomalies, and sudden infant death syndrome.[125] [126] [127] [128] [129] [130] [131] [132] [133] [134] [135] [136] [137] [138] [139] [140] Associations have been found in studies since 1957.[141] [142] A Canadian study concluded that risk of perinatal death is 20% higher in women smoking more than 20 cigarettes per day.[143] In a study of U.S. Native American women in three areas, the proportional reduction (impact fraction) and the absolute reduction (impact risk) in neonatal

and postneonatal deaths were calculated following a smoking cessation intervention[144]. With the conservative estimates that 14% of the pregnant smokers in a cessation program would quit, and that doing so would have 60% relative efficacy in preventing infant deaths attributable to smoking, 11 neonatal deaths and 42 postneonatal deaths per 100,000 live births could be prevented in the study areas. Variables such as smoking rate, exposure to sidestream smoke, and gestational age when the intervention takes place should be considered to adjust these calculations for other populations. However, they provide a useful epidemiologic method for comparing the preventive impact on infant deaths of maternal smoking interventions.

Relapse and postpartum smoking

The postpartum relapse rate for women who quit smoking before or during their pregnancies is very high.[145] [146] In a review of published studies, Edwards et al. (1994)[147] found relapse rates of 24% to 58% by three months, and up to 79% by six months postpartum in descriptive studies. In intervention studies, there was a wide range of rates at six weeks to four months postpartum. However, after six to eight months, 53% to 84% had relapsed, and up to 91% by one year postpartum. There were no substantial differences in relapse rates between women in the intervention and control groups in the studies reviewed, especially as more time passed after the birth of

the child.[148] Women who quit earlier in their pregnancies had lower relapse rates than those who quit later, but both were still over 50% It is also notable that most (nearly three-quarters) of the women in these studies had returned to smoking by six weeks after childbirth, indicating that this is a crucial period for relapse prevention measures.

Edwards et al. have noted that some methodological considerations in reviewing the literature on smoking in pregnancy and the postpartum should be observed: there was a paucity of studies on postpartum smoking relapse, and their methods and sample sizes varied widely. Length of follow-up was often insufficient. Smoking status was not biochemically validated in most studies; in those that did, smoking was underreported, indicating that reported postpartum relapse rates are most likely underestimates of the true rate. Women's subjective reasons for resuming smoking were rarely measured.

Curry and McBride, in a review of studies recording relapse rates in general populations, remarked that "regardless of whether cessation in self-initiated or the result of participation in a formal treatment program, a large proportion of those who quit smoking will relapse in the first three months after quitting, with estimates varying from 35% to 81%"[149] They noted that rates tend to stabilize around six months after quitting. Thus, while more women may quit smoking while pregnant than at any other time, their relapse

rates following pregnancy are similar to those found in the general population.

Exposure to smoke in the postpartum is important because of the adverse consequences on the infant, who is still undergoing rapid development. The effects of passive smoking, or environmental tobacco smoke (ETS) on infants and children include acute and chronic respiratory problems, allergies, middle ear infections, and sudden infant death syndrome.[150] [151] [152] [153] [154] [155] [156] According to the most recent Canadian smoking survey, 39% of respondents reported that smoking was banned in their workplaces, but there were also 39% who reported that they were exposed to smoke at home - this figure was the same regardless of whether there were young children at home.[157] Thus, even if pregnant women reduce their consumption or quit, they and their babies may be exposed to cigarette smoke from other sources.

The long-term effects of smoking during pregnancy and the postpartum include small but significant deficiencies in physical growth, auditory and language performance, intellectual and emotional development, and increased hyperactive or disruptive behaviour, which have been measured even in school-age children.[158] [159] [160] [161] [162] [163] [164] [165] [166] [167] While it may be difficult to separate out the effects of exposure to smoke in utero and after birth, children of smoking mothers are likely to have more frequent and more serious respiratory illnesses in the first year of life, and

the relative risk for cancer of all sites was 1.3 (95% CI 0.8-2.2) for children of smokers.[168 169 170 171 172 173 174] Maternal smoking may be related to subsequent problems in the offspring including thyroid enlargement[175] and infertility.[176] Moreover, children whose family members smoke are also more likely to become smokers.[177]

Smoking during pregnancy and the postpartum may also be related to other unhealthy behaviours and attitudes.[178 179 180 181 182 183 184 185 186] On the whole, smokers may value the attainment, restoration and maintenance of good health less than other life goals or attributes.[187 188 189] Women who smoke while pregnant, even when the pregnancy was planned, are less likely to seek early prenatal care.[190] Smoking during the postpartum is more common among women who bottlefeed their babies rather than breastfeeding them.[191 192 193 194 195] This may be partly due to suppressed lactation (and subsequent difficulty in breastfeeding) among smoking mothers.[196]

Interventions

Several reviews of smoking interventions for pregnant women have been published.[197 198 199 200] Floyd et al.[201] reviewed 13 studies, 10 of which showed greater cessation rates in the intervention groups. While these studies varied in parameters and methodology, some general conclusions were drawn. The most successful programs followed up one-on-one

counselling at prenatal visits with take-home written materials, and frequent personal or telephone contacts.[202] Quit rates were higher among women who attended prenatal classes earlier in their pregnancies, and among those who were lighter smokers. The highest cessation rate was 32%, found in a study of private clinic patients[203]. Among participants in two HMO trials by Ershoff et al., cessation rates were 28% and 22%[204, 205] For lower-income women attending public prenatal and nutritional aid programs in the United States, quit rates were lower, about 14% Three European programs, with participants of unreported or mixed sociodemographic status, had quit rates of 9% to 14%[206, 207, 208]

Mullen et al.[209] conducted a meta-analysis of randomized prenatal cessation intervention trials where quitting was biochemically confirmed. They found 11 studies which met their inclusion criteria. Quit rates ranged from 4.9% to 31.9% in the intervention groups. Risk ratios of smoking cessation in the intervention vs control groups ranged from 0.9 to 7.1; however, the latter was an outlier - the average RR excluding this value was 1.5 (95% confidence intervals 1.22-1.86). This homogenous group of studies showed that even brief interventions may produce up to a 50% increase in cessation rates of pregnant smokers. Although the small number of studies does not allow direct comparison of effectiveness, some themes emerged. The most successful programs used materials specifically designed for pregnant

women. The study producing the greatest effect (RR = 7.1, 95% CI 1.7-30.6)[210] had the most frequent and intensive contact with participants, suggesting that this was an effective strategy.

Walsh and Redman[211] used stringent criteria to examine controlled trials, and found only eight methodologically adequate studies of the 20 they reviewed. They categorized the studies by the following types: feedback trials, nurse home visitation trials, advice trials, and cognitive behavioural trials. In the first three categories only one (or none) of the studies met methodological criteria on several rating scales, and the results of the acceptable studies were inconclusive, i.e. there was insufficient evidence to conclude whether feedback, home visitation, or advice could significantly increase cessation rates for pregnant women. Six of ten trials categorized as taking a cognitive behavioural approach were admissible. Of these, the quit rate for the experimental groups (20%) was substantially higher than that for control groups (8%), suggesting that cognitive behavioural interventions tailored to pregnancy can be effective in increasing cessation rates compared with the usual care given. However, more research is needed to find intervention materials that are feasible and acceptable for delivery by usual care providers.

Summary

Thus, despite the relative success of these more pregnancy-specific smoking interventions, the rates of cessation achieved were low on an absolute level, and relapse in the postpartum period was uniformly high: from 21% to 70% smoked again, most by six weeks after the baby's birth. Clearly, many pregnant women have difficulty quitting and maintaining cessation either on their own, or while enrolled in programs. While part of the problem is physiological addiction, and part may be linked to sociodemographic characteristics, more studies are acknowledging that behavioural factors play a large part in whether smokers decide to, and are able to successfully quit and maintain cessation. However, few studies have included theory-based models of constructs to explain why so few pregnant women are able to stop. Merely imparting facts about harm from smoking has not been successful in bringing about cessation.[212] [213] Furthermore, the effects of even a well-designed, controlled trial will be diluted if the program is applied to clients who have no intention of quitting, or whose motives and reasons for smoking are not addressed first. The following section will examine some theoretically-based models and their applicability to pregnant smokers.

Theoretical Approaches to Understanding Smoking

As noted above, sociodemographic characteristics are often associated with a higher prevalence of negative pregnancy outcomes. However, the relationship of these characteristics to those outcomes does not have a foundation in theory. In methodologically strong studies, smoking has been found to be the dominant factor in models predicting negative pregnancy outcomes from smoking status and demographic variables; that is, after controlling for smoking, the other variables ceased to be significant predictors. This suggests that, while demographic characteristics may be associated with higher smoking rates, that they are not independent predictors of outcomes. They can be correlated with negative health outcomes, but they cannot directly cause them - they are acting as proxies for other factors which have a biologically plausible causal relationship to risk factors for illness.[214] Oakley[215] has suggested that while smoking has an undisputed causal link with low birth weight, it may act synergistically with other factors prevalent in the lives of disadvantaged women (e.g. inadequate diet, hazardous work and home environments, high stress) to produce their higher rates of adverse pregnancy outcomes.

Moreover, demographic characteristics generally are not modifiable. Therefore, while identification of these correlates can assist with the segmentation of target groups, health interventions should focus on factors that can be

altered to bring about healthier behaviour, for instance, knowledge, attitudes, and beliefs which affect decisions about behaviour change. These factors can also be modelled in ways which describe and predict their relationships to one another and to the behavioural outcome, in a theoretically meaningful manner. The following section will discuss the dominant theories around determinants of change, and their application to the present study.

Risk knowledge and perceptions

The traditional public health approach to smoking cessation intervention has been to give factual information (generally in a "passive", impersonal format such as posters, pamphlets, and media messages), which is assumed to change knowledge, beliefs, attitudes and intentions, consequently resulting in more healthy behaviour. However, critics of this approach have noted that while it raises the guilt and anxiety of people who struggle with change, it often results in a low rate of cessation of the undesirable behaviour (e.g. smoking).[216 217 218 219]

One model which has endeavoured to explain this gap between knowledge and behaviour is the Health Belief Model (HBM).[220 221] According to the HBM, the likelihood of people engaging in preventive health behaviour is dependent not only on their knowledge of risk, but also on their perceptions of personal susceptibility to negative outcomes and the severity

of these outcomes, which are modified by assessments of the benefits and barriers of taking action.

Windsor et al.[222] developed and tested an HBM-based instrument on a small sample of pregnant smokers. Although there were no statistically significant differences in mean health belief scores between smokers and nonsmokers (which may have been due to low power from the small sample size), nonsmokers held more favourable health beliefs than smokers about fetal harm. Three-quarters of the smokers said they would take part in a smoking cessation program.

However, health beliefs alone have often failed to predict actual behaviour.[223] [224] In a study of pregnant women[225] who were asked to assess the theoretical tradeoff between smoking and having a healthy pregnancy, 81% of those who perceived the risks of smoking scenarios to be unacceptable still continued to smoke.

Macleod Clark and Maclaine[226] reviewed several studies which investigated the impact of interventions to increase knowledge of harmful effects of smoking while pregnant. They found that some women denied knowledge of any harmful effects to the fetus,[227] [228] [229] [230] while others knew the risks but did not think <u>their</u> babies would be harmed seriously (especially if they, or someone they knew, had had a "healthy" baby while smoking).[231] [232] [233] [234] [235] Others may believe the fetus could be harmed by smoking, but not at the amount they were consuming,[236] [237] or that some outcomes such as low

birth weight may actually be desirable (believing that a smaller baby is easier to deliver).[238] [239] Thus, high risk perceptions may not be adequate predictors of cessation.

Thus, despite the vast evidence and publicity that smoking is hazardous, smokers may ignore or suppress this information, or believe that while it may apply to others, the risks will not affect them.[240] [241] This may be true regardless of educational attainment: some studies have shown that while knowledge of harmful effects and education levels are positively associated, smokers are less likely to believe in harmful effects, even at higher educational levels, than nonsmokers.[242] [243] These authors and others have labelled this a cognitive dissonance-reduction strategy - in order to overcome the conflict of smoking despite known health consequences, the smoker either quits or exempts her- or himself from those at risk, or disbelieves the severity of the effects.[244] [245] [246] [247] [248] [249] [250]

Appel has also described this process of coping with decisional confrontations.[251] Decision-making is risky as it involves delving into the unknown. Therefore, people will tend to engage in strategies which (a) take the least amount of time and effort, (b) draw on previous experience, whether or not past attempts were successful in achieving the desired goal, or regardless of whether they are applicable to the current one. Once decided on a course of action, people are reluctant to change their minds, no matter how much evidence

is put before them. This is especially true when choices are dichotomous (rather than having multiple options), and when they are forced (coerced). Presented with the awful choice urged upon them by health-care providers and increasingly, by society at large, of quitting smoking (and facing withdrawal symptoms and the removal of a familiar habit and coping strategy) or the threat of harming their babies if they continue, pregnant women may decide to continue smoking - as with (a) above, continuing takes less effort, and they can justify it by (b) noting other pregnant smokers who experienced no ill effects, or even their own prior "healthy" pregnancies.

Finally, in a study[252] which developed a HBM-based instrument for examining women's health beliefs relevant to low-birthweight risk factors such as inadequate prenatal care, poor nutrition, alcohol consumption, and smoking, the smoking items emerged with a different factor structure than that of the other behaviours. Perceived susceptibility, severity, and benefits combined in one factor, with barriers to quitting on the other. The authors concluded that barriers are the most salient construct for smoking cessation. What kinds of barriers to quitting do pregnant smokers perceive, and why? How are these barriers important? Some explanations may be found in the motives and reasons smokers have to justify their behaviour.

The experience of smoking for women

Numerous papers have been published in the last decade suggesting that the experience of smoking is different for women than for men. Their reasons for initiation, motivation to continue, and desire and ability to quit are unique.[253] [254] [255] For this reason, it is important to understand the role that smoking plays for women, not just during pregnancy (which occupies relatively short periods of time), but throughout women's lifecycles.

Women's concepts about smoking begin in childhood. The social acceptability of smoking in children's environment (home, neighbourhood, school, other social groups) will influence their own likelihood of smoking.[256] School-age children are developing their own sense of autonomy and self-worth, and are shifting their sphere of influence from their parents to their peers.[257] [258] Advertising approaches used by tobacco companies present an image of a smoker who is sophisticated, "cool", independent, and attractive, even rebellious[259] [260] [261] [262] [263] [264] [265] Blake et al. have suggested that women may have more of their self-image invested in smoking than men - girls want to emulate the slim, sexy, popular women they see in the cigarette ads.[266] Tobacco companies have made it easier for them by specifically targeting advertising and products to these young recruits.[267] [268] [269] [270] [271] [272] These factors seem to be the most important in the initiation of smoking - knowledge

(even at age seven) of health hazards and negative attitudes towards smoking[273] have not been consistently predictive of smoking behaviour.[274] [275]

Girls soon learn also that there are few acceptable outlets for anger, frustration, anxiety, depression, loneliness and low self-esteem - they are expected to suppress or control these negative feelings, and put others' needs above their own. Smoking begins as a tool to promote a desired image and to fit in with perceived expectations of peers, but other functions soon dominate,[276] and it becomes viewed as a reliable coping mechanism.[277] [278] [279] [280] [281] [282] [283] [284] [285] [286] [287]

For some women, cigarettes may even be personified as "good friends" and as the only thing they can count on being there for them.[288] This is particularly true for low-income women, who may see cigarettes as a rare luxury they afford themselves, a means of stepping away from, and suppressing the daily problems of living they face.[289] [290] [291] [292] [293] [294] Graham notes that taking a smoke break is a way to structure the day into work and relaxation (whether working at home or in a job), and to temporarily distance oneself from children and other demanding obligations.[295] [296] In Finlayson's qualitative study, the issue of exerting control over one's feelings and environment were dominant in the motivations of pregnant women who continued to smoke.[297] Pomerleau et al. have suggested that women may increase their use of tobacco

when negative affect is greatest, which may correspond to hormonal cycles (which shift dramatically in pregnancy).[298] [299]

In western culture, social pressure to be thin is aided by tobacco's anoretic properties - especially important for adolescent girls[300] and women in the postpartum, who may feel a particular need to achieve the ideal (slim) body, and see cigarettes as a tool to achieve that goal.[301] [302] [303] [304] Lucky Strikes initiated a successful campaign (one of the first aimed specifically at women) in 1929 with the slogan: "for a slender figure, reach for a Lucky instead of a sweet." Lucky Strikes were also promoted as "torches of freedom" in the suffragette movement; hence their association with liberation and privilege. Sales of this brand soared, women's smoking prevalence began its steady climb, the portrayal in advertising of women smoking became acceptable, and the aspiration of young women to emulate the desirable figures in the ads became entrenched.[305] [306]

Pregnant women, too, may see smoking as a way to avoid excessive weight gain,[307] [308] and may believe having a low-birth weight baby would be a benefit (a baby that is smaller is "easier to deliver").[309] [310] By the time most women become pregnant, those who smoke have probably done so for a decade or more. Distortion of body image again becomes dominant, especially in the first two trimesters, when the reason for weight gain may be misconstrued by others. When

the physiological changes exerted on women by pregnancy (and pressure for behavioural changes by health professionals, family, and others) threaten perceptions of volition and self-control - particularly as another's (the baby's) needs are placed above the mother's - women may again see smoking as a way of asserting their independence and behavioural choice, of establishing their territory of resistance.

Several studies have shown differences in cessation strategies and perceptions between women and men.[311] [312] [313] Women perceive more barriers, and have stronger negative reactions to quitting. They express lower confidence in their ability, and are more likely to despair in their failure if they resume smoking after a quit attempt.[314] [315] However, their actual rate of quitting may not differ much from men's (depending on how smoking cessation is defined), except for older women and disadvantaged women, who generally find it harder to quit.[316] [317] [318] Greaves, Oakley, Lawson, and others[319] argue that women under particularly high levels of stress from outside forces that they have little control over (e.g. poor socioeconomic circumstances, abusive partners) may find it especially hard to quit, as smoking may be seen by disadvantaged women as their only outlet for meeting personal needs.

Thus, given the social, economic, and environmental context in which women live, they may find self-validated motives and reasons for the role that smoking serves for them,

and minimize perceived risks. Indeed, smoking may be viewed as a valid pleasure and coping mechanism, a "subjectively rational" choice.[320] [321]

Motives for smoking

The utility or function of smoking for the individual has been explored in studies of smoking motives. Tomkins[322] originally formulated categories of smoking motives in 1966 as 1) smoking to increase positive affect, 2) smoking to decrease negative affect, 3) habitual smoking, where affect is not an important factor, and 4) addictive smoking, involving both negative and positive affect. Horn and Waingrow developed a scale of items to measure these concepts, which was tested in population-based samples and analysed by Ikard, Green, and Horn in 1969.[323] The items were factor analysed, and the 23 items loaded distinctively on six factors: 1) habit, 2) addiction, 3) reduction of negative affect (i.e. smoking to reduce tension or sedate oneself when upset), 4) pleasure or relaxation, 5) stimulation (to perk oneself up), and 6) sensorimotor manipulation or handling (the feel of the cigarette, the sensation of the smoke, etc.) These authors found that for women, reduction of negative affect was the most important motive for smoking.

Replication of the Horn-Waingrow model by Livson and Leino[324] reproduced these same components, with women again being more prone to smoke for the reasons of reduction of

negative affect and for pleasure. These self-reported motives have also been experimentally manipulated, and it was found that negative affect smokers do smoke more under laboratory-induced stressors, while pleasure-oriented smokers smoked less when cigarettes were adulterated with vinegar (while smokers who rated pleasure as less important did not reduce consumption).

Several studies examined smoking motives for pregnant women. These articles generally confirmed that pregnant women smoke primarily to relieve negative feelings, especially for coping with stress.[325] [326] Gillies et al.[327] found that women over age 31 were most likely to report smoking to relax or calm their nerves, while younger women were more likely to cite the relief of boredom as a motive. Women who smoked nine or fewer cigarettes a day were more likely to say they smoked to relax or calm themselves than women who were heavier smokers. Addiction and habit were more dominant among the motives women in this sample gave than in other studies.

Reasons for smoking

Meichenbaum and Fong[328] have conceptualized a hierarchy of reasons for nonadherence with smoking cessation recommendations consisting of three levels, some aspects of which have parallels in other theories. Level 1 is evidence-based reasons: challenging the evidence and challenging the sources of information. Pregnant women may not believe their

babies could be harmed by their smoking, or may cite other smokers who have had healthy babies.

Level 2 contains self-relevant reasons, including perceived negative aspects of adherence, perceived positive aspects of nonadherence, and concerns about ones's ability to adhere. Pregnant smokers may not believe they have the willpower to quit, that they are addicted and therefore unable to quit, that the stress of quitting will be worse for their babies' health than continuing to smoke, or that their irritability during withdrawal will threaten their relationships with their partners.

Finally, Level 3, affective and motivational reasons, contains expressions of dysphoric affect, negative models of world and self, denial and avoidance, and free will arguments. These reasons are the most rigid and difficult to change, and may include statements such as "it's my right to smoke; no one can tell me what to do", or "what's going to happen, will; there's nothing I can do about it that would make any difference."

Maclaine and Macleod Clark explored women's reasons for continuing to smoke in pregnancy in a small qualitative study.[329] Reasons women gave corresponded to Level I and Level II of Meichenbaum and Fong's classification. Sexton et al.[330] found that multigravid smokers who have given birth to other babies (or know someone who has) who are apparently "healthy" may feel that they cannot harm this baby by smoking

either (Level I reasons). Oakley's subjects[331] cited reasons at all three levels. Disagreement with risk information was a dominant reason pregnant women gave for continuing to smoke. Level II reasons were prevalent in Oakley's study. For disadvantaged women, smoking was the main mechanism of coping with stress and anger, often the sole luxury, and a means of rewarding themselves by taking breaks during a busy day. At the third level, smoking was a way to assert control over one's body despite the wishes of dominant others (e.g. doctors, husbands).

Level III reasons are also apparent in a study by Lawson of low-income pregnant adolescents.[332] As with Oakley's study, disadvantaged teens had few options for indulging in personal pleasures. Smoking was a way for these pregnant teens to assert their independence, to promote a desired self-image of confidence, control, and belonging when they felt little of these elements in their lives. Because many saw cigarettes as the only thing that could fulfill these functions for them, their committment to smoking was entrenched.

Regarding women's reasons for smoking, Level 1 Reasons are related to perceived risk from the Health Belief Model. Level 2 Reasons roughly correspond to barriers (from the HBM), decisional balance from the TTM, and self-efficacy from Social Cognitive Theory. At Level 3, there are parallels to

cognitive-dissonance theory, and to "immotive" (nonprogressing) smokers described by Prochaska et al.[333]

Stages of change

Research into the behavioural determinants of smoking and smoking cessation has been developing since the 1960s. Prochaska and DiClemente, in their development of the Transtheoretical Model (TTM)[334] [335] of behaviour change, have shown that current smokers may be divided into three subtypes or "stages": Precontemplation, where people are not planning cessation in the foreseeable future (generally measured as six months); Contemplation, where they are thinking about it; and Preparation, where people are taking concrete steps towards cessation in the near future (generally measured as the next 30 days). Once behaviour change occurs (e.g. cessation of smoking), people are classified in Action if they have carried out the change for less than six months, or in Maintenance if longer. Occasional "slips" and even full relapse after a period of cessation are seen as normative events in the TTM. Thus, while the desired trend is a linear progression through the stages to sustained maintenance, the TTM acknowledges that for many people, several attempts involving "recycling" through the change process will be necessary - especially for addictive and habitual behaviours such as smoking.[336] [337] People in these five stages differ on their assessment of the pros and cons of smoking (decisional balance), their perceived

ability to carry out the change and ability to resist temptations to smoke (self-efficacy), and the cognitive and behavioural coping strategies they use (processes of change).

While much of the important foundational work on the TTM was done around smoking cessation, these factors have consistently been related to stage of change across a number of populations and behaviours, including: reducing psychological distress, alcohol intake, dietary fat consumption, and sun exposure; and promoting exercise, weight loss, mammography screening, and contraceptive use.[338, 339]

Stable trait variables such as social desirability, locus of control, and persistence have zero or low correlations with staging in tests of discriminative validity, and staging has better predictive validity for behaviour change than such commonly used variables as demographics, problem duration, frequency and intensity, health history, goals, and expectations.[340] Thus, the TTM serves as a framework describing *how* people change, and not just *who* changes.

One important focus of the TTM is its emphasis on assessing *intermediate* outcomes, not just the final outcome of (maintained) behaviour change such as cessation of smoking. The goal of these interventions is to move from one stage to the next in a reasonable period of time. Prochaska and DiClemente's research suggests that such a progression doubles the chances of cessation within six months.[341]

The first three stages, Precontemplation, Contemplation, and Preparation constitute the decision-making process. If people do not first *consider* the decision to change volitional behaviour, they will not actually do it. It is estimated that some 90% of smokers are in "indecision", i.e., Precontemplation (60%) and Contemplation (30%).[342] Thus, only 10% of smokers are preparing to take action to quit, and yet the vast majority of health interventions are geared to this stage, presuming people will act if enough "evidence" is presented to them as to why they should. Health care planners and providers need to know more about the decision-making process in order to design efficient and effective self-help materials and interventions, and to evaluate their success. They need to understand what determines why healthy change happens or does not, and in what way this process occurs.

The most essential variable in the TTM for these early stages is Decisional Balance, assessments of the advantages and disadvantages of present behaviour.[343] [344] This scale, developed by O'Connell and Velicer,[345] measures the psychological utility of smoking, based on a gain versus loss model where the benefits and costs of smoking are central determinants of considering change, while health threat is dominant in the decision to change.

Analyses of Decisional Balance have shown important differences between stages, and yet consistent patterns across behaviours and populations.[346] In Precontemplation, Pros of

smoking exceed Cons, although both are low as little weighing of the decision is going on. For Contemplators, Pros and Cons are, on average, in balance (although unstable), as the advantages and disadvantages of smoking are assessed. By Preparation, Cons are exceeding Pros. This asymmetry (Pro-Con difference) increases in Action, especially as the decision is reinforced by successful maintenance and by overcoming temptations and slips. With sustained maintenance, the decision-making process again has less salience.

In a longitudinal study of progressing versus nonchanging profiles for Contemplators and Relapsers[347], Fitzgerald and Prochaska found that Relapsers and Contemplators who cycled back into the decision-making process rated the pros of smoking as lower and cons as higher than did chronic relapsers or immotive contemplators. This distinction was most marked at the final two-year follow-up.

Integrating models

While the TTM is a useful organizing framework for describing how the process of change occurs, variables from other models such as the Health Belief Model, motives and reasons can expand its explanatory power regarding why people do or don't change, and can provide more detailed information about the decision-making process. Several studies have incorporated other variables in the TTM, including

sociodemographic characteristics, smoking history, and risk perceptions.

Owen et al.[348] examined population correlates of stages in 1048 men and women and found that Precontemplators were significantly more likely to be male, and less well educated than subjects in Contemplation or Preparation. The authors dichotomized age at the median (33 years) and found that there were significantly more Precontemplators above this median than in the other two stages. There were no significant differences by stage on marital status. Using logistic regression yielding odds ratios to compare Precontemplation to Contemplation, and Contemplation to Preparation on smoking behaviour and risk perception variables, Owen et al. found that significantly more Precontemplators smoked 25 or more cigarettes a day than Contemplators (OR 1.54), and fewer Precontemplators had made a previous quit attempt than subjects in either Contemplation or Preparation (ORs 2.57, 1.66).

DiClemente et al.[349] examined some smoking history correlates of stages in Tukey comparisons, and found that men and women in Preparation smoked significantly fewer cigarettes per day, both currently and at any point in the past, than Precontemplators or Contemplators (who did not differ from each other).

Chapman et al.[350] studied health belief concepts by stages of change, and found that Precontemplators held more

self-exempting beliefs than people in Contemplation or Action (e.g. "other people may be susceptible to ill health effects of smoking, but I am not"). Despite agreement that smokers were more likely to get various diseases, smokers in the study believed they were not personally susceptible. Owen et al.[351] found similar results: significantly more Precontemplators than Contemplators perceived low health risk from smoking (OR=2.74).

One published paper was found which examined Horn's typology of smoking motives by stages of change. In a study of 1466 men and women (63% female), DiClemente et al.[352] found that Contemplators had significantly higher mean scores than subjects in Preparation for the Habit, Addiction, and Relaxation (similar to Pleasure in this study) motives. Subjects in Precontemplation also had a significantly higher mean than those in Preparation for Relaxation and Addiction motives. Precontemplators were significantly higher than Contemplators for Relaxation, but did not differ significantly from them on Addiction scores. There were no significant differences by stage on the other motives subscales in DiClemente et al.'s report. The authors did not hypothesize how motives may vary by stage, nor did they discuss the statistical results they reported.

Only one study examined pregnant women at the stages of change. In their study of low-income women attending public health clinics, Crittenden et al.[353] found that 40% of

pregnant smokers were in Precontemplation, 31% in Contemplation and 29% in Preparation. These authors found that stage of change was unrelated to demographic characteristics, but was positively related to attitudes about the health and social benefits of quitting (Precontemplators were least likely to endorse these advantages of quitting). Regarding some smoking motives, stage of change was negatively associated with level of habituation or addiction (Precontemplators were most likely to smoke from habit or addiction).

Theoretical Framework for the Present Study

To sum up the findings from the literature review, regarding background characteristics, smoking during pregnancy is more frequent among women who are unmarried, have a high school education or less, who smoked more than 10 cigarettes daily before pregnancy, who are exposed to a partner, housemate and/or coworker who smokes, and who have smoked in previous pregnancies. Regarding psychosocial characteristics, despite knowledge of the scientific data linking smoking to poor pregnancy outcomes such as low birth weight (General Risk Knowledge), many women do not believe these data or espouse self-exempting beliefs (Personal Risk Perceptions). Their justification for smoking is affected by their attributions about their smoking (Motives), their rationale (Reasons) for sustaining their behaviour, and their assessments of the Pros

and Cons of continuing to smoke. Each of these factors is hypothesized to contribute to the decision-making process through stages of change, and will hereafter be called "decision-making variables". Their relationship to each stage of change is hypothesized to vary as follows:

Hypotheses

The three stages of smokers will have unique patterns of decision-making variables, such that:

a) **Precontemplation** will be characterized by general risk knowledge levels that may be either high or low, but will have low levels of personal risk perceptions; motives which support an addictive/habitual need for smoking; reasons which are lower on the hierarchy (Level 3), i.e. are more rigid and based in deeply-rooted affective and personal liberty assertions; and a higher level of Pros of smoking than Cons.

b) **Contemplation**, when compared with Precontemplation, will be distinguished by higher levels of general risk knowledge and personal risk perceptions; motives which include some addictive/habitual stimulus, as well as some affect regulation needs; reasons which are intermediate on the hierarchy (Level II, self-relevant reasons); and more equal levels of Pros and Cons of smoking.

b) **Preparation**, when compared with Precontemplation and Contemplation, will be distinguished by higher levels of general risk knowledge and personal risk perceptions; motives which are indicative of less of an addictive/habitual need for smoking and more for affect regulation; reasons which are at the top of the hierarchy (Level I, evidence-based); and higher scores on Cons of smoking than Pros.

Justification and Relevance

This study is the first known application of the stages of change model to pregnant smokers. As pregnancy is a unique period in a woman's life, it is important to explore why some women continue to smoke, despite the dangers to their babies and themselves. The stages of change model served as an organizing framework, while the inclusion of general risk knowledge, perceived personal risk, motives, reasons, and decisional balance for smoking contributed additional explanations for smoking behaviour, which may provide direction for cessation interventions.

It is important to note that while other studies have included many of these variables, generally speaking they have not done so in an integrative, theory-based model. A theoretical foundation allows researchers to infer expected relationships between variables, to predict behaviour, and thus to generalize to other populations (given sound research methods and adequate sample size).

CHAPTER 3 - STUDY METHODOLOGY

Study Design

This study is based on a secondary analysis of cross-sectional survey data collected for the Smoking and Pregnancy Study (SPS), (Dr. Stephen Hotz, principal investigator). The study was funded by the Ontario Ministry of Health and co-sponsored by the Community Health Research Unit, which is a joint venture of the University of Ottawa Department of Epidemiology and the Ottawa-Carleton Regional Health Unit.

Sample Selection

The SPS was conducted in two phases. In phase one, an initial ("intake") sample of 2641 pregnant women was surveyed from all prenatal clinics in Ottawa, during the period of January to December 1992. Prenatal class teachers asked every woman to complete the Intake questionnaire, and obtained verbal consent. There were no recorded refusals. Of this screened sample, 371 were current smokers (14%). These current smokers were invited to participate in the next phase of the study by completing the request on the back of the Intake questionnaire. Those who responded were contacted by a research assistant, who obtained written informed consent and who sent them the Smoking Attitudes Questionnaire (SAQ). A second copy was sent approximately two weeks later in order for the researchers to assess test-retest reliability.

Participants were paid $20 after returning their questionnaires. The participation rate was 151 of 371 current smokers (41%) and the present study is based on these women's responses.

Instruments

Questionnaire design

The Intake and SAQ questionnaires were compiled by the principal investigator, Dr. Stephen Hotz. Descriptions are confined to variables analysed in this study.

The Intake Questionnaire inquired about standard demographic characteristics, pregnancy-related variables, and smoking history questions, including maternal age, marital status, years of education; weeks of gestation, and parity; number of cigarettes smoked per day prior to pregnancy and currently, participation in cessation programs, number of and length of previous quit attempts, exposure to other tobacco smoke from partners, other housemates, and/or coworkers, whether subjects smoked in previous pregnancies, if they have quit or cut down their consumption during pregnancy, and whether they intend to resume former smoking habits after pregnancy.

The Smoking Attitudes Questionnaire (SAQ) included the following decision-making variables: general risk knowledge, personal risk perceptions, motives, reasons and decisional

balance (pros and cons of smoking), and stages of change. These are described in detail below.

Derivation and psychometric properties of instruments

General Risk Knowledge, Personal Risk Perceptions - Items for these scales were developed by the principal investigator, Dr. Stephen Hotz, based on risk knowledge and perceived susceptibility concepts from the Health Belief Model. The Knowledge instrument consists of nine true/false items assessing knowledge of risks to infants and mothers *in general* from maternal smoking during pregnancy. Correct items were summed for the score, with higher scores reflecting more correct responses. Cronbach's alpha was 0.65, and the test-retest correlation was 0.66 for the Knowledge scale.

Personal Risk Perception assesses the pregnant smoker's *own* estimations of risk to herself and her baby from her smoking. It is comprised of the mean of scores on six items scaled by percentage of perceived risk (from 0% to 100%, in increments of 10%), from "no risk" to "extremely high risk" for each item. Cronbach's α was 0.87, and test-retest reliability was 0.71.

Motives - These items and components were taken from the factor structure of Ikard, Green, and Horn's work on smoking motives."[4] A summary score for each subject was based on responses to 23 items, scored on a four-point rating scale of importance. Subscales from the factor structure of Ikard et

al.'s work were also examined here. Motives concerning habit had four items, addiction motives had five items, alleviation of negative affect comprised six items, pleasure motives had two items, stimulation motives had three items, and sensorimotor/handling motives had three items. Cronbach's alpha coefficient and test-retest correlation were as follows for the subscales in this sample: habit $\alpha = 0.68$, $r = 0.50$; addiction $\alpha = 0.74$, $r = 0.73$; negative affect $\alpha = 0.85$, $r = 0.79$; pleasure $\alpha = 0.82$, $r = 0.62$; stimulation $\alpha = 0.69$, $r = 0.64$; and sensorimotor/handling $\alpha = 0.53$, $r = 0.42$.

Reasons - These items were developed by Dr. Stephen Hotz, based on Meichenbaum and Fong's Hierarchy of Reasons.[355] Summary scores for subjects were based on endorsement of 33 items, scored on a five-point rating scale of importance. Items comprising subscales of the three levels of reasons hypothesized by Meichenbaum and Fong were also formulated. The Level 1 (evidence-based reasons) subscale had 13 items, Level 2 (self-relevant reasons) subscale had nine items, and Level 3 (affective and motivational reasons) subscale had 11 items. Cronbach's α for the Reasons instrument (all items) in this sample was 0.89; test-retest reliability was 0.74. By subscale, Cronbach's alpha and test-retest correlations for Level 1 Reasons were $\alpha = 0.78$, $r = 0.72$; Level 2 $\alpha = 0.74$, $r = 0.69$; and Level 3 $\alpha = 0.74$, $r = 0.62$.

Decisional Balance - In their developmental work for this scale[356], Velicer et al. assessed the factor structure of

Decisional Balance items using principal components analysis, which yielded two orthogonal components labelled "Pros" and "Cons". In confirmatory factor analysis, the two components accounted for 46% of the variance on the scale rating importance of the pros and cons of smoking. Internal consistency was high (Pros α =0.87, Cons α = 0.90 for smoking) as were the test-retest correlations (r = 0.73 for Pros, r = 0.82 for Cons) (c.f. [357]).

The scale for the present study reproduced Velicer et al.'s validated instrument. The Decisional Balance scale consisted of 20 items (5-point rating scale of importance), with a mean score for each of the 10 items indicating Pros and Cons of smoking. Higher scores on the Pros or Cons scale indicated greater endorsement of those items. Cronbach's alpha coefficients were 0.78 for the Pros scale, and 0.85 for the Cons scale. Test-retest correlations were 0.73 for the Pros scale and 0.74 for the Cons scale.

Stages of Change - These items and the scoring algorithm were taken from published papers on the Transtheoretical Model.[358] [359] The Stages of Change instrument consists of five items (yes/no responses), which are scored according to an algorithm (pattern of responses). These items and the scoring algorithm which determines stage assignment are reproduced in Appendix 1.

Analytic Approach

The SAS statistical software package[360] was used for all analyses.

Descriptive analyses

Frequencies for all variables, and means for continuous variables were calculated for the purpose of comparison with other published studies using similar samples. Ninety-five percent confidence intervals (95% CI) were calculated for means.

Multivariate analysis of decision-making variables

Multivariate Analysis of Variance (MANOVA) was used to assess whether scores for General Risk Knowledge, Personal Risk Perceptions, Motives, Reasons, and Decisional Balance varied by Stage, where Stage (for smokers) had three levels: Precontemplation, Contemplation, and Preparation. Because designation to stage was determined by naturalistic assignment based on smoking behaviour and intention, rather than as a product of a controlled experiment, there were unequal numbers of subjects per Stage (see Power, below). Thus, the GLM (General Linear Model) procedure in SAS for unbalanced designs was used. The MANOVA procedure tested whether the mean score of at least one of the dependent variables differed significantly from chance by the Stage group, based on the 5% probability level ($p < .05$). Given that the omnibus test of

MANOVA was significant (by Wilk's lambda), the variables which contributed to the significance of the Wilk's lambda were examined by ANOVA and the Tukey post hoc test. A Bonferroni correction to the test probability level was made, based on the number of follow-up tests conducted.

The rationale for using multivariate statistics has been carefully considered. One function of the multivariate approach is that it protects against inflation of the experimentwise error rate, which might have occurred if separate ANOVAs were run on the dependent variables, given the sample size. Secondly, univariate analyses do not address the relative relationships and linear combinations among the dependent variables possible in the multivariate application, nor is it possible for the intercorrelations among dependent variables to be illuminated and utilized in the univariate method. In epidemiological studies investigating behavioural elements of risk factors, many variables will be significantly correlated. Thus, in order to take account of these intercorrelations while avoiding loss of power to explain group differences, the use of multivariate statistics was necessary. Few studies using the variables of interest to this study in similar populations employed multivariate modelling. The use of this method in the present study provided a more rigourous test of the utility and explanatory power of the study variables. Thus, the multivariate statistic (Wilk's lambda) indicated whether there were any

overall differences by stage on the decision-making variables. Follow-up univariate analyses were conducted to determine on which stages each of the significant variables differed.

Power

As this was a secondary data analysis, the sample size was already established. Therefore, it was necessary to determine if the obtained sample per group (i.e. by stage) was sufficient to conduct the planned multivariate analysis with the number of variables of interest, and to be able to detect true differences. Laüter[361] developed a table, presented by Stevens[362], of adequate sample sizes for multivariate analysis when there are three to six variables. With groups (stages) = 3:

Power = .70 α = .05 effect size = medium

The required sample size is 42-54 per group.

The obtained sample sizes per group (stage of change for multivariate analyses) were as follows, with a total N of 141 for those who completed all stages of change questions.

Stage:	Precontemplation	Contemplation	Preparation
N	45	49	47
(%)	(31.9%)	(34.7%)	(33.3%)

The obtained sample size per group was within the range specified by Laüter. The n:k ratio (sample size to number of variables) is also a rough estimate of power, and was over 20:1, with a total N of 141 and six variables. A medium

effect size was selected as estimates of the standard deviations for the study variables in this population (pregnant smokers) are unknown, and as application of these variables to this type of population has not been conducted before, according to the published literature.

It should be noted that sample size (and therefore N per stage) is different in the Intake-SAQ matched sample, most likely due to automatic casewise deletion during the matching process of subjects with missing data. As these Intake variables were not used in multivariate analyses, the loss of power due to smaller sample size would not affect the ability to detect differences in univariate comparisons used to describe the sample. Furthermore, as the model of decision-making variables by stage was the main focus of this study, threats to the power to detect differences in multivariate analysis were of higher concern. As noted above, sample size was adequate for these purposes.

CHAPTER 4 - RESULTS

Descriptive statistics were calculated for all variables to characterize the sample for comparison with other studies on pregnant smokers.

Sample Characteristics

Sample characteristics for all women initially interviewed in the Intake sample who were current smokers, and for women who participated in the second phase (SAQ) of the study were compared in order to establish the representativeness of the SAQ sample. These data are summarized in Tables 1a and 1b. Thereafter, results refer to women in the second phase, who completed the SAQ.

Participants in the second phase (SAQ) were quite similar to current smokers in the Intake sample in demographic characteristics, pregnancy history, and smoking history and habits. On average, participants in the second phase (SAQ) of the study were in their late twenties, were married or living in a common-law relationship, had a high school education or less, and spoke English. Most women were in their second or third trimester of their first pregnancy.

Most women smoked about a pack of cigarettes a day prior to pregnancy, and half a pack during pregnancy. More than half had reduced consumption during pregnancy, and about a third had tried to quit. About half of respondents who had

TABLE 1a
Sample Characteristics: Intake and SAQ Surveys
Means, Standard Deviations, and 95% Confidence Intervals

	Current smokers, Intake sample		Current smokers, SAQ participants	
	n[a]	x/s.d. (95% CI)	n	x/s.d. (95% CI)
Age	367	27.1 (26.5-27.6) 5.5	125	27.7 (26.7-28.7) 5.6
Educ	366	12.9 (12.71-13.15) 2.2	125	12.98 (12.6-13.4) 2.3
Gest	370	21.3 (20.5-22.1) 7.7	125	21.1 (19.8-22.4) 7.4
Cigs/day before	364	18.9 (18.0-19.7) 8.1	125	20.2 (18.9-21.5) 7.3
Cigs/day now	357	9.3 (8.7-9.9) 5.9	123	10.0 (9.0-10.9) 5.5
# of life-time quit attempts	330	2.5 (2.2-2.8) 2.9	115	2.8 (2.4-3.2) 2.3

TABLE 1b...

[a] The following abbreviations were used: n = number of subjects; x = mean; 95% CI = 95% confidence interval around the mean; s.d. = standard deviation; educ = education in years; gest = gestational age in weeks; cigs/day before = number of cigarettes smoked per day before pregnancy

TABLE 1b
Sample Characteristics: Intake and SAQ Surveys
Frequencies and Percentages

	Current smokers, Intake sample		Current smokers, SAQ participants	
	Freq	%	Freq	%
Marital status				
married/c.law	293	79.4	98	78.4
sing/sep/div	76	20.6	27	21.6
Education level				
≤ high school	227	61.2	75	59.5
univ/college	144	38.8	51	40.5
Mother tongue				
English	284	76.5	107	84.9
French/other	87	23.5	19	15.1
Trimester				
1	46	12.9	18	15.2
2	179	50.1	60	50.9
3	132	37.0	40	33.9
Parity				
1	284	77.0	90	72.0
2	62	16.8	22	17.6
3+	23	6.2	13	10.4
Stage				
Precont	107	31.8	43	34.1[b]
Contemp	118	35.0	37	29.4
Prepar	112	33.2	46	36.5
Quit attempts (preg)				
tried quit	126	34.2	46	36.5
reduced	216	58.7	73	57.9
neither	26	7.1	7	5.6

TABLE 1b, cont...

[b] Stage prevalence differs in this table from that presented in the Power Analysis section, above. Refer to that section for an explanation. Stage prevalence presented in the power analysis was used in all subsequent statistical tests. The following prevalences were obtained: Precontemplation (31.9%), Contemplation (34.7%), and Preparation (33.3%)

TABLE 1b, cont.
Sample Characteristics: Intake and SAQ Surveys
Frequencies and Percentages

	Current smokers, Intake sample		Current smokers, SAQ participants	
	Freq	%	Freq	%
Intended length of smoking reduction				
permanent	110	55.6	32	52.5
just pregnancy	8	4.0	4	6.6
not sure	80	40.4	25	41.0
Partner smokes				
no	113	31.1	40	32.3
yes	250	68.9	84	67.7
Household smokers				
no	29	7.9	10	8.0
yes	338	92.1	115	92.0
Exposed to smoke at work				
no	221	60.5	72	58.5
yes	144	39.5	51	41.5

made a change intended it to be permanent. On average, respondents had tried to quit two to three times during their lives. Most women had a partner or other household member who smoked, and many were exposed to smoke at work. Roughly a third of the women were in each of the three stages.

Variables Related to Smoking Decision-making

The first Study Question inquires about differences among the stages on the decision-making variables. While statistical tests of differences on items were not part of the analysis plan for this study, patterns of item endorsement can yield more detailed information than summary measures. Therefore, frequencies by item for each scale by the three stages are described in the tables, and mean scores and 95% confidence intervals by stage are represented in the figures which follow. (A summary table of these means and confidence intervals may be found in Appendix 2). Apart from general summaries of responses, comments are limited to: a) absolute differences in endorsement of items of 15% or greater between stages, or b) where a distinct and consistent pattern of responses among the stages exists.

Missing responses

The number of missing responses per item by stage was generally low (zero to two). Those items which had more than two missing cases are footnoted.

General Risk Knowledge regarding smoking during pregnancy

The percentage of correct responses on participants' knowledge of the risks of smoking for pregnant women in general are reproduced in Table 2. Most women correctly responded that smoking during pregnancy would increase the risk of miscarriage, low birth weight, hypertension, and breathing problems for the baby, and that stopping smoking would increase the chances of having a healthy pregnancy. About half knew that smoking could increase the risk of bleeding in pregnancy. Few women in any stage responded "false" (i.e. the correct answer) to the item "smoking decreases the risk of a baby being born early". Most women were incorrect in responding "true" to "smoking has no proven effect on the unborn baby", and "continuing to smoke will not result in any health problems".

Differences between stages were small, for the most part. While women in the Preparation stage got the most correct answers overall, fewer responded correctly to the items on increased risk of prematurity, "no proven effect", and "no health problems" with continued smoking than women in the other two stages. On two items, there were differences between stages which exceeded 15% There was a stage gradient on the hypertension item, where women in Precontemplation gave the fewest correct responses and women in Preparation the most. On the question regarding risk of bleeding, there were

TABLE 2
General Risk Knowledge, by Stage

Knowledge item (total # of ♀)	% correct Total (141)	Precont (45)	Cont (49)	Prep (47)
↑ chance of healthy pregnancy if quit	92.9	93.3	91.8	93.6
↑ risk of LBW	92.2	97.8	85.7	93.6
↑ risk of breathing problems for baby	79.4	81.4	75.5	87.0
↑ risk miscarriage	78.7	79.5	73.5	87.0
↑ risk hypertension	73.8	63.6	75.5	86.7
↑ risk bleeding	55.3	48.8	40.4	68.3[c]
no proven effect on unborn baby	14.2	15.6	18.4	8.5
↑ risk prematurity	9.9	8.9	16.3	4.3
no health problems with continued smoking	7.1	6.7	10.2	4.3

[c] six missing responses in Preparation

about 20% fewer correct responses among Precontemplators and Contemplators than among women in Preparation.

Figure 1, representing General Risk Knowledge scores, shows that the 95% confidence intervals for Contemplation and Preparation do not overlap, indicating a significant difference in their mean scores. The confidence intervals for Precontemplation overlapped those of both Contemplation and Preparation, suggesting no significant difference in their mean scores.

Personal Risk Perceptions

Frequencies of responses for personal risk of harm from smoking while pregnant are given in Table 3. Overall, about half of the participants perceived their risk of harm to themselves and their babies as being 50% or higher. Highest overall perception of risk was around having a low birth weight baby, followed by having a premature baby. The lowest overall assessment of personal risk was for having a stillbirth as a result of smoking during pregnancy.

Personal estimations of risk followed a gradient by stage, with lowest perceived risk on any item for women in Precontemplation, and the highest risk among women in Preparation. Women in Preparation estimated their risk of having a low birth weight baby and of developing hypertension considerably higher than women in the other two stages.

Figure 1 - Means and 95% confidence intervals of General Risk Knowledge scores by Stage of Change

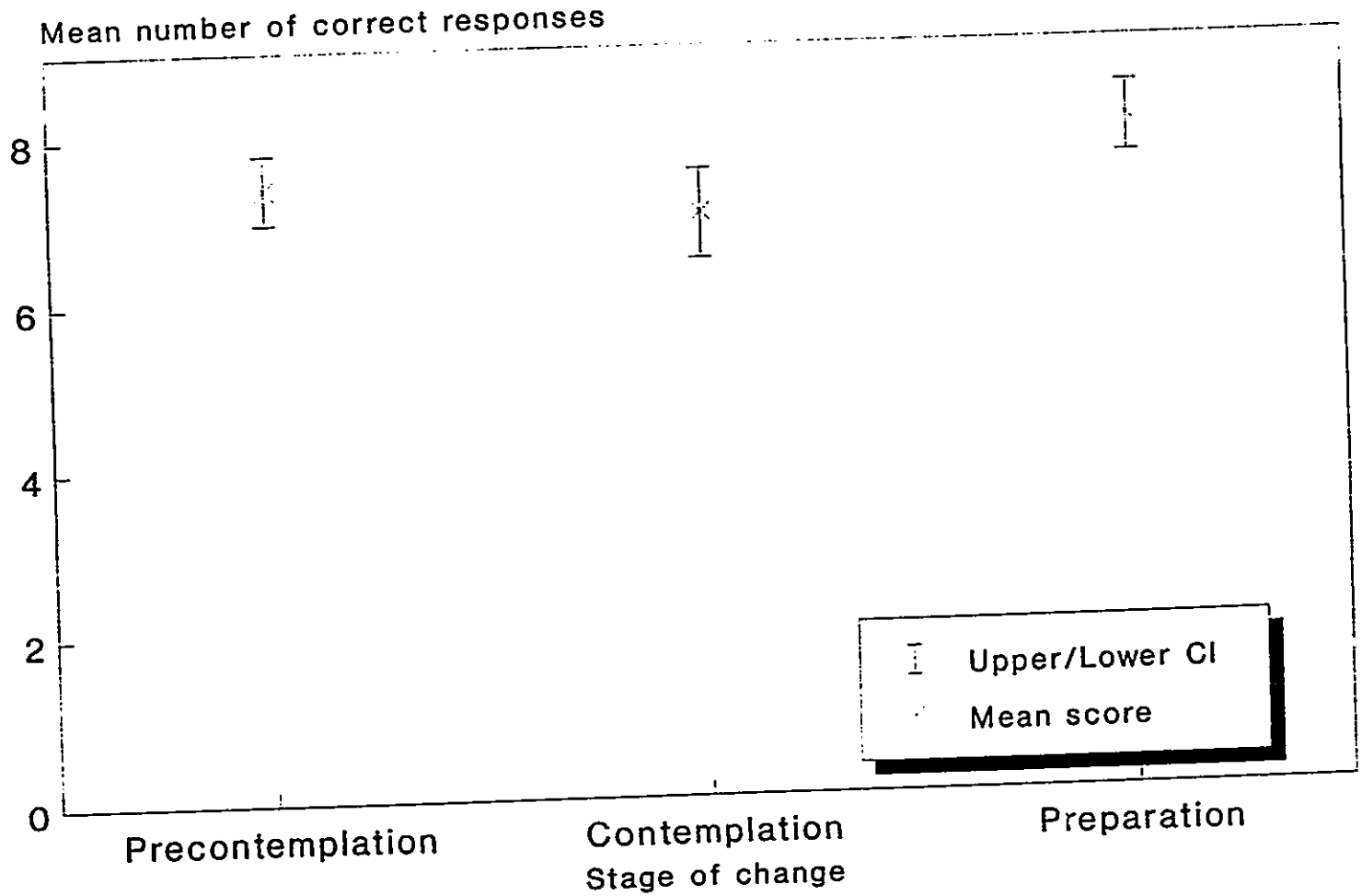


TABLE 3
Personal Risk Perceptions, by Stage

Personal risk item (total # of ♀)	% who rated personal risk at 50% or above			
	Total (141)	Prec (45)	Cont (49)	Prep (47)
Risk of:				
low birth weight	78.7	68.9	75.5	91.5
prematurity	66.7	62.2	63.3	74.5
hypertension	48.2	26.7	49.0	68.1
bleeding	40.5	34.9	37.5	48.9
miscarriage	38.6	31.8	40.8	42.6
stillbirth	28.1	20.4	30.6	32.6

The gradient by stage is clearly evident in Figure 2, representing the mean scores of personal risk assessments. Confidence intervals (95% CI) around the mean score for Precontemplation did not overlap those for Preparation, indicating a significant difference in their mean scores. Confidence intervals for Contemplation overlapped those of the other two stages, suggesting that their means did not differ significantly.

Motives for smoking during pregnancy

The proportions of women rating motives as being "moderately" or "very" important to their continued smoking are given in Table 4. On the whole, participants expressed the strongest smoking motives to regulate affect: for the alleviation of negative feelings and the promotion of pleasant feelings and relaxation. Two-thirds to three-quarters of the women endorsed these affect motives.

Habit and addiction were less important motives, endorsed strongly by about one-third of respondents. Participants were least likely to endorse items related to "unconscious" smoking - to finding a cigarette in one's mouth without remembering putting it there, or to lighting a cigarette when one was already burning in the ashtray. Three habit/addiction items were rated moderately or very important for about half the respondents. These related to habit in general ("I smoke

Figure 2 - Means and 95% confidence intervals of Personal Risk Perceptions scores by Stage of Change

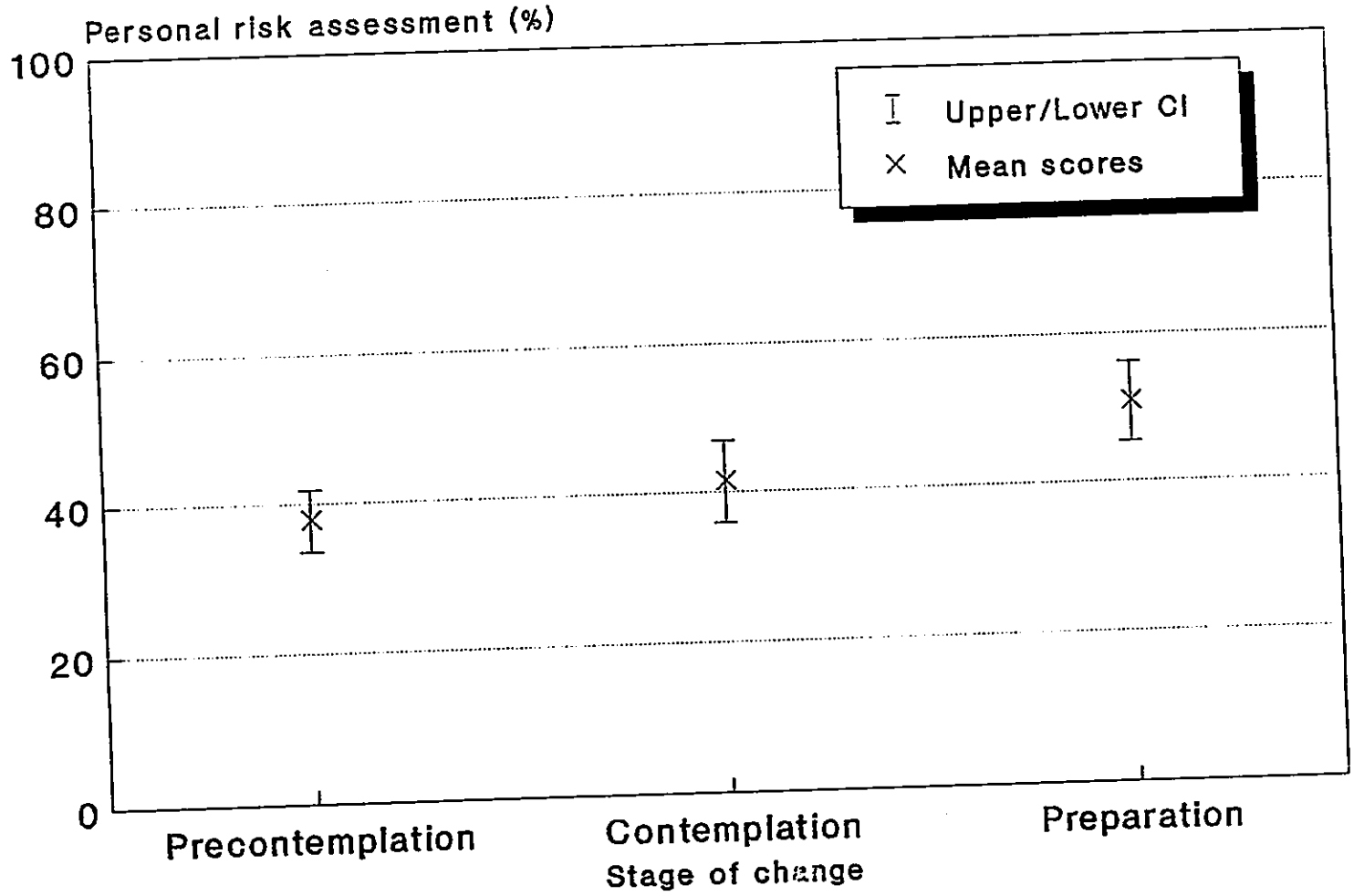


TABLE 4
Smoking Motives, by Subtype and Stage

Motive subtype/item (total # of ♀)	Total (141)	Prec (45)	Cont (49)	Prep (47)
	% rating item "moderately" or "very" important			
Habit				
smoke from habit	45.0	40.9	36.7	57.4
smoke automatically	25.0	25.0	26.5	23.4
found cig in mouth	11.5	11.4	10.4	12.8
light one while one's in ashtray	8.6	11.4	6.1	8.6
Addiction				
hunger for cig	58.6	56.8	63.3	54.3
unbearable to go without	55.0	61.4	59.2	44.7
craving only for cig	39.6	34.1	39.6	44.7
aware of not smoking	36.0	36.4	35.4	36.2
not contented for long without cig	20.7	22.7	18.4	21.3
Negative affect				
I smoke to/when:				
uncomfortable or upset	77.3	75.0	75.5	83.0
angry	74.5	68.2	75.5	80.9
feel "blue" or worried	69.5	68.2	67.3	74.5
help solve problem	60.7	61.4	59.2	61.7

Table 4, cont...

TABLE 4, cont.
Smoking Motives, by Subtype and Stage

Motive subtype/item	% rating item "moderately" or "very" important Total	Prec	Cont	Prep
Negative affect, cont.				
few things are better when I'm upset than a cig	57.4	54.5	55.1	63.8
ashamed or embarrassed	39.7	25.0	44.9	48.9
Pleasure				
Cigarettes are: pleasurable	62.4	75.0	59.2	55.3
pleasant & relaxing	5..5	68.2	42.9	48.9
Stimulation				
I smoke to: to give me a lift	21.3	20.5	18.4	25.5
perk myself up	17.1	14.6	14.6	23.4
to keep from slowing down	9.3	6.8	6.2	8.5
Handling				
I like: handling the cig	25.5	20.5	26.5	29.8
lighting up	5.7	4.5	2.0	10.6
watching the smoke	2.9	4.7	0	4.3

cigarettes just from habit, without even really wanting the one I'm smoking"), and to two aspects of addiction.

Stimulation and handling were the least important motives for these respondents; only 14% stated that they were moderately or very important. While smoking "to perk myself up" or to "give me a lift" were important to 15-20% of the women, smoking "to keep myself from slowing down" was much less commonly endorsed. Regarding the sensorimotor aspects of smoking, one-quarter of respondents agreed that "handling a cigarette is part of the enjoyment of smoking it", but very few found it important to watch the smoke as they exhaled it, or took pleasure from the process of lighting up a cigarette.

There were no clear and consistent trends by stage. However, on the whole, Precontemplators more strongly endorsed smoking from pleasure than women in the other stages, and were less likely to say they smoked when feeling ashamed or embarrassed. Women in Preparation were much more likely to say smoking from habit was moderately or very important to them than Precontemplators or Contemplators. On the other hand, fewer women in Preparation strongly endorsed the importance of the addiction item: "when I have run out of cigarettes I find it almost unbearable until I can get them". Women in Contemplation were intermediate between the other two stages in their assessments of the importance of smoking motives, or gave lower ratings on most items.

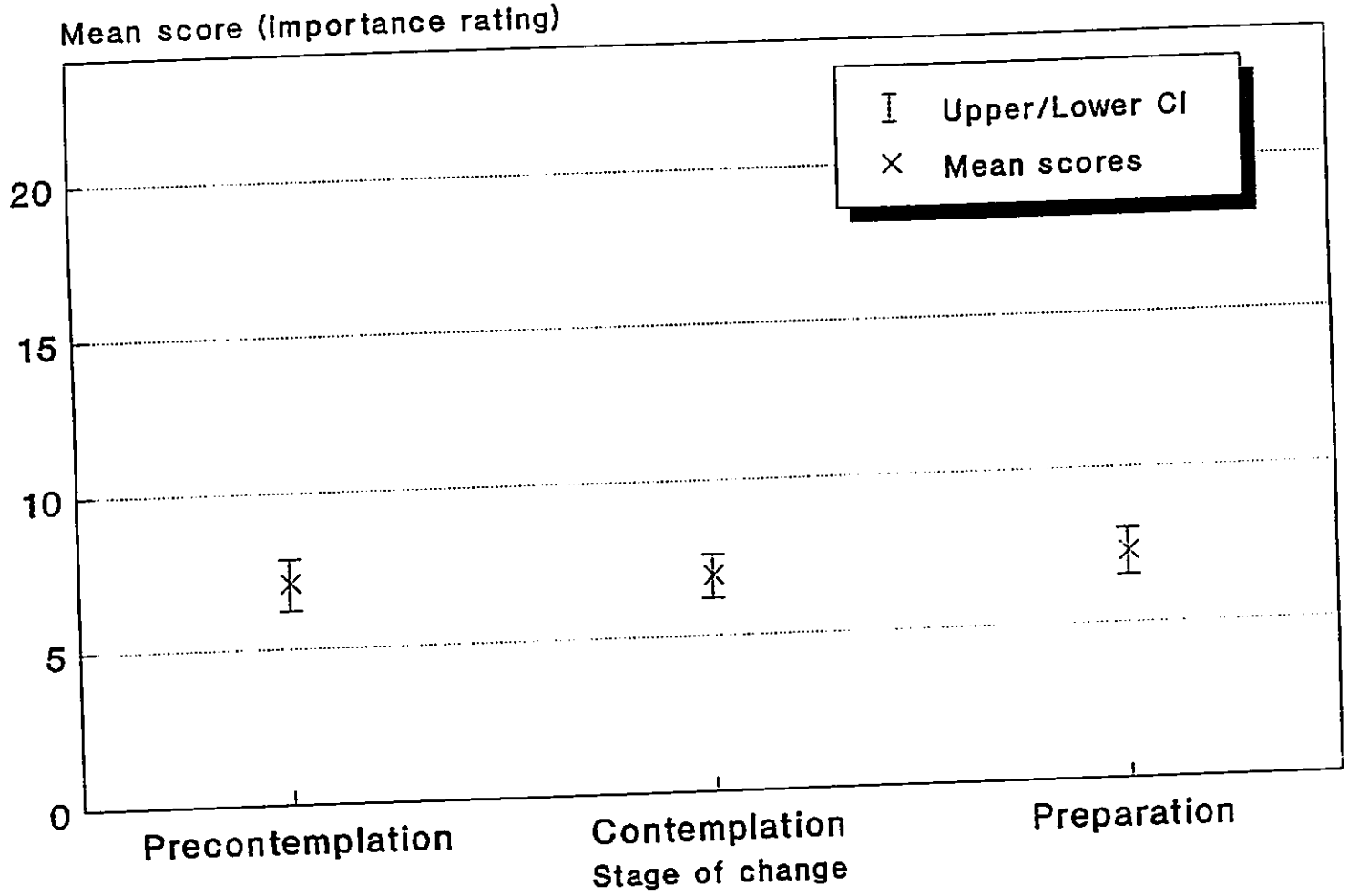
Figures 3 through 8 show that 95% confidence intervals overlap for all three stages in each of the Motives, indicating no significant differences in mean scores among the stages.

Reasons for smoking during pregnancy

The percentages of participants rating reasons for smoking items as being moderately or very important to them are presented in Table 5. On the whole, women were most likely to endorse Level 1 Reasons over the others, but there was no clear pattern of women in one stage endorsing a particular level of reasons. Certain items, however, were selected as being important by 40% or more of the participants in each stage. At Level 1, most women felt strongly that the stress of quitting was worse for the baby than continuing to smoke, that smoking wasn't as harmful as other drugs during pregnancy, that other smokers they knew had had "healthy babies", and that quitting would be difficult as their partners smoked. Precontemplators endorsed these items most often, followed by Contemplators.

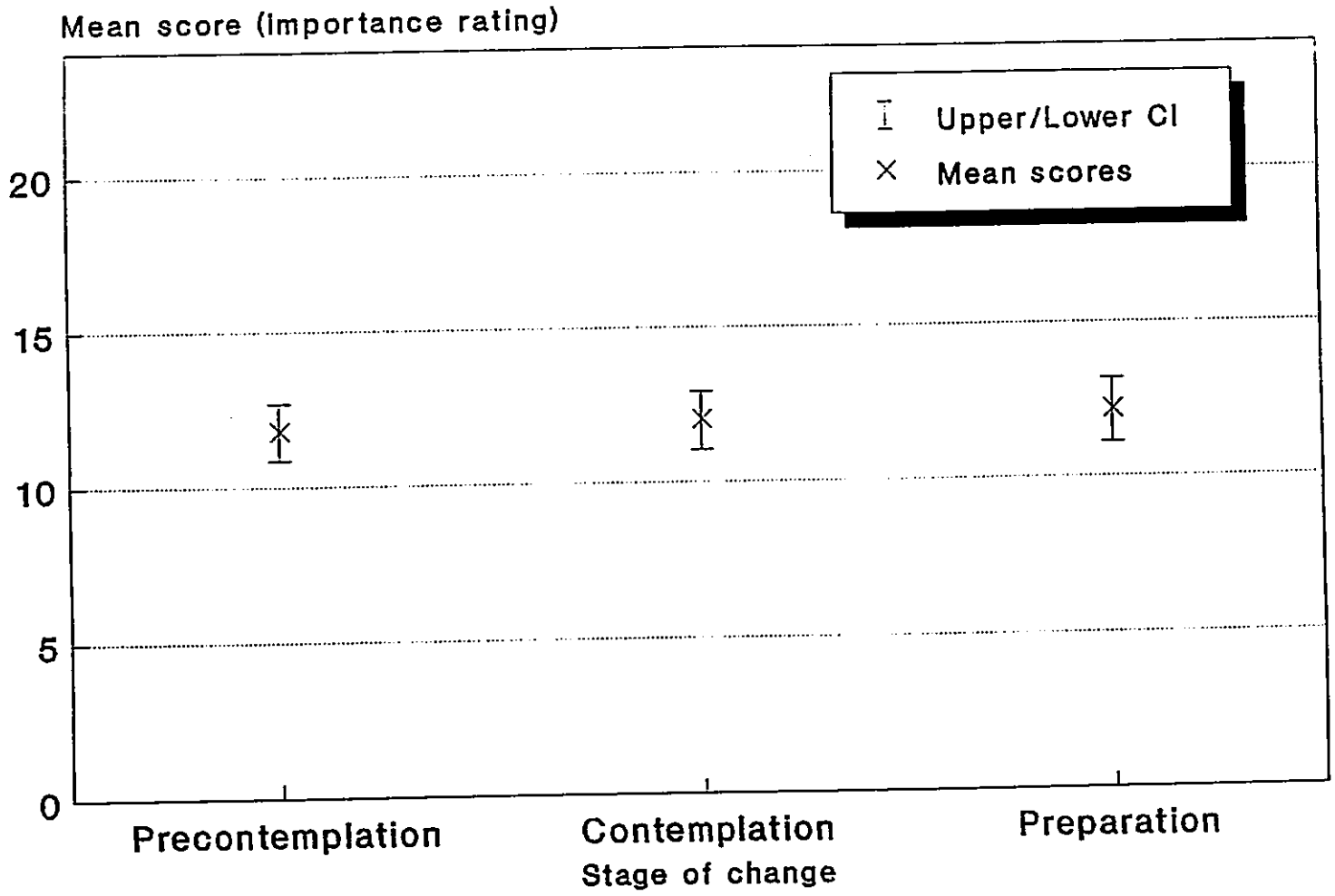
At Level 2, nearly two-thirds of Precontemplators felt strongly that their quitting smoking would be bad for the baby because it would make them tense and upset. Over a third of women in the other two stages also strongly endorsed this item. Over 40% of women did not believe they could quit because they hadn't succeeded before. More than half of the

Figure 3 - Means and 95% confidence intervals of Habit Motive scores by Stage of Change



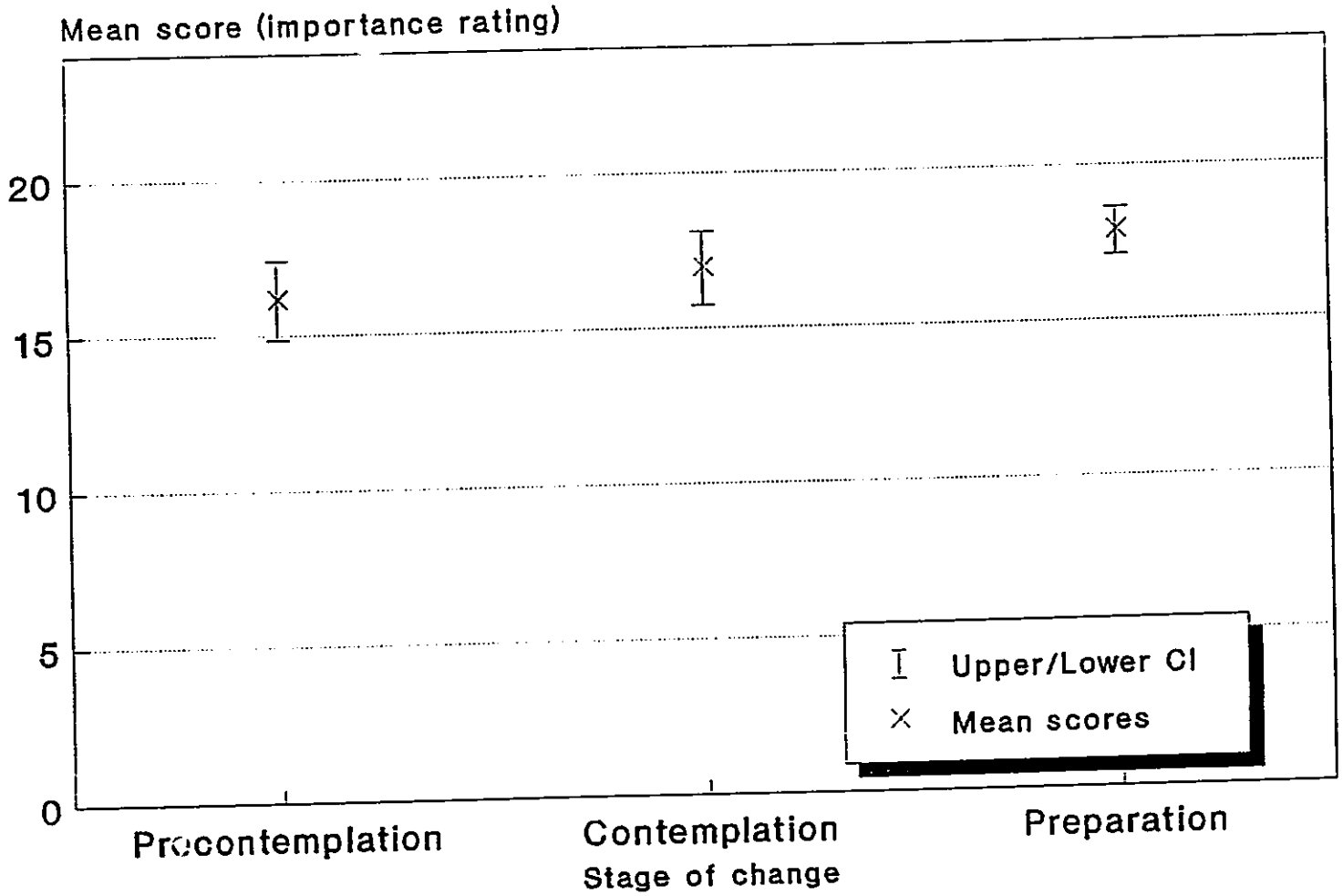
Range of possible scores: 4-16

Figure 4 - Means and 95% confidence intervals of Addiction Motive scores by Stage of Change



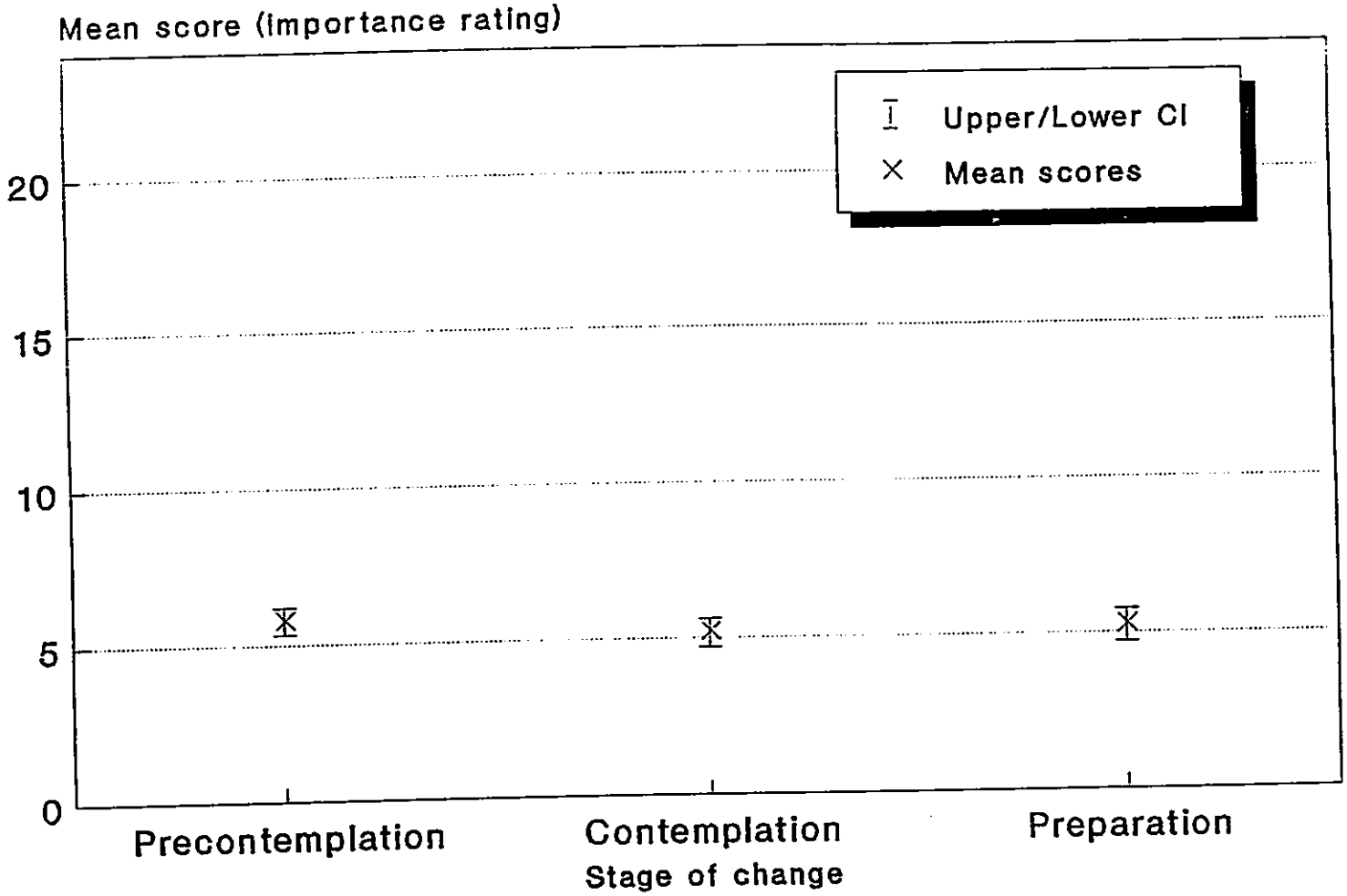
Range of possible scores: 5-20

Figure 5 - Means and 95% confidence intervals of Negative Affect Motive scores by Stage of Change



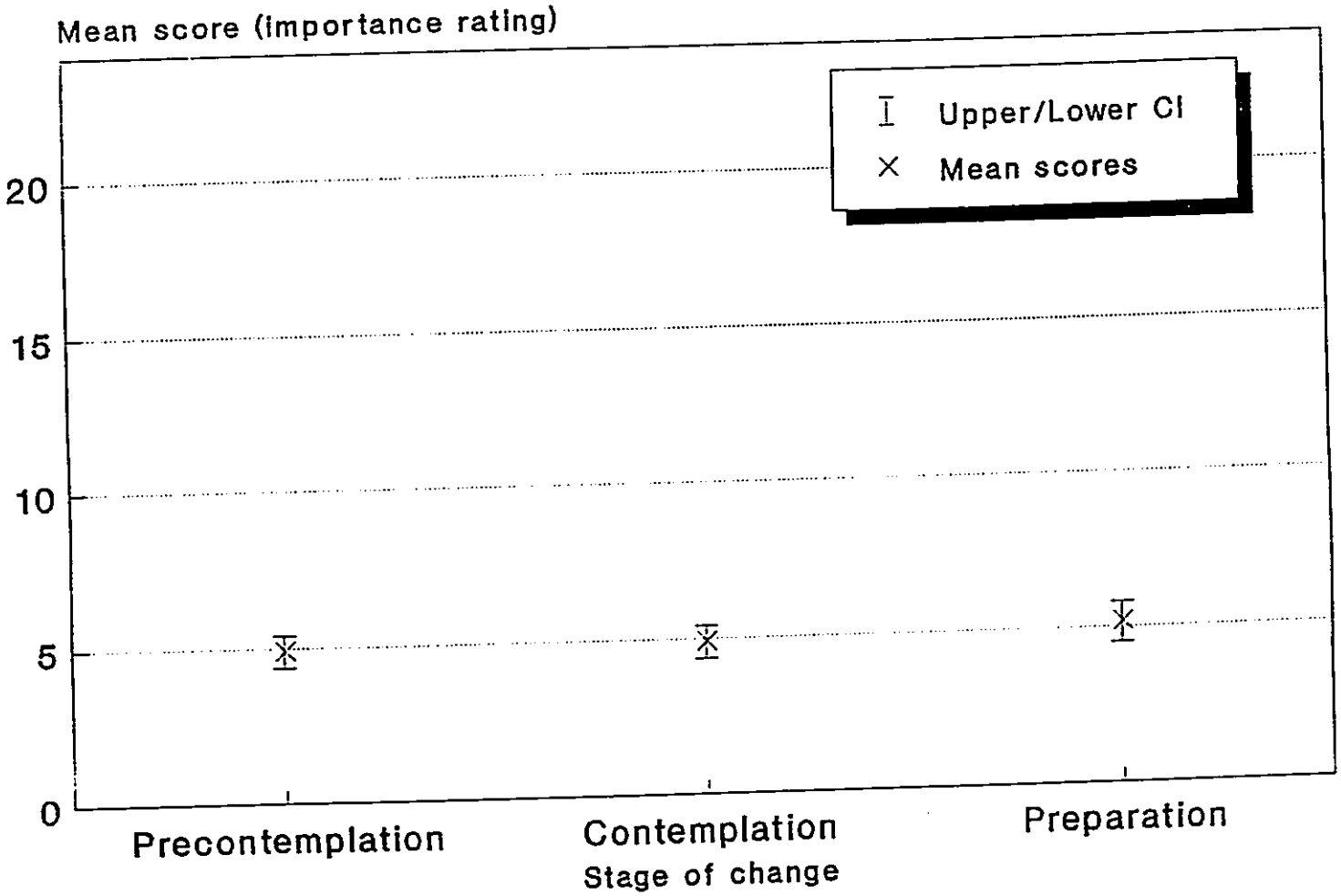
Range of possible scores: 6-24

Figure 6 - Means and 95% confidence intervals of Pleasure Motive scores by Stage of Change



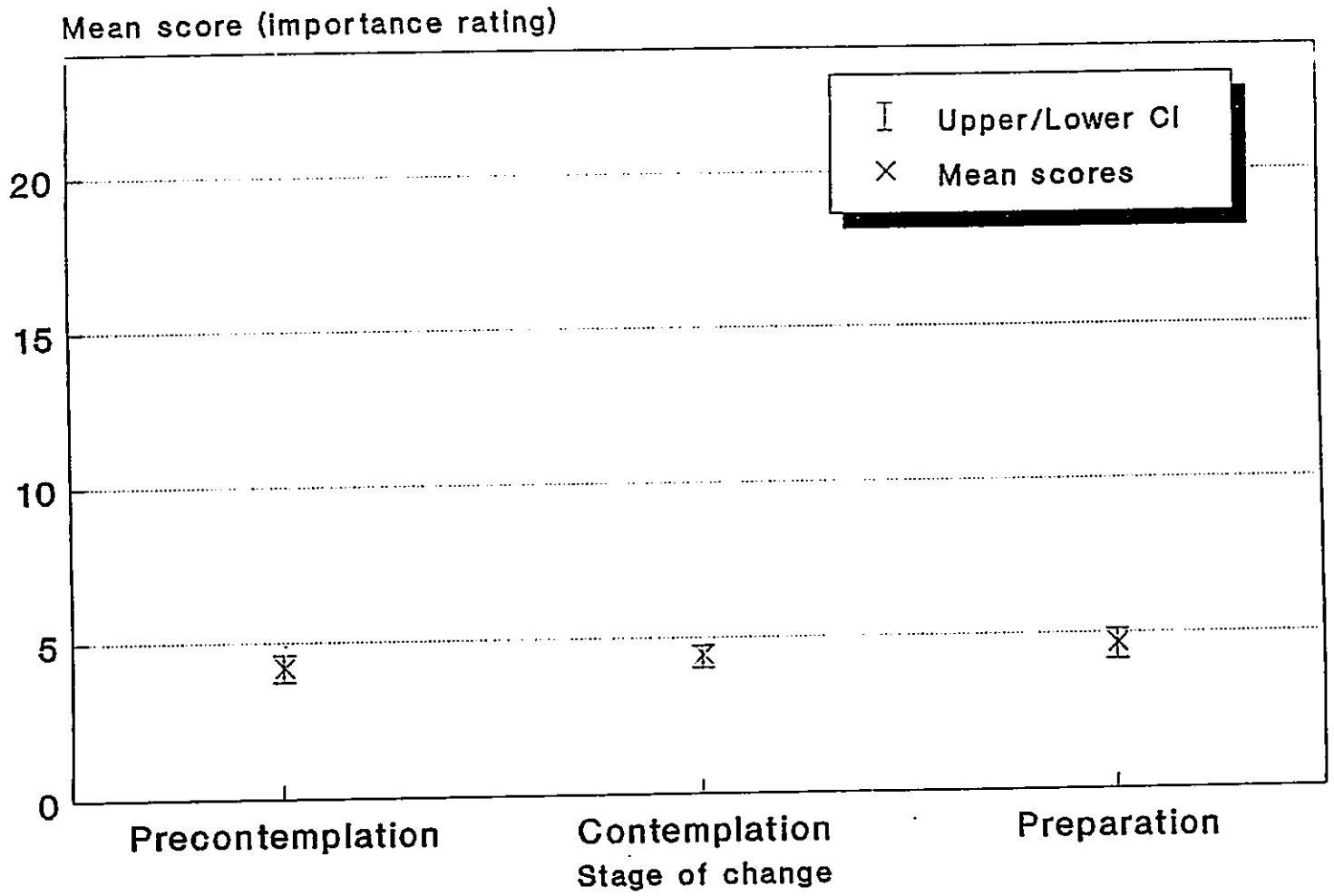
Range of possible scores: 2-8

Figure 7 - Means and 95% confidence intervals of Stimulation Motive scores by Stage of Change



Range of possible scores: 3-12

Figure 8 - Means and 95% confidence intervals of Handling Motive scores by Stage of Change



Range of possible scores: 3-12

TABLE 5
Smoking Reasons by Level and Stage

Reason level/item (total # of ?)	% rating item "moderately" or "very" important Total (141)	Prec (45)	Cont (49)	Prep (47)
Level 1				
I know other smokers with healthy babies	50.0[d]	52.4	50.0	47.7
I don't take other drugs worse for baby	49.3	58.1	51.0	39.1
Stress of quitting worse than smoking	42.9	51.1	45.8	31.9
Hard to quit as my partner smokes	41.7	43.2	40.8	41.3
I don't smoke enough to harm baby	29.2	27.9	34.5	23.9
No one warned me of serious risks	26.9[e]	28.6	30.4	21.7
Baby won't have serious problems	26.1	25.0	30.6	22.2
No proof of harm	22.6	23.3	28.6	15.6
No baby died from mother smoking	19.5[f]	11.9	21.7	24.4
I know sick babies whose mothers quit	14.9	17.8	12.2	14.9
Smaller baby easier to deliver	10.9	6.7	12.2	13.6

Table 5, cont...

[d] three missing responses in Precontemplation and Preparation

[e] three missing responses in Precontemplation and Contemplation

[f] three missing responses in Precontemplation and Contemplation

TABLE 5, cont.
Smoking Reasons by Level and Stage

Reason level/item	% rating item "moderately" or "very" important			
	Total	Prec	Cont	Prep
Level 1, cont.				
Smoking can't hurt until I can feel baby moving	6.0[g]	4.8	8.7	4.4
Too late to quit now	4.3	2.3	4.1	6.5
Level 2				
I enjoy smoking	54.1[h]	54.8	61.7	45.6
Quitting makes me tense & upset, bad for baby	46.8	63.6	44.9	32.6
I've never been able to quit before	43.5	46.5	44.9	39.1
I'm hooked; can't quit	35.6[i]	50.0	27.6	30.4
Not convinced of harm	31.9	27.9	34.0	26.1
Pregnancy already too stressful	28.8	31.8	32.7	21.7
Easier to not think of risks than to quit	18.5[j]	21.4	17.0	17.3
Keeps appetite /weight down	6.6	2.3	6.4	10.8
Baby not "real" until born; I'll quit then	5.8	4.5	10.2	4.4

Table 5, cont...

[g] three missing responses in Precontemplation and Contemplation

[h] three missing responses in Precontemplation

[i] three missing responses in Precontemplation

[j] three missing responses in Precontemplation

TABLE 5, cont.
Smoking Reasons by Level and Stage

Reason level/item	% rating item "moderately" or "very" important			
	Total	Prec	Cont	Prep
Level 3				
It's my business if I smoke	21.0	34.9	18.4	10.9
I don't have to listen to advice to quit	19.1	23.3	19.1	15.2
I'll make up my own mind whether to quit or not	19.0	20.9	20.8	15.2
Other pregnant women smoke, so I can	16.2	18.6	12.2	18.2
Smoking is my only bad habit; I'm entitled to it	14.0[k]	16.7	17.0	8.6
My addiction stronger since pregnant	13.1	16.3	12.5	10.9
Quitting is pointless now; damage is done	12.3	7.0	32.4	6.5
I don't care what smoking could do	10.3	7.0	17.0	6.5
Doctors & nurses smoke so I don't believe them	7.4[l]	7.1	10.6	4.4
Not enough energy to quit	4.3	2.3	4.1	6.5
I eat well, exercise; I can afford to smoke	3.0[m]	2.4	4.3	2.2

[k] three missing responses in Precontemplation

[l] three missing responses in Precontemplation

[m] three missing responses in Precontemplation

participants said that they wanted to quit for the baby, but that they enjoyed smoking too much. Contemplators were more likely to rate this item highly than women in the other stages. Half of Precontemplators acknowledged that they were "hooked" on smoking, and that not even the pregnancy could make them quit. About a third of women in Contemplation and Preparation endorsed this addiction item as strongly.

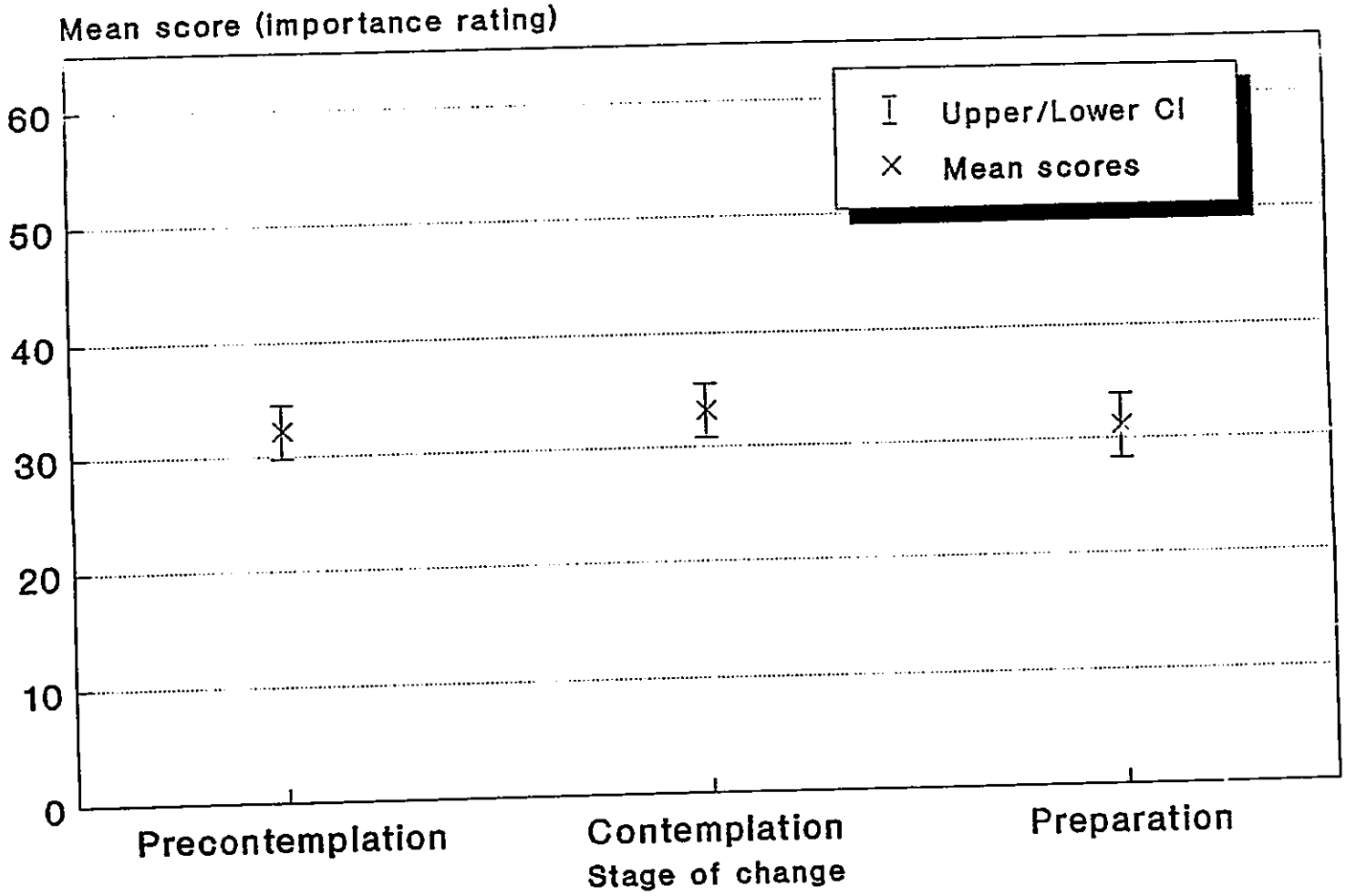
No item at Level 3 was endorsed by 50% or more of women in any stage. Two items obtained about a third of the high ratings: Precontemplators were twice as likely as women in the other stages to rate as highly important that it was their business if they smoked or not, while Contemplators were three times as likely as other women to feel that since they hadn't stopped before pregnancy, it was too late to quit because the damage was already done.

Figures 9, 10 and 11 represent the mean scores and 95% confidence intervals, by stage, for each of the three levels of Reasons. As confidence intervals overlap among the stages at each of the three levels, there do not appear to be any significant differences between mean scores.

Decisional Balance

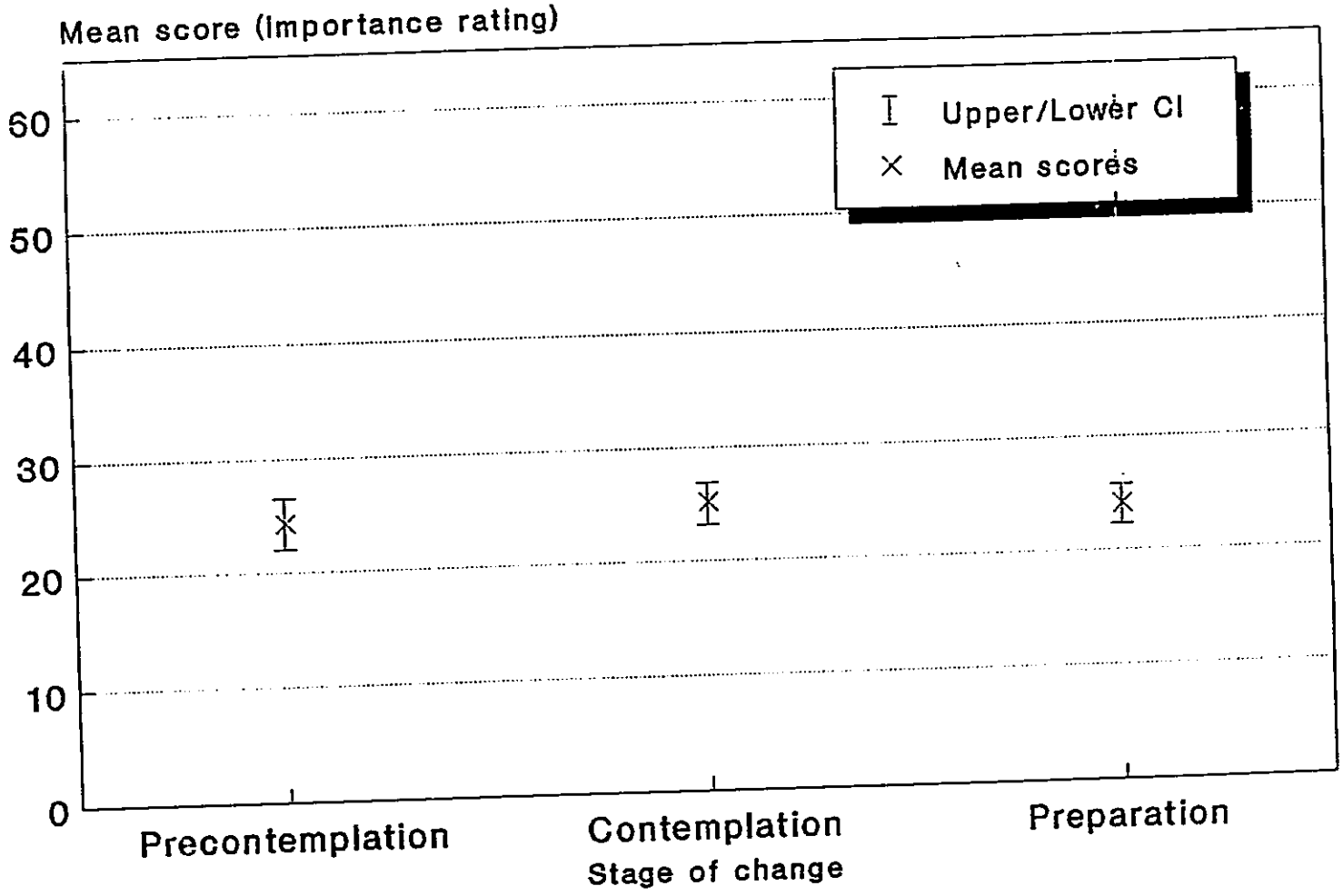
Frequencies for Decisional Balance items are given in Table 6. On the whole, participants endorsed the Cons of smoking items more strongly than the Pros items (24.55% over all rated Pros of smoking as very or extremely important,

Figure 9 - Means and 95% confidence intervals of Level 1 Reasons scores by Stage of Change



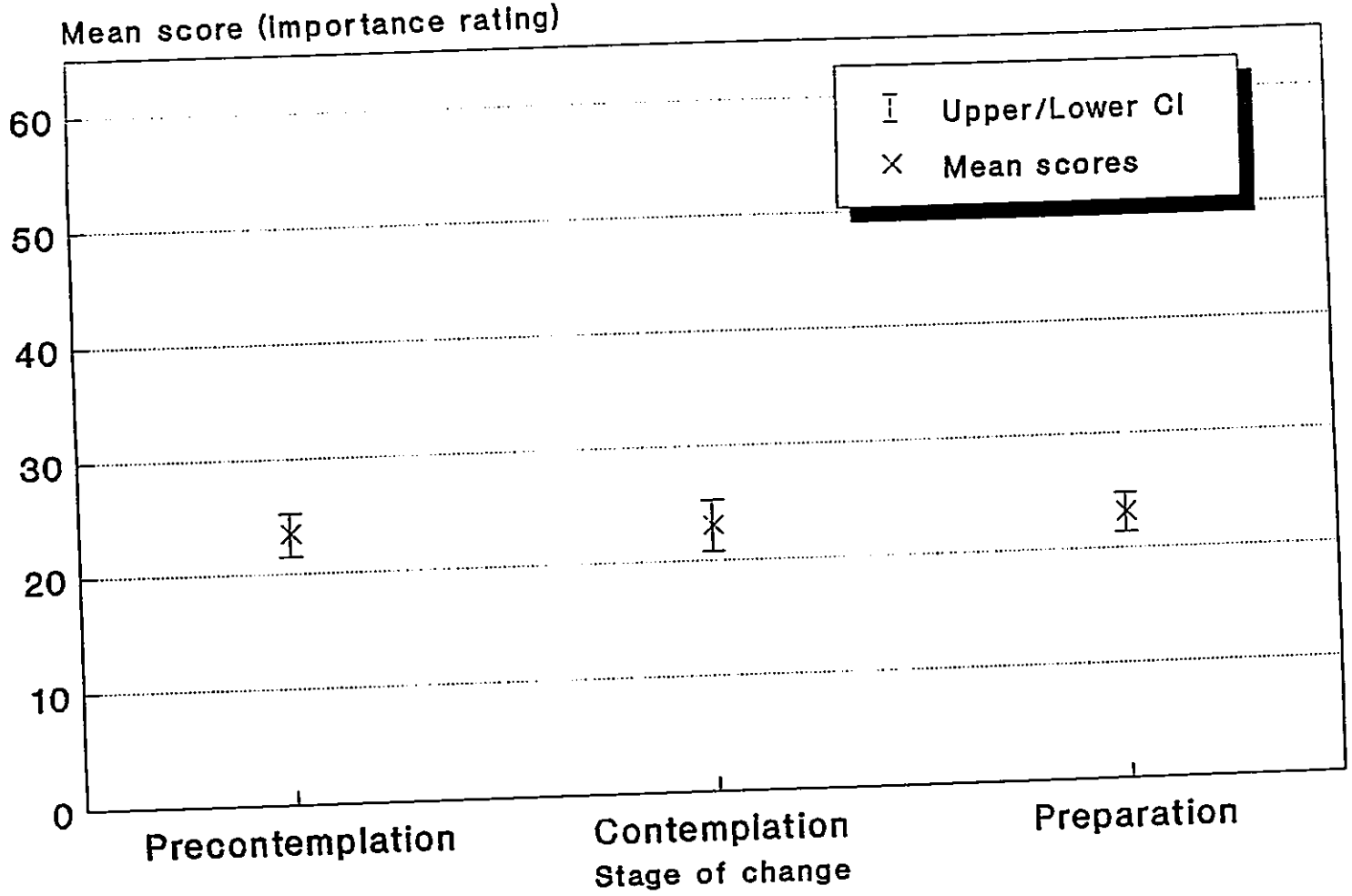
Range of possible scores: 13-65

Figure 10 - Means and 95% confidence intervals of Level 2 Reasons scores by Stage of Change



Range of possible scores: 9-45

Figure 11 - Means and 95% confidence intervals of Level 3 Reasons scores by Stage of Change



Range of possible scores: 11-55

TABLE 6
Decisional Balance (Pros/Cons) of Smoking, by Stage

	% rating item "very" or "extremely" important			
(total # of ♀)	Total (141)	Prec (45)	Cont (49)	Prep (47)
Pros items				
Smoking relieves tension	51.4	44.4	49.0	60.9
I'll be irritable if I try to quit	47.9	51.1	51.0	41.3
Smoking is pleasurable	35.7	59.1	16.3	35.0
I'm more relaxed & pleasant when smoking	31.4	23.3	32.7	28.2
Smoking makes me feel great	30.2	34.1	32.6	23.9
My family & friends like me better when I'm happily smoking than miserably quitting	18.0	17.8	12.5	23.9
I am making my own decisions when I smoke	10.8	18.2	12.2	2.2
Smoking helps me concentrate, work better	10.0	11.1	8.2	10.9
I like myself better when smoking	9.4	2.3	6.1	19.6
I like image of smoker	.7	0	2.0	0

Table 6, cont...

TABLE 6, cont.
Decisional Balance (Pros/Cons) of Smoking, by Stage

	% rating item "very" or "extremely" important			
	Total	Prec	Cont	Prep
Cons items				
Smoking is hazardous to my health	73.6	62.2	79.6	78.3
If I became ill from smoking others would suffer	60.7	56.8	63.3	61.7
I would be more energetic if I didn't smoke	59.0	52.3	69.4	54.3
I'm foolish to ignore warnings about smoking	54.0	47.7	75.5	58.7
My smoking affects others' health	51.4	48.9	59.2	45.7
I'm embarrassed to have to smoke	42.1	20.0	46.9	58.7
My smoking bothers others	39.6	26.7	51.0	40.0
People think I'm foolish for ignoring warnings about smoking	37.1	15.6	42.9	52.2
People close to me disapprove of my smoking	36.7	34.1	44.9	52.2
Some people think I lack the character to quit	25.2	15.9	26.5	32.6

versus 47.94% for Cons). The most highly endorsed Pros items ("I'll be irritable if I try to quit" and "smoking relieves tension") garnered strong support from around 50% of participants. Less than 40% of participants rated each of the remainder of the Pros items as very or extremely important.Only one person (a Contemplator) rated liking the image of a smoker as very important. A related item ("I like myself better when I smoke") also obtained low support.

On the Cons scale, there was strong overall agreement in the high rating of the item "smoking is hazardous to my health". Only one-quarter of the respondents rated the itempeople I know think I lack the character to quit" as being of the highest importance in the Cons of smoking.

There was no clear trend on the Pros items by stage. Precontemplators endorsed four Pros items more strongly than participants in Contemplation or Preparation, but only one of these items was supported by more than 50% of subjects in Precontemplation. Women in Preparation were more inclined than women in the other stages to rate tension relief as a very or extremely important advantage of smoking, and least likely to rate the item "by continuing to smoke I feel I am making my own decisions" as a highly important Pro of smoking.

There was a consistent trend by stage on the Cons scale, with Precontemplators rating the disadvantages of smoking lower than women in Contemplation and Preparation on all but one item. Compared with women in the other stages,

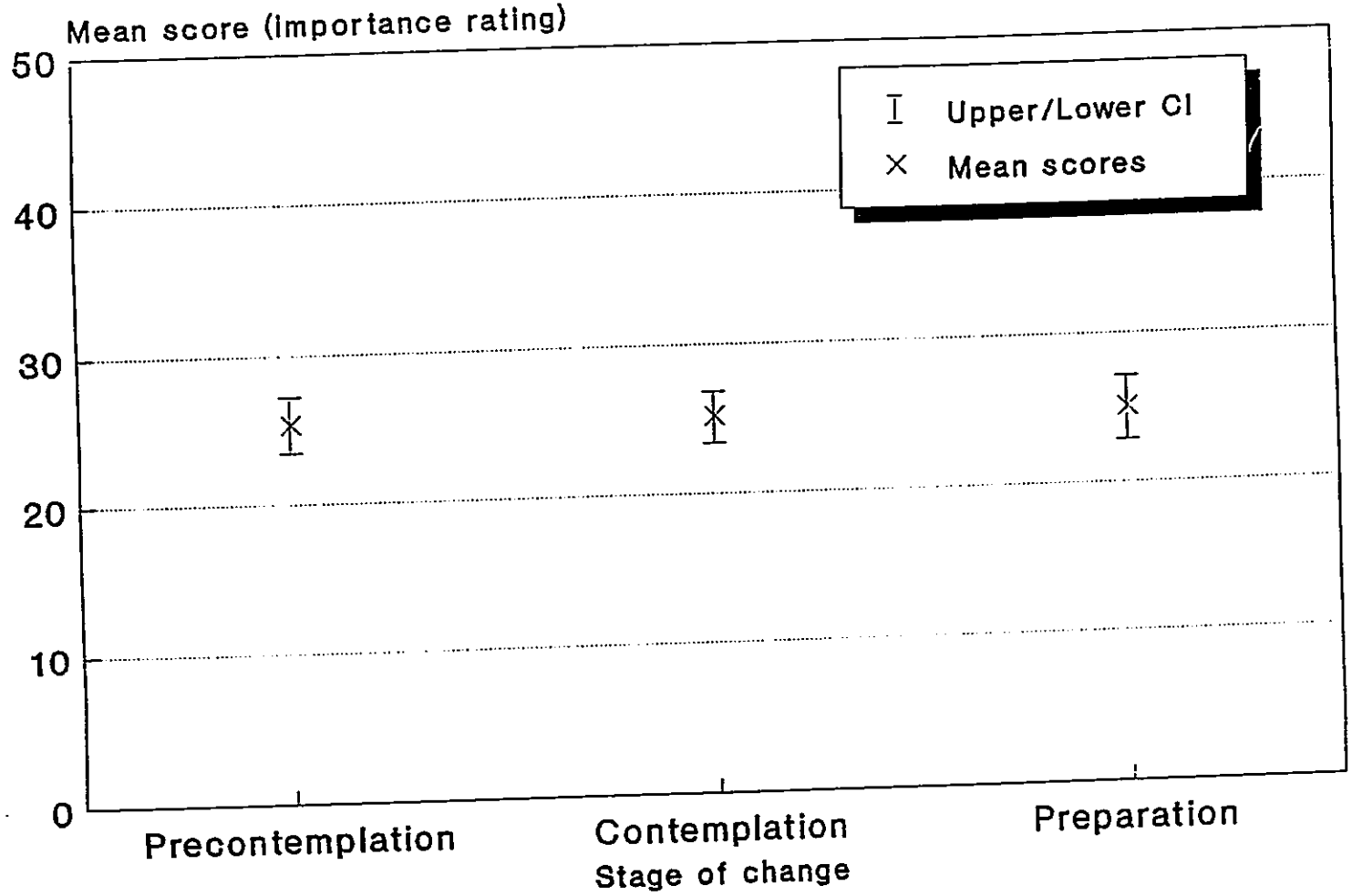
Precontemplators were much less likely to rate as highly important the disadvantages items regarding embarrassment about smoking, bothering others by smoking, and others' assessments of the foolishness of smoking.

Figure 12 shows no significant difference in the mean scores on Pros items, as 95% confidence intervals for the stages overlap. However, Figure 13 indicates a separation of the mean Cons score and confidence intervals for Precontemplation from both Contemplation and Preparation, which do not differ from one another.

The magnitude of the difference between Pros and Cons within each stage was much smaller in Precontemplation than in Contemplation or Preparation: there was only a four-point difference between Precontemplator's mean score on the Pros of smoking (25.3) and their mean score on the Cons of smoking (29.4), whereas there was a 10-point spread between Pros mean scores and Cons mean scores in both Contemplation (25.1 Pros mean score, 35.4 Cons mean score) and Preparation (25.0 vs 34.6).

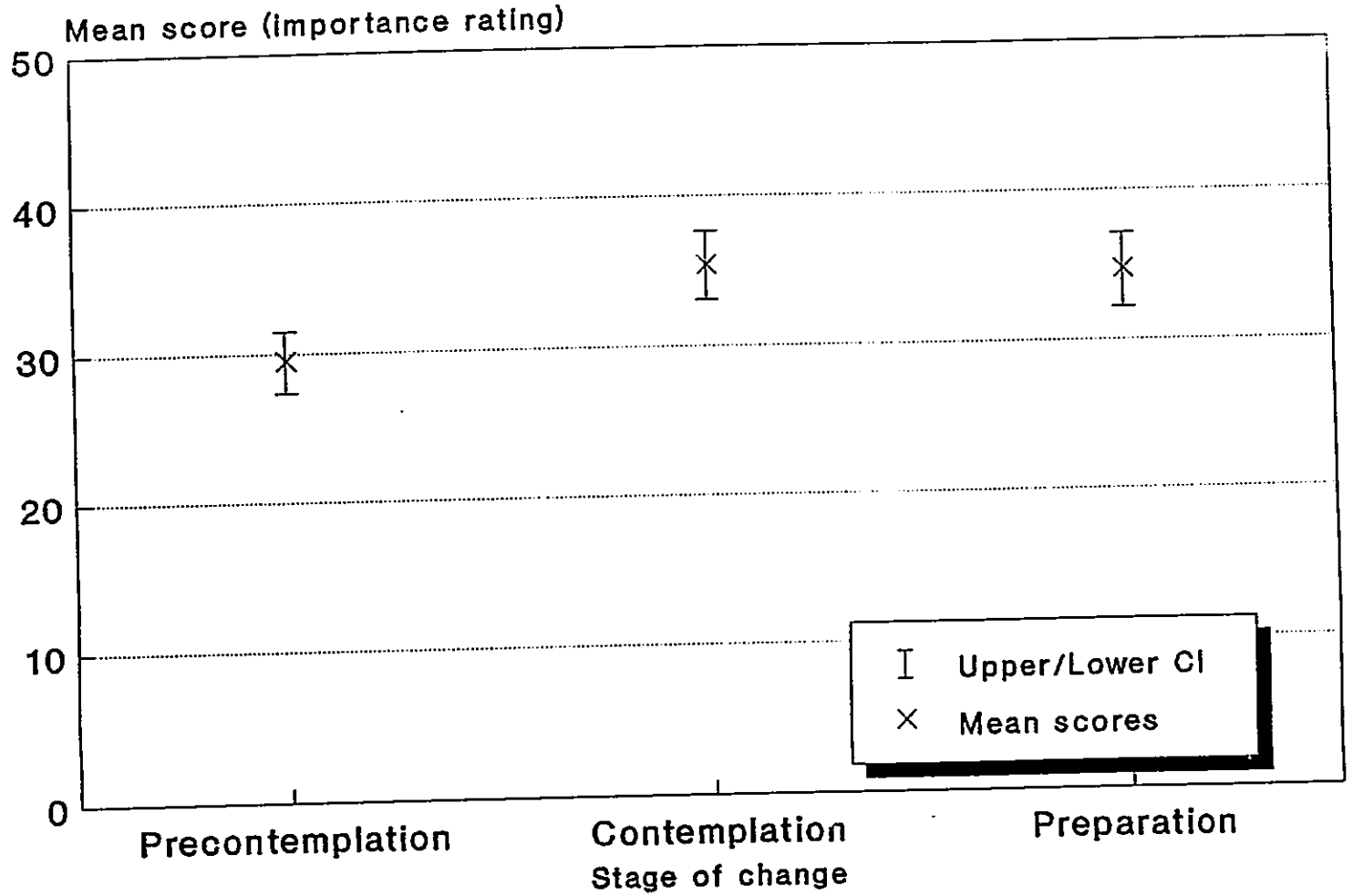
The section above addressed the first study question, regarding the extent to which participants endorse items on general risk knowledge, personal risk perceptions, motives, reasons, and the pros and cons of smoking, and whether there are patterns by the stages of change for each of these variables. The second research question, regarding whether

Figure 12 - Means and 95% confidence intervals of the Pros of Smoking scores by Stage of Change



Range of possible scores: 10-50

Figure 13 - Means and 95% confidence intervals of the Cons of Smoking scores by Stage of Change



Range of possible scores: 10-50

there are overall differences among the decision-making variables by stage, will be addressed through multivariate analysis, described below.

Multivariate analysis of the relationship between stages of change and decision-making variables

For the multivariate analysis, the assumptions of independence, normality, and homogeneity the covariance matrix by each stage were tested, as violations of these assumptions may cause potentially serious inflation of the Type I and Type II error rates and invalidate the test results. Criteria for these assumptions were examined, and no serious violations were found (see Appendix 3).

Multivariate analysis of variance (MANOVA) was run using the General Linear Models in the SAS statistical software. The decision-making scales were entered as dependent variables, with stages of change as the grouping variable in the model. Stages of change had three levels (Precontemplation, Contemplation, and Preparation). Because the decision-making variables had different scales, they were standardized to a mean of 50 and a standard deviation of 10 before the MANOVA was conducted. Intake variables (demographics, pregnancy history, and smoking history) and stages of change were compared to the dependent variables in a Pearson correlation matrix to determine if they might have acted as confounders of the dependent variables by stage

relationship. None of the coefficients exceeded 0.40, so correction of the MANOVA model for covariates was deemed unnecessary.

The results of MANOVA are reproduced in Table 7. The MANOVA produced a significant omnibus statistic, indicating that there were differences among the stages due to some linear combination of the Decision-making variables. The univariate statistics under the MANOVA procedure showed that differences between stages could be attributed to General Risk Knowledge, Personal Risk Perceptions, and Decision Balance - Cons.

These three variables also accounted for most of the variance (R^2) in stage designation. The Cons of smoking accounted for 11% of the variance in stage differences, while the two variables from the Health Belief Model, General Risk Knowledge of smoking in pregnancy, and Perceived Personal Risk, accounted for 7% and 10%, respectively. The remaining variables (Motives, Reasons, Pros) <u>together</u> accounted for 11%

As the significance of the omnibus statistic from the multivariate model showed that there were stage differences on some variables, the next step was to determine how stages were distinguished on these variables, by doing post hoc analyses. Each of these three variables were examined in follow-up analysis of variance (ANOVAs) with Tukey's Studentized Range test and a comparison of least squares means (LSMEANS). As three tests were conducted, a Bonferroni correction of the

TABLE 7
MANOVA of Stages by Decision-making Variables

Scale/subscale	F Value (2, 135 df)	Pr > F	R^2
1. Knowledge	4.81	.0096*	.07
2. Personal risk	7.42	.0009*	.10
3. Motives			
Habit	.32	.7299	.01
Addiction	.20	.8161	.00
Neg Affect	2.70	.0708	.04
Pleasure	1.41	.2488	.02
Stimulation	.36	.6964	.01
Handling	1.14	.3226	.02
4. Reasons			
Level 1	.38	.6875	.01
Level 2	.29	.7450	.00
Level 3	.13	.8820	.00
Decisional balance			
5. Pros	.04	.9609	.00
6. Cons	8.21	.0004*	.11
Wilks' Lambda = .7094 (26, 246 df)	1.77	.0143*	
Total R^2			.39

* statistically significant, $p < .05$

test probability value allowed the determination of a significant difference at $p < .05/3 = .017$.

Tukey's test for differences in General Risk Knowledge mean scores by stage found that women in Preparation had a significantly higher mean score on General Risk Knowledge (53.47) than women in Contemplation (47.11), but did not differ significantly from women in Precontemplation (49.42). Mean scores for Precontemplation and Contemplation did not differ significantly.

Tukey's test for differences in Personal Risk Perception mean scores by stage indicated that women in Preparation had a significantly higher mean score (53.89) on Personal Risk Perceptions than either Precontemplators (46.83) or Contemplators (48.80), who did not differ from one another.

Tukey's test for differences in Cons mean scores by stage showed that Precontemplators had a significantly lower mean score (45.47) on the Cons of smoking than women in Contemplation (52.48) or Preparation (51.62). There was no significant difference between the latter two stages on their Cons mean scores.

CHAPTER 5 - DISCUSSION

Synopsis of Findings

On the whole, volunteer participants in this study were remarkably similar in demographic characteristics and smoking history variables to the Intake sample from which they originated, and to a similar population sample studied by Stewart et al.[363]

Overall level of knowledge of the risks of smoking during pregnancy was high, but many participants considered their personal risk to be lower than other pregnant smokers'. Negative affect was the dominant motive for continued smoking, and Level 1 reasons ("doubting the evidence of harm") were cited as being most important to participants. Generally, women gave higher ratings to the cons of smoking than to the pros.

Approximately one-third of the sample was categorized in each of the three stages (Precontemplation, Contemplation, and Preparation). The hypotheses regarding differences in decision-making variables by stage were partially supported. Although the multivariate analysis indicated an overall distinction among stages by the set of decision-making variables, primarily three variables accounted for this difference: General Risk Knowledge, Personal Risk Perceptions, and the Cons of smoking in pregnancy.

Subject Characteristics and Smoking Behaviour

Demographics and pregnancy-related variables

Participants in the SAQ study differed very little on demographic characteristics, pregnancy-related variables, and smoking history and habits from current smokers in the Intake sample. The similarity of the SAQ sample to its base population indicates that the data for this thesis represent pregnant smokers who attended prenatal classes during the study period.

Compared with Stewart et al.'s 1992 data of women in Ottawa-Carleton who smoked during pregnancy, the present sample had more current smokers under age 30 (71.4% in this study vs 63.6% in Stewart et al's), a lower percentage of smokers who were married or in a common-law relationship during pregnancy (78.4% vs 85.6%), and slightly lower educational levels (59.5% vs 61.2% with Grade 12 or less). Considering that Stewart et al.'s sample size was much larger than this sample (N = 151 here vs 1924 in Stewart et al's), the proximity of the demographic characteristics suggests they measured similar populations of pregnant smokers.

Smoking prevalence and cigarette consumption

At 14%, the self-reported prevalence of current smoking in the Intake sample was lower than that found by Stewart et al. in 1992 (21%) Prevalence of smoking among pregnant women in the present study was the same as that estimated in the

1990 Ontario Health Status Survey (14%)[364], but was lower than those rates found in American and European studies (median = 32%).[365 366 367 368 369]

Many women in this study cut their cigarette consumption in half while pregnant, to about 10 cigarettes a day, a significant drop from prepregnancy consumption. This behaviour is similar to that found in other studies.[370] The overall decline in smoking rate at the time of this study suggests that most of the pregnant women had elected to cut their intake *because* they were pregnant (but were unwilling or unable to quit). Thus, while pregnant women may have been receptive to the message that they should cut down their smoking rate, many still found it difficult to contemplate quitting. Why this is so may be linked to some of the decision-making variables.

Stages of Change and Decision-making Variables

In this section, results of this study's data on stages of change and the decision-making variables will be compared to other published studies. Two questions arise in making these comparisons: a) are the stages of change and decision-making variables different for pregnant women than for other population samples? b) does pregnancy constitute a special period in the natural history of a smoker (e.g. re their likelihood of quitting)? Aspects of these questions will be addressed throughout the following section.

Stages of change

In the present study, there was a fairly equal distribution of women in each of the three smoking stages (32% in Precontemplation, 35% in Contemplation, and 33% in Preparation). The prevalence of smokers at the stages of change has varied widely in published studies. Pooling data across populations and studies, Prochaska et al.[371] [372] have found a predominance (60%) of smokers in Precontemplation. However, some individual studies have tended to find a much lower proportion of smokers in Precontemplation (11%[373] to 24%[374]), with the majority of smokers in Contemplation (47%[375] to 63%[376]). However, the samples from most studies on the stages of change used a different population base (men and women), which could account for some of the difference in stage prevalence.

The type of sample in the present study is closest to Crittenden et al.'s study of low-income women[377] - which is also the only stages of change study which specifically identified pregnant women. Stage prevalence in this thesis is also most similar to that found by Crittenden et al. Of the pregnant smokers in Crittenden et al.'s study, 40% were in Precontemplation, 31% in Contemplation and 29% in Preparation.

As there is only one study of stages of change in pregnant smokers for comparison with this thesis, it may be difficult to ascertain if stage prevalence in this sample is representative of pregnant smokers. However, compared with

general population samples, pregnant women may tend to have a different pattern of stage prevalence. Pregnant women - perhaps especially those who attend prenatal classes such as this sample - may be more motivated to consider changing unhealthy habits such as smoking. Therefore, a higher proportion of pregnant women may be in Contemplation and Preparation than in Precontemplation, compared with a community sample. On the other hand, the true proportion of Precontemplators may be undersampled. Precontemplators, who by definition are not considering changing, may be less likely to participate in surveys or interventions which have change as their "modus operandi". As more studies of pregnant smokers are conducted, stage prevalences can be more rigorously compared across studies to determine whether there are patterns in pregnant smokers' readiness to quit or reduce their smoking which differ from nonpregnant populations.

There are several sampling issues which can affect the likelihood of people in different stages being included. Differences in stage distribution can occur due to characteristics of the sampling frame, setting, the sampling method, or the response rate.

In a study of pregnant women, such as this one, the sampling frame is restricted to one sex, to one relatively brief period of women's lives (pregnancy), and to the ages at which women have children. Most other samples of smokers included both men and women at all ages. As the stage

prevalence in this study is similar to Crittenden et al.'s, the findings from this thesis research may be generalizable to other pregnant smokers, but may not be applied to general populations without first retesting the study variables.

The sampling setting may also affect the obtained prevalence and the generalizability of the results. Prenatal classes were selected as the sampling setting in this study because most pregnant women in the study region attend these classes during their pregnancies, and thus the expected (and actual) yield of participants was high. However, as all women in prenatal classes at the time of this study were surveyed regarding their stage of change, and as the participants in the full study (SAQ) were remarkably similar to nonparticipants on demographic and smoking history variables, these data can be said to be representative of women who attended prenatal classes at that time. The stage prevalence of the population of pregnant smokers who were not attending prenatal classes is unknown. Smokers as a whole generally enrol in prenatal classes less often than nonsmokers, and come later in their pregnancy when they do enrol. Because this study sampled women in all trimesters, it likely captured "typical" smokers who did attend prenatal classes - even if they enrolled late.

The participation rate can affect stage prevalence, as nonparticipants may vary from participants in factors which would affect the study variables and their outcomes. In this

cross-sectional survey, all women in prenatal classes were asked to complete the one-page Intake questionnaire and none refused. This "perfect" response rate is not typically found in cross-sectional studies. As the Intake instrument was on a single page and probably took only a few minutes to complete, participants may readily have agreed to complete it. However, as it was administered in prenatal classes, women may have felt under pressure to respond in "acceptable" ways (e.g. underreported their cigarette consumption). As biochemical confirmation of smoking status was not conducted, there is no way to verify smoking intake.

Forty-one percent of current smokers in the Intake sample volunteered to complete the SAQ. While this participation rate is only moderate, the stage prevalence of smokers in the Intake and SAQ samples was virtually the same (31.8% vs 31.9% in Precontemplation, 35.0% vs 34.7% in Contemplation, and 33.2% vs 33.3% in Preparation). This similarity, along with the overall proximity of the two groups on demographic and smoking history variables, suggests that the SAQ group was a representative sample of the entire group of current smokers in the Intake group.

General risk knowledge and personal risk perceptions

The overall level of knowledge about the risks of smoking to the fetus and to the women themselves were well known to most of this sample. Yet personal risk of a negative outcome

was rated much lower than knowledge of the same risk for most of the potential outcomes listed.

Precontemplators did not differ significantly in their knowledge scores from women in either Contemplation or Preparation. Women in Preparation did have a significantly higher level of knowledge about risks than Contemplators. While it was expected that knowledge scores for women in Preparation would be higher than women in Contemplation, the relationship of scores for Precontemplation versus Preparation was less clear. It is conceivable that Precontemplators were not lacking *knowledge* of the risks, but perceived that they were not personally at risk, or they were unwilling or unable to change for other reasons. Therefore, their level of knowledge was high, but it did not motivate them to consider quitting smoking.

Indeed, for personal risk assessments, there was a stage gradient in the expected direction: a consistently higher proportion of women in Preparation rated their risk of adverse pregnancy outcomes as being at 50% or above than women in Contemplation, who rated their risk higher than Precontemplators. Here, however, the significant difference was between Precontemplation and Preparation. As hypothesized, women in Preparation clearly thought they were at higher risk of negative pregnancy outcomes than women in Precontemplation. A task for health educators will be to make the hazards of smoking during pregnancy more salient to

Precontemplators by *personalizing* health risk information - explaining the relationship between pertinent events in women's medical history (e.g. previous low birth weight baby or miscarriage) and smoking, but maintaining a sympathetic and nonjudgmental attitude to avoid raising Precontemplators' defences.[378]

Both knowledge and personal risk contributed to the differentiation of the stages in multivariate analysis for these data. In Owen et al.'s study of male and female smokers,[379] significantly fewer Precontemplators than Contemplators knew about health risks related to smoking. Owen did not test the difference between Precontemplation and Preparation. The difference in knowledge between Precontemplation and Contemplation was not replicated here; instead, subjects in Preparation had a significantly higher knowledge mean score than those in Contemplation according to the Tukey test, while neither differed significantly from Precontemplation.

As was discussed in the literature review, the dominant public health model states that high levels of risk knowledge should result in higher personal perceptions of harm, and changes in behaviour to avoid harm. However, as several authors have noted[380] [381] [382] [383], people may suppress the knowledge of risk, or believe that it does not apply to them. These ideas are supported by the lack of cohesion between knowledge and personal risk assessments in this study. These

results suggest that participants were overriding their knowledge of harm by asserting that they were not personally susceptible.

In addition, although it was not measured extensively in this study, there is some evidence to suggest that risk perceptions vary according to personal experience. For instance, the lower assessments of personal risk of miscarriage may have been partly dependent on gestational age: women past the point where most miscarriages occur may correctly have said that their risk *at that time* was low. In contrast, if they had already experienced bleeding or hypertension, the only correct assessment of their risk would be 100% Women's experiences in previous pregnancies (or among women they know) may affect their perceived risk, as well as their absolute risk. Women who are underweight or who had a previous low birth weight baby are at higher risk of having another, regardless of smoking status.[384]

Moreover, some women's assessments of their personal risk could be accurate, whether or not they know their actual risk. McIntosh[385] calculated relative and attributable risks of smoking during pregnancy for various adverse outcomes. While attributable risks (per 1000 smokers) for any pregnancy bleeding or for birth weight less than 2500g are high (ARs $\geq$ 40.0), the proportions of miscarriages and stillbirths attributable to smoking are relatively low (ARs 13.4 and 3.2, respectively). While one must be cautious applying population

parameters to individual risk assessment, a future study might more rigourously compare women's perceived risks with McIntosh's risk ratios.

Motives for smoking

While there were no significant differences among the stages on the six motives subscales, there were some patterns of interest. Women in all stages endorsed the Negative Affect motive the most, i.e. it had the highest mean scores. Addiction was the next most important motive for smoking, followed by Habit, Pleasure, Stimulation, and Sensory Appeal/Handling.

Although the hypothesized differences among the stages on motive endorsement were not supported in this sample, the overall prediction that respondents would see the control of negative affect as the most important motive for continuing to smoke in pregnancy was confirmed. Ikard et al.[386] and other researchers on smoking motives have shown women to have higher endorsement of Negative Affect motives than men. That is, women smoke primarily for the "sedative" effect, to calm themselves down in periods of high stress, rather than for the pharmacological stimulant effect of the nicotine per se.[387] [388] As pregnancy is, at times, stressful (both physically and emotionally) for many women, it would be expected that study participants' endorsement of the control of negative affect motive would be ranked highest.

As noted in the literature review, the only published study comparing smoking motives to stages of change was conducted by DiClemente et al.[309] They found significant differences among the stages (for men and women together) on Relaxation (equivalent to Pleasure), Addiction, and Habit. Men and women in the Preparation stage had the lowest means on these scales. There were no distinctions made by sex, and there was no discussion of these findings or their implications.

It is not clear why no significant differences in motives by stage were found in this example. There are three possibilities why this occurred: 1) insufficient sample size, and thus power, to detect differences, 2) poor instrumentation, or 3) no real differences between stages on smoking motives for this population.

One strong possibility for the lack of significant findings on motives by stage is that there was an insufficient number of subjects in each stage-motive group to correctly ascertain statistical significance. Thus, the hypothesized relationship between motives and stage of change should be reassessed in a larger sample. Larger studies may detect stage trends that were noted. For instance, women in Preparation were most likely to rate control of negative emotions highly, while women in Precontemplation rated pleasure as a highly important motive. If such trends are found to be consistent in larger studies, self-help and

intervention materials can be developed which are tailored to each group. That is, for Precontemplators, substitute means of achieving the pleasurable aspects of smoking can be suggested.

A second possibility for the lack of differences in motives by stage is that the smoking motives questionnaire was not measuring those elements most important to pregnant women's smoking. The smoking motives instrument was developed for and tested on general populations (men and women). While the regulation of negative feelings was the dominant motive both in this sample and in other samples of women, there may be other motives not measured here which are more important to pregnant women in each stage. Qualitative work on smoking motives among pregnant smokers at each stage of change should be conducted in order to determine whether there are more important motives for their smoking. Some possibilities may be the control of weight gain, or the assertion of control over one's body, when pregnancy otherwise dominates so many bodily processes.

Thirdly, it is possible that pregnant smokers, as with nonpregnant women, smoke to control negative feelings, regardless of which stage they are in. As noted above, there is only one empirical study in the literature (DiClemente et al.) to inform the examination of smoking motives by stage, and it did not report women's results separately. Therefore, more empirical evidence is necessary before it is possible to

conclude whether there is a difference by stage on smoking motives for pregnant women.

Reasons

It was hypothesized that Precontemplators would support Level 3 Reasons (deeply-rooted affective and personal liberty assertions) for smoking more strongly than women in the other stages, while Contemplators would endorse Level 2 Reasons (related to barriers and self-efficacy), and Level 1 Reasons (doubting the evidence) would be more dominant among women in Preparation. There were no significant differences among the stages - women in all stages most commonly endorsed Level 1 Reasons.

While differences between stages were small, there were some trends in the expected direction. Precontemplators did have the highest mean score among the stages for Level 3 Reasons, and Contemplators had the highest mean for Level 2 Reasons, but women in Preparation had the lowest mean for Level 1 Reasons. Thus, while all women said their most important reasons for continuing to smoke were related to their doubt about the evidence of harm, more Contemplators cited barriers and doubting their ability, and more Precontemplators asserted it was their right to smoke than women in the other stages. However, these differences are only suggestive of patterns, as their magnitude is small.

On individual Reasons items, women in all stages, but especially Precontemplators, were likely to cite negative mood changes associated with quitting and the loss of a pleasurable activity as among the most important reasons for continuing to smoke during pregnancy. They did not believe in their ability to quit, both because they had relapsed before, and because they had partners who smoked. They cited other women they knew who had had "healthy" babies as examples of the lack of evidence of harm from smoking, and did not feel cigarettes were as bad for the baby as other drugs. In any case, they felt, the damage might already be done, so there was no point in quitting. These factors could be instructive for the development of self-help pamphlets and cessation programs, to be discussed below.

As with smoking motives, the lack of stage differences in smoking reasons could be attributed to inadequate sample size, to instrumentation, or to a lack of true difference between stage groups. The validity and reliability of the three subscales (levels) should be further tested, through principal components or confirmatory factor analysis. In this sample, the fact that women in all stages endorsed Level 1 Reasons may indicate that a single factor structure (rather than three) exists. In addition, certain items should be written more clearly, as there is a possibility of interpreting their meaning more than one way. Item restructuring, scale development, and application of the Reasons instrument to a

larger sample should yield further information regarding the importance and hypothesized statistical significance of reasons for pregnant smokers in each stage. At this point, there are no other published studies using similar samples comparing smoking reasons by stage.

Decisional balance

The expected pattern of stage differences on Pros scores was not supported by data from this study. Pregnant smokers in Precontemplation, Contemplation, and Preparation differed little on their mean ratings of the Pros of smoking, and women in all stages rated the Cons of smoking higher than the Pros. The Cons scores did follow the expected stage pattern. As hypothesized, Cons were lowest for Precontemplation. But while Cons mean scores for Contemplation and Preparation were significantly higher than those for Precontemplation, the same gradient was not found. Contemplators had a slightly higher mean score than women in Preparation, although this difference was not significant. Therefore, the primary difference in the rating of Cons was between Precontemplation and the other two stages.

Decisional balance - the relationship of Pros to Cons - did not occur in the expected way for each stage. Mean scores for Pros should have exceeded Cons for Precontemplation, but were lower. Contemplators had a substantially lower mean score for Pros than Cons, when these scores should have been

close. The relationship of Pros to Cons did occur as hypothesized for Preparation, with the mean score of Cons higher than that for Pros.

The lack of a significant stage relationship to Pros scores, and the inconsistency in the expected ratios of pros to cons is puzzling. It is possible the expected differences would have been found in a larger sample (i.e. the problem was inadequate power). Another consideration is that while the instrument has been validated and replicated across populations and behaviours,[390] these items are not specific to pregnancy. Thus, participants may have been judging what the pros and cons of smoking are for them *in general* rather than what these advantages and disadvantages are during pregnancy. However, that possibility does not explain why Precontemplators did not assess pros higher than cons, as expected. The more likely explanation is that pregnant smokers are aware of the cons of smoking and respond in what they feel is the "politically correct" way - reducing their *reported* valuation of the pros of smoking and inflating their cons scores.

Or, pregnant smokers may genuinely believe that the cons of smoking outweigh the pros, but feel they are unable to change because of barriers such as the lack of other coping mechanisms, or low self-efficacy from previous failed quit attempts. There are two aspects which separate the stages in this case: the nature of the perceived barriers, and the

magnitude of the difference between pros and cons. Some barriers were explored in the Motives and Reasons scales. Further qualitative work should elucidate which barriers are most salient to pregnant smokers in each stage, and will direct the corresponding health recommendations.

The magnitude of difference between scores on pros and cons may be instructive. Most other studies comparing pros and cons at stages of change have found the smallest difference in the Contemplation stage - this is where the pros and cons of smoking hang in the balance, with cons exceeding pros in subsequent stages.[391] [392] This transition implies movement towards change; therefore, closing the gap between pros and cons, and then maximizing the cons should correspond to movement through the stages and eventual cessation. As this difference was smallest in Precontemplation in this sample of pregnant women, rather than being smallest in Contemplation as in other populations, this would suggest that the transition is occurring earlier (i.e. in the Precontemplation stage) in pregnant smokers than with other populations. Self-help and intervention materials should emphasize the cons of smoking, and seek ways to make these disadvantages of smoking more salient to pregnant women in Precontemplation.

Finally, other researchers may wish to explore further certain patterns of items by stage. For instance, pregnant smokers in Precontemplation gave lower endorsements than women

in the other stages on Cons items related to how their smoking affects others, or what others think of their smoking. While the health practioners' goal may be to increase Precontemplators' awareness of how their smoking affects others (not just their babies), the method of doing so is problematic.

Because Precontemplators may be more defensive and resitant regarding change, rather than try to change Precontemplators' attitudes, health practitioners should concentrate on identifying and reducing barriers, and should suggest concrete, achievable steps towards thinking about quitting, and eventual cessation.

The overall model

While the findings from each of the dependent variable scales are useful for comparing with other samples, the addition of these variables to the stages of change framework met with mixed results. Overall variance in stages of change explained (R^2) by the six variables in the model presented here was relatively small (39%), and the addition of Motives, Reasons, and the Pros of smoking did not contribute much to the ability of the stages of change model to explain why pregnant women continue to smoke. The individual characteristics and limitations (such as the sample size to variable ratio and instrumentation effects) of these scales have been discussed above. There are two additional potential

reasons why the contribution of these three scales to the total model was more limited than expected: 1) Motives, Reasons, and Pros collectively may have redundant items and therefore may not represent unique scales or constructs, or 2) Motives, Reasons and Pros are not important in the decision-making process of pregnant women who continue to smoke.

Some of the items in the Motives, Reasons, and Decisional Balance questionnaires were similar. Although item analysis was not a goal of this study, an examination of response patterns should reveal whether women gave the same answer on similar items in the three questionnaires, as would be expected. However, it is possible that respondents tired of answering similar questions, or had second thoughts about the relative importance of a motive, reason, or advantage of smoking, and changed their response the second time they saw an item. Pooling all the items and conducting principal components analysis could aid in variable reduction and construct formation for these scales (particularly as some subscales had only moderate Cronbach's alphas), possibly resulting in a single scale with several components. This reduced scale would likely alleviate respondent fatigue as well. However, any revisions to these scales should be informed by discussion of their theoretical bases and whether it is meaningful to combine them, even if coherent factors do emerge from principal components analysis.

In addition, the scaling of responses differed in the three questionnaires, with a different number of options and different labels on the options for Motives, Reasons, and Decisional Balance. Thus, the scaling could have had an effect on response patterns. Although scores were standardized for the multivariate test in this study in order to avoid distortion of scores due to differences in scaling, future applications of these measures should use uniform scaling.

Finally, assuming that the instrument components were valid and reliable, and that scaling, the order of items and/or questionnaires, and respondent fatigue did not bias the results, it is possible that Motives, Reasons, and the Pros of smoking did not vary substantially between the stages because these concepts were equally important to the pregnant smokers in this study, or because other factors (e.g. low perceived personal risk) were more important.

However, as other studies of smoking among women (though not pregnant women) found that elements related the Motives, Reasons and Pros were important in the continuance of smoking, these factors should not be discarded without some further empirical testing and analysis. That is, these variables may not be relevant in the differentiation of stages, but they may still be clinically important in understanding why pregnant women continue to smoke. Future research should include qualitative work in order to determine the importance of

Motives, Reasons and Pros for smokers during pregnancy, and the best way of applying these factors to efforts to help pregnant women quit.

How well did the model as a whole work in explaining stage differences in pregnant smokers? Returning to the discussion on cognitive dissonance, it is possible to explain the synergistic effect of some variables on others. Because participants' level of knowledge was high about the harmful outcomes of smoking on their babies, it is consonant that they rated the pros of smoking lower than the cons - they knew they should. However, this knowledge did not supplant their need to smoke in order to control negative feelings. Because the need to smoke and the knowledge that it could be harmful to their babies caused dissonant reactions, participants refuted the information about harm, believing it did not apply to them, and espoused reasons which supported this doubt about the evidence.

Expected relationships between scores on knowledge, personal risk perceptions, and the cons of smoking with stage of change were most consistent with study hypotheses for women in Preparation. On these three decision-making variables, significant differences between stages contrasted one pair of stages against the third - but just which stages were combined and contrasted was inconsistent. For instance, Precontemplators were not significantly different from either one of (or the combination of) the other two stages on the

three variables. Therefore, statements about characteristics of pregnant smokers in each stage which are based on this study's data must take into consideration relative, and not just absolute differences between the stages on each variable.

Considerations in applying the Stages of Change model to pregnant smokers

The five questions which comprise the stages of change instrument were designed to be applied to broad population samples of men and women. Their application to pregnant smokers may need some modification. The time periods which distinguish Precontemplation from Contemplation (considering quitting in the next six months) and Contemplation from Preparation (planning to quit in the next 30 days) may not be meaningful for pregnant women - they may no longer be pregnant in six months, or even in 30 days.

Instead, time periods should be keyed to "sentinel events" in pregnancy, at which women may be cued to consider their role in the health of the fetus, and may be more open to quitting smoking. These landmarks probably occur at the following points: upon confirmation of pregnancy, when "morning sickness" occurs, when the mother feels her baby move, when she starts to "show", at prenatal checkups, during ultrasound appointments, at the end of each trimester, and at the birth of the baby. These events remind the mother of her

condition, and may make the pregnancy (and her effect on it) seem more real to her.

Which sentinal event is most salient will depend on women's gestational age. Target dates should be close enough to be meaningful - both in terms of reducing risks of adverse outcomes from smoking, as well as being events pregnant women can relate to - but distant enough to allow them to seek help if they need it, and to find alternative coping strategies to meet their needs. Thus, the time limits could be changed to focus on the next sentinal event about one month away for Contemplation, and one to two weeks for Preparation. The importance of these sentinal events and their new time periods should be assessed in qualitative research with pregnant smokers to establish their parameters. Quantitative work should follow in large, diverse samples of pregnant women in order to establish the validity and reliability of the modified instrument.

Study Limitations and Recommendations for Further Research

As with any secondary analysis of existing data, research questions and analyses were limited by the scope and methods of the original study design and data collection. The cross-sectional design restricted the ability of a dynamic model such as the stages of change to describe and predict behaviour. Instead of tracing the course of change in attitudes, beliefs and intentions about smoking throughout

pregnancy, this study captured "snapshots" of these variables at a single time period.

However, while a cross-sectional design with nonrandom sampling is generally considered less rigourous than randomized controlled trials, cohorts or case-control designs, it was appropriate in this circumstance for several reasons. Ideally, cross-sectional studies yield insights into the characteristics of individuals at each level of the variables measured (e.g. at each stage of change, and in all three trimesters of pregnancy), giving a broad picture of the range of responses. Cross-sectional studies are efficiently and economically administered, and generally consume less of the participants' time and effort. The high response rate on the Intake questionnaire reflected this factor. The lower response on the SAQ instrument may have been indicative of smokers' hesitancy to respond to a longer series of questions about their behaviour, for which they may already feel defensive.

Disadvantages of the cross-sectional design include its inability to separate "cause" and "effect" (as they are measured simultaneously), and to measure change over time (i.e. whether the variables' characteristics at the time of measurement are representative of the average or "true" picture). However, in a study such as this thesis research, no cause and effect was being studied. Rather, knowledge and attitudes about smoking during pregnancy were compared at each

stage of change. Therefore, a cross-sectional design was appropriate.

Nevertheless, a prospective design with several measurement points (e.g. each trimester, and in the postpartum) would provide the researcher the ability to trace patterns of attitudes about smoking over time. Repeated sampling using a prospective design would inform researchers about how smoking attitudes change over the course of pregnancy, and which other factors might influence stage of change. It would also further validate the stages of change instrument for pregnancy.

That women were included in this study who were at all gestational ages had both advantages and disadvantages. Studying women in all trimesters allowed the shortcoming of a cross-sectional design to be mitigated somewhat because each phase of pregnancy could be sampled at the same time. However, as individual women are likely to change their attitudes, beliefs, and intentions about smoking throughout their pregnancies, a prospective, longitudinal design would yield richer data enabling a more thorough analysis of pregnant smokers' decision-making processes.

Also, because potential negative outcomes from smoking in pregnancy are so much closer (nine months away) than potential outcomes such as cancer and heart disease from smoking in general (possibly decades away), some women may decide (consciously or tacitly), to just "wait it out" - every day

that goes by and each landmark that is passed (feeling the baby move, having a normal ultrasound) without apparent ill effect confirms smokers' belief that the baby is not being harmed.

For these reasons, future research on why women smoke in pregnancy should be longitudinal, beginning as early as possible in pregnancy, and continuing with frequent contacts throughout gestation. Because postpartum relapse rates are extraordinarily high within the first six months after the birth of the baby, women should also be closely followed during this period. Also, emphasis about the benefits of quitting should be placed on women quitting for their own sake as well as for their unborn babies, so that pregnancy is not seen as a temporary justification for stopping.

Ideally, women would be assessed prior to pregnancy, to establish baseline factors related to smoking. Then it could be determined if and how pregnancy alters these beliefs and actions, and how public health messages and interventions could best be developed and timed to be most effective in reducing smoking. These points will be further discussed in the section on program implications, below.

While the sampling method used in this study yielded a high response rate of women attending prenatal classes, pregnant smokers who were not attending classes at the time of the study may have differed in important ways from those who did attend. As noted above, smokers (and especially

Precontemplators) are less likely to attend early prenatal classes, and thus a substantial portion of the the target population may have been missed.

Future studies should find ways to contact pregnant smokers who do not attend early prenatal classes. Some possibilities include putting tearsheets or flyers near pregnancy test kits in pharmacies, or in clinics where pregnancy testing is done and prenatal care given (e.g. Planned Parenthood, community or student health clinics). While this method will likely result in a smaller yield of participants (because the "hit rate" will be lower than the "captive audience" of a prenatal class), data from women who are not currently being assessed will be captured, improving the generalizability of research findings. Wherever possible, self-reported smoking status should be confirmed with biochemical testing (e.g. saliva cotinine). Other methodological and measurement concerns have been noted in the discussion of each variable, above.

Finally, some variables not assessed for this thesis work may be relevant to successful smoking cessation among pregnant women. This thesis did not examine self-efficacy or the processes of change - two elements shown to be very important to the successful completion of all five stages of change in the full Transtheoretical Model.[393] [394] Pregnant smokers may have the knowledge, "desirable" attitudes, and intention to quit, but may perceive insurmountable barriers to their

quitting (e.g. having a partner who smokes), may use inappropriate coping strategies which do not facilitate successful change, or may think themselves incapable of quitting successfully because of the unpleasant experience of previous failed attempts. While perceived barriers likely impede progress through the early stages of change, self-efficacy concerns are more important in the Preparation and Action stages.[395] Likewise, when inappropriate coping strategies (processes of change) are used, progress is thwarted, or relapse becomes more likely.[396] [397] The impact of these factors should be addressed in further research with pregnant smokers.

Implications for Program Development

Many women who quit smoking will do so on their own. These women would benefit more from well-designed self-help materials than offers of programs. However, others will want the structure and group setting of a program. Data from this study can inform both approaches.

Since the level of knowledge of health risks was high among study participants, these pregnant smokers would not be likely to want pamphlets, lectures, or other materials which seek to inform them of the medical facts. However, as many do not believe the risks could affect them, or disbelieve the association between smoking and negative pregnancy outcomes,

materials and strategies should be developed which help to overcome these misconceptions.

Because self-exempting beliefs are part of a cognitive dissonance-reduction strategy, one method of addressing this issue is to raise the consciousness of pregnant smokers who fit this profile. While this task may be achieved by pointing out the contradiction between knowledge of risk and perceived personal risk, doing so will "expose" the sublimated dissonance and bring about an uncomfortable tension. Once pregnant smokers acknowledge the contradiction, health researchers and providers should be prepared to give repeated assurances and understanding, and to provide a concrete plan for the next steps toward cessation. The message is likely to be better received if it is given by someone the smoker admires or can relate to. In a cessation program, this might include one-on-one discussion and counselling by a peer, while self-help materials could have pictures and use language appropriate to the pregnant smokers' situation.

As women in this study indicated that the strongest motive for their continued smoking is the alleviation of negative affect, self-help materials and program elements should be designed which provide alternative methods of coping with stress, anger, frustration, depression, anxiety and other feelings. It is necessary, therefore, to start from a point of understanding the functions that smoking serves for them,

and to find adequate substitutes to help pregnant women cope with these very real needs to control negative feelings.

Pregnant women in all stages rated the cons of smoking higher than the pros. Capitalizing on this phenomenon may help to move pregnant smokers towards cessation. Prochaska has suggested that increasing the cons of smoking by one standard deviation can result in predicted progression through the stages.[398] Measuring progress in this way also enables health researchers to predict the magnitude of the difference of behaviour changes. When the course of health behaviour change can be better predicted, more efficient and effective program planning can occur.

As evidenced by the significant relationship of some of the decision-making variables with pregnant smokers' level of readiness to change, self-help materials and programs can use stages of change as an organizing framework from which to deliver their materials. Doing so structures self-help materials or intervention sessions into logical "packages", using information and strategies around the variables associated with each stage.

For instance, Precontemplators were most likely (compared with women in other stages) to express self-exempting beliefs about harm to their babies from smoking and to reason that it is their right to smoke, but also to be most resistant to messages refuting these beliefs. Therefore, strategies must

be developed which get their attention without raising their defences.

Precontemplators also acknowleged that, while there were some cons to smoking, the pleasure they derived from smoking was an important motive for them to continue. Therefore, ideas for more healthy substitute pleasures should be solicited from pregnant smokers and promoted (e.g. buying something for themselves with the money saved from not smoking).

An important reason for not quitting for Precontemplators in this study was because they thought the stress and anxiety of quitting would be worse for the baby than continuing to smoke. Alternate methods of dealing with these feelings during the transition to nonsmoker could include keeping a smoking diary (recording feelings associated with the need to smoke, and alternatives tried), and enlisting the help of a buddy for moral support and encouragement.

Finally, physicians, public health nurses, and other health care providers can play a vital role in aiding the cessation process for pregnant women.[399] A brief questionnaire should be developed for use by health care providers in their first prenatal checkup with pregnant women who smoke (e.g. an appointment to confirm pregnant status). This questionnaire would assess stage of change, knowledge and personal perceptions of harm from smoking, motives, reasons, pros and cons of smoking. Because the physician or nurse has

access to patient records, she or he can personalize messages about health hazards specifically for the pregnant smoker being counselled.

Ideally, the baseline information would be processed by a computer which is programmed to produce stage-based booklets geared to solicit discussion between provider and patient. Depending on need, these discussions could address self-exempting beliefs and other barriers to change, and substitute behavioural strategies for coping without smoking. The booklets and discussion would have a progressive approach, focussing on timely and attainable goals towards quitting - perhaps involving a mutually agreed-upon contract. In between clinic visits, pregnant smokers can keep a smoking diary and mark their progress and reactions to the stage-based booklets. The health care provider should address the issue of smoking with an attitude that is friendly, sympathetic, supportive, and concerned, in order to get pregnant clients "on side" and to lower their defensive reactions.[400] This protocol of stage-based manuals, computer-generated feedback, and individual counselling has been found to be effective in achieving cessation in general populations,[401] and should be tested in pregnant smokers.

The importance of developing self-help materials and interventions specifically tailored both to pregnancy and to pregnant smokers' stage of change needs further study. Other studies have shown that more generalized materials have not

been as effective in eliciting changes as these more tailored efforts.[402] Windsor et al.[403] showed that pregnant smokers randomized to receive self-help materials geared to pregnancy had a higher cessation rate (14%) than women who received a standard manual (6% quit) or those in the control group (2%). Prochaska et al.[404] have shown that stage-based protocols achieve higher rates of cessation in general population samples than standard self-help protocols.

Thus, self-help materials and intervention protocols for pregnant smokers should focus on increasing beliefs in personal susceptibility to harm from smoking, seeking alternative means of coping with negative feelings, and providing practical support and encouragement for efforts to quit. After baseline assessment of stage of readiness to change and scores on the decision-making variables, participants should receive materials that are tailored to their particular profile. Materials should then be administered to them periodically from early pregnancy until six-months' postpartum, following stages of change which are linked to key landmarks in the process of pregnancy (e.g. trimesters).

Conclusion

Data from pregnant smokers in this thesis have confirmed the importance of certain decision-making variables in the stages of readiness to change smoking behaviour. This thesis

has provided new data on the distribution of stage prevalence regarding smoking in pregnancy. It has confirmed that while pregnant womens' knowledge of potential harm to their fetuses and assessments of other cons of smoking may be high, smoking serves an important function for them in the control of negative feelings. Therefore, they espouse self-exempting beliefs about personal susceptibility, and cite reasons regarding why they doubt the evidence.

The relationship of knowledge, personal risk perceptions, and the cons of smoking have been found to be particularly associated with stages of change. While empirical support for the role of smoking motives, reasons, and the pros of smoking did not meet expectations in this study, the theoretical value of these variables to pregnant women's continued smoking recommends that they be more thoroughly examined in larger studies before being dismissed as unimportant. These data largely confirm the findings of other studies, but combine important decision-making variables to enrich the explanatory power of the stages of change framework.

The stages of change framework has been shown in this study to be capable of incorporating other theoretically meaningful constructs in order to expand the explanatory power of the model for describing why women smoke during pregnancy. Prochaska et al. confirm the robust nature of the stages of change model by stating the following about their broad-based empirical research:

> The present results add substantial evidence that core constructs from a decision-making model can also be integrated within the stage dimension. We hope that such results can advance us beyond the all-too-common form of either-or thinking (either this model is correct or the competing one is better), and we anticipate the possibility of integrating alternative perspectives into more comprehensive approaches to behavior change.[105]

The outcome of this thesis research should be to guide the design of interventions based on the decision-making factors pertinent to each stage of change. Given research findings from other studies using this model, such stage-based interventions, tailored to the particular needs of clients, should have a higher success rate for smoking cessation, and thus better outcomes for mother and child. Although data from this study were collected cross-sectionally, these findings may aid in this goal, by helping health researchers and practitioners to gain a better understanding of why some pregnant women feel the need to smoke, and how these needs might be addressed.

APPENDICES

Appendix 1 - Stages of Change Instrument

1. Do you currently smoke cigarettes?

   __ Yes __ No

2. Have you smoked any cigarettes during the past 6 months?

   __ Yes __ No

3. Are you seriously considering quitting within the next 6 months?

   __ Yes __ No __ I don't smoke

4. Are you planning to quit in the next 30 days?

   __ Yes __ No __ I don't smoke

5. In the last year, how many times have you quit for at least 24 hours?

   __ 0 __ 1 or more times

Scoring Algorithm

1	2	3	4	5	Stage
yes	yes	no	no	0	Precontemp
yes	yes	yes	no	0	Contemp
yes	yes	yes	yes	1+	Preparation
no	yes	--	--	1+	Action
no	no	--	--	1+	Maintenance

Appendix 2
Means, 95% Confidence Intervals, and Standard Deviations of Decision-making Variables, by Stage

Variable	Stage of change		
	Precontemplation mean/[s.d.] (95% CI)	Contemplation mean/[s.d.] (95% CI)	Preparation mean/[s.d.] (95% CI)
1. KNOWLEDGE	7.38 (6.96-7.80) [1.43]	7.00 (6.47-7.53) [1.88]	8.04 (7.62-8.46) [1.46]
2. PERSONAL RISK	37.69 (33.49-41.89) [14.37]	41.33 (35.79-46.87) [19.78]	50.72 (45.41-56.03) [18.59]
3. MOTIVES			
Habit	7.04 (6.22-7.86) [2.78]	6.90 (6.20-7.60) [2.50]	7.28 (6.53-8.03) [2.61]
Addiction	11.77 (10.84-12.70) [3.14]	11.98 (11.05-12.91) [3.33]	12.15 (11.12-13.18) [3.62]
Neg Affect	16.14 (14.85-17.42) [4.35]	16.92 (15.75-18.09) [4.17]	17.87 (17.12-18.62) [3.97]
Pleasure	5.77 (5.33-6.21) [1.48]	5.16 (4.71-5.60) [1.59]	5.23 (4.69-5.77) [1.89]
Stimulation	4.89 (4.38-5.40) [1.73]	4.88 (4.38-5.38) [1.79]	5.15 (4.51-5.79) [2.24]
Handling	4.16 (3.75-4.57) [1.38]	4.39 (4.04-4.74) [1.24]	4.62 (4.13-5.11) [1.73]

Appendix 2, cont...

Appendix 2, cont. - Means, 95% Confidence Intervals, and Standard Deviations of Decision-making Variables, by Stage

	Precontemplation mean/[s.d.] (95% CI)	Contemplation mean/[s.d.] (95% CI)	Preparation mean/[s.d.] (95% CI)
4. REASONS			
Level 1	32.09 (29.75-34.43) [8.01]	33.12 (30.75-35.49) [8.48]	31.06 (28.24-33.88) [9.87]
Level 2	24.22 (21.98-26.46) [7.68]	25.06 (23.22-26.90) [6.57]	24.04 (22.30-25.78) [6.01]
Level 3	23.43 (21.54-25.32) [6.40]	23.04 (20.81-25.27) [7.59]	23.11 (21.40-24.82) [5.93]
5. DB - Pros	25.32 (27.34-31.50) [6.54]	25.10 (23.35-26.85) [6.25]	24.98 (22.81-27.15) [7.59]
6. DB - Cons	29.42 (27.34-31.50) [7.12]	35.35 (33.05-37.65) [8.22]	34.62 (32.10-37.14) [8.83]

Appendix 3 - Assumptions for Multivariate Analysis

Independence: Independence of subjects' responses is safeguarded primarily in the sampling technique and study design - i.e., subjects should not have a greater than chance likelihood of responding the same way. Violation of the assumption of independence (that subjects' responses are not linked) has the effect of reducing the between-subjects variability, thereby reducing the likelihood of producing a significant F statistic in analysis of variance.

Intuitively, responses for any pair of subjects enrolled in this study have no reason to be linked. The sample drew from a cross-section of women throughout a mid-sized (population 380,000) urban area, who theoretically had nothing in common other than that they were pregnant, smoking, and were attending prenatal classes. The distribution of data for age, educational attainment, gestational age, and daily cigarette consumption all had broad ranges.

However, latent variables such as health attitudes and beliefs are often correlated with each other and with sociodemographic characteristics, as was discussed in the literature review. As the object of epidemiologic applications of social scientific research is generally to study precisely the similarities on these variables within a group of interest (e.g. pregnant smokers), nonindependence may merit being the focus of such studies, rather than just being a statistical problem.[406] [407]

Independence is known to be reduced within a group - for example, within households or among students in a classroom. As participants were sampled from prenatal classes, it is possible that some of their responses (on the SAQ) may have been affected by their common exposure to this environment, and since women who have attended more classes will have had more opportunities to be exposed to other opinions which may change their views, these subjects may present responses which have reduced intragroup variability. This effect is difficult to measure. One way to guard against this effect is to ensure that subjects were not exposed to materials to be tested (i.e. the SAQ items) prior to test administration. Of the SAQ scales, knowledge about the effects of smoking on fetal health is the construct most likely to have received previous exposure, as this is a topic commonly covered in prenatal classes and in the media (e.g. on cigarette packages). The potential violation of the independence assumption on this construct will be considered in interpreting results of analyses.

Multivariate normality: Due to the Central Limit Theorem, the F statistic from analysis of variance (even in the multivariate model) is fairly robust to violations of normality, even with small sample size, as long as group sizes are equal. Stevens[408] remarks that F is still robust with unequal group sizes, as long as the difference between the largest and smallest group size is not greater than 1.5. For

the present sample, the difference between the largest group size (n = 49) and the smallest (n = 45) is 1.09, well within Stevens' guidelines.

However, one must also examine the shape of the distributions, as abnormally distributed data can threated the power to detect true group differences. Stevens recommends examining the skewness and kurtosis of variables by group, and comparing them to critical values. Variables which are nonnormal in more than one group raise concern. Skewness does not appear to have a significant effect on power. In small samples, platykurtic (flattened) distributions, especially when present in more than one group, may lower power.

Skewness and kurtosis were calculated by the Univariate Procedure in SAS, for each decision-making variable within each stage. The table which follows shows the sample size per variable within a stage, the obtained skewness and kurtosis values (note that one must add 3 to all kurtosis values given by the SAS program), and whether these obtained values exceed critical values. Critical values were taken from Stevens' table (p.255) where provided, or were calculated (for skewness) or interpolated (for kurtosis) using the following methods:

$$\text{Skewness: } z_1 = s_k \sqrt{(n+1)(n+3)/6(n-2)}$$

where: z_1 is the critical value to be calculated, s_k is the skewness value, and n is the group size for that variable.

A Bonferroni correction was made for α, due to the multiple tests being conducted. Therefore, α for this series was .002.

Kurtosis: Because the table contained critical values for the group sizes proximal to those for this study, the missing critical values could be interpolated using these steps: 1) the tabled critical value of the next smallest group size was subtracted from the tabled critical value of the next largest group size; 2) this number was divided by five (as the interval between tabled values was five) to get the value for one "unit"; 3) this unit value was multiplied by the number of units' difference the group size was compared with the closest smaller group size in the table; 4) this multiplied value was added to the tabled critical value of the next smaller group size to obtain the interpolated critical value. This procedure was conducted for both the 1st and 99th percentile values in the table, in order to obtain critical values for platykurtosis and leptokurtosis. Values within these bounds approximate a normal distribution. Values less than the lower bound indicated platykurtosis (a flattened distribution), while values greater than the upper bound indicated leptokurtosis (a peaked distribution). The following example will clarify these steps:

1) Critical value to obtain: for n = 42

   Proximate tabled critical value for n = 45 is 1.93, n = 40 is 1.89

   Difference in proximate tabled critical values: 1.93 - 1.89 = .04

2) Value for one unit: .04 / 5 = .008

3) Number of units' difference from next smaller tabled value = 2 (i.e. 42 - 40 = 2), so .008 X 2 = .016

4) Interpolated critical value for n = 42:

   Critical value for next lowest tabled value (n = 40), plus interpolated coefficient: 1.89 + .016 = 1.906

Thus, for a variable with a sample size of 42, if its kurtosis value is smaller than 1.906, the distribution of this variable for this group would be platykurtic.

The following table gives the skewness and kurtosis values for each variable within each stage, their critical values according to group size, and whether their distibutions are significantly skewed, and platykurtic or leptokurtic.

TABLE 8 - Normality of Decision-making Variables by Stage

Critical values	N	Skewness	Kurtosis
	42	2.839	1.906, 5.000
	44	2.897	1.922, 4.960
	45	2.925	1.930, 4.940
	46	2.954	1.934, 4.944
	47	2.981	1.938, 4.948
	49	3.036	1.946, 4.956

Stage/Scale	N	Skew	+/- skew	Kurt	Kurt+3	P/L kurt
Precontemplation						
KNOWLEDGE	45	- .61	ok	- .33	2.67	ok
RISK HAZARD	45	.54	ok	- .01	2.99	ok
Motives: habit	44	.95	ok	.37	3.37	ok
Motives: addiction	44	- .21	ok	- .84	2.16	ok
Motives: neg affec	44	- .19	ok	- .35	2.65	ok
Motives: pleasure	44	- .45	ok	.29	3.29	ok
Motives: stimul	44	.44	ok	- .83	2.17	ok
Motives: sensory	44	1.04	ok	- .04	2.96	ok
Reasons Level 1	45	- .79	ok	.22	3.22	ok
Reasons Level 2	45	- .53	ok	.32	3.23	ok
Reasons Level 3	44	- .47	ok	1.42	4.42	ok
REASONS	45	-1.08	ok	1.93	4.93	ok
DB Pros	45	- .20	ok	- .86	2.14	ok
DB Cons	45	.16	ok	- .81	2.19	ok
DB DIFFERENCE	45	.96	ok	1.60	4.60	ok

Table 8, cont...

TABLE 8, cont. - Normality of Decision-making Variables

Stage/Scale	N	Skew	+/- skew	Kurt	Kurt+3	P/L kurt
Contemplation						
KNOWLEDGE	49	-1.39	ok	2.48	5.48	leptokurtic
RISK HAZARD	49	.02	ok	- .74	2.26	ok
Motives: habit	49	1.28	ok	2.44	5.44	leptokurtic
Motives: addiction	49	.19	ok	- .48	2.52	ok
Motives: neg affec	49	- .42	ok	- .18	2.82	ok
Motives: pleasure	49	.31	ok	- .62	2.38	ok
Motives: stimul	49	.99	ok	.78	3.78	ok
Motives: sensory	49	.30	ok	-1.07	1.93	platykurtic
Reasons Level 1	49	.16	ok	.15	3.15	ok
Reasons Level 2	49	- .30	ok	- .58	2.42	ok
Reasons Level 3	49	.28	ok	- .43	2.57	ok
REASONS	49	.09	ok	- .29	2.71	ok
DB Pros	49	.23	ok	- .71	2.29	ok
DB Cons	49	- .08	ok	- .74	2.26	ok
DB DIFFERENCE	49	.11	ok	- .33	2.67	ok

Table 8, cont...

TABLE 8, cont. - Normality of Decision-making Variables

Stage/Scale	N	Skew	+/-skew	Kurt	Kurt+3	P/L kurt
Preparation						
KNOWLEDGE	47	-2.14	ok	4.75	7.75	leptokurtic
RISK HAZARD	47	- .03	ok	- .23	2.77	ok
Motives: habit	47	1.23	ok	.91	3.91	ok
Motives: addiction	47	.41	ok	- .47	2.53	ok
Motives: neg affec	47	- .36	ok	- .89	2.11	ok
Motives: pleasure	47	- .07	ok	-1.13	1.87	platykurtic
Motives: stimul	47	1.15	ok	.73	3.73	ok
Motives: sensory	47	.97	ok	.17	3.17	ok
Reasons Level 1	47	- .06	ok	.31	3.31	ok
Reasons Level 2	46	.48	ok	.21	3.21	ok
Reasons Level 3	46	.61	ok	.26	2.26	ok
REASONS	47	- .55	ok	2.37	3.37	ok
DB Pros	47	- .28	ok	.72	3.72	ok
DB Cons	47	- .77	ok	.30	3.30	ok
DB DIFFERENCE	47	.01	ok	- .31	2.69	ok

None of the variables is significantly skewed within a stage. No variable exceeds the kurtosis critical values for the Precontemplation stage. Within the Contemplation stage, two variables (knowledge, motives: habits) are leptokurtic, and one variable is slightly platykurtic (motives: sensory). For Preparation, the knowledge variable is also leptokurtic, while motives: pleasure is platykurtic.

Stevens comments that platykurtosis is more likely to threaten power than leptokurtosis, but only if it occurs on the same variable in more than one group. This is not the case with this sample. One variable (knowledge) is leptokurtic in two groups (Contemplation and Preparation); however, as leptokurtosis has a lesser effect on alpha, and as this distortion is found only on one variable in more than one group, caution will be used in interpreting results of statistical tests using the knowledge variable, but no transformation will be conducted.

Homogeneity of the covariance matrices: In statistical investigations of latent variables, particularly regarding traits such as demographic characteristics, and states including attitudes and beliefs, it is often found (and is expected) that many of the variables will be correlated. An examination of the correlation matrices of the Decision-making variables for each stage Table 9 shows that this is so.

TABLE 9 - Correlation Matrices of Decision-making Variables, by Stage

(r ≥ |.40| are in bold)

Correlation Matrix - **PRECONTEMPLATION**

	R2	R3	R	K	DBP	DBC	DBD	RH	RC	RQ	MN	MH	MA	MP	MSt	MSe
R1	**.63**	**.55**	**.87**	-.25	.38	.06	.27	-.14	-.18	-.01	.15	-.03	.12	.13	.35	.25
R2		**.52**	**.87**	-.19	**.43**	.07	.31	.15	-.19	.02	.24	.15	.33	.17	.38	.35
R3			**.80**	-.15	**.47**	.16	.24	.10	-.19	-.03	.25	-.03	.25	.21	.33	.34
R				-.23	**.44**	.08	.30	-.13	-.20	.01	.20	.07	.23	.14	**.43**	.37
K					-.27	.00	-.24	.24	.01	.08	-.32	-.17	-.25	-.18	-.23	-.25
DBP						.38	**.50**	-.04	.01	.11	**.62**	.10	**.63**	**.53**	**.53**	.35
DBC							**-.61**	.33	.33	.03	.39	.22	**.43**	.38	**.40**	.22
DBD								-.34	-.30	.06	.16	-.12	.14	.09	.08	.09
RH									-.11	.13	.13	.20	.01	.10	.12	.07
RC										.37	.26	-.03	.13	.16	.29	.14
RQ											**.40**	-.21	-.10	.26	.16	.27
MN												-.05	**.46**	**.52**	**.49**	.26
MH													.27	.02	.07	.08
MA														**.50**	**.70**	.32
MP															**.43**	.27
MSt																**.42**

Table 9, cont...

TABLE 9, cont. – Correlation Matrices of Decision-making Variables, by Stage

Correlation Matrix – **CONTEMPLATION**

	R2	R3	R	K	DBP	DBC	DBD	RH	RC	RQ	MN	MH	MA	MP	MSt	MSe
R1	**.69**	**.79**	**.93**	−.04	.09	.30	−.23	.19	.10	−.24	.01	.39	.05	−.15	.19	−.09
R2		**.65**	**.85**	−.04	.21	.38	−.22	.17	−.11	−.20	.19	**.45**	.17	−.14	.29	.02
R3			**.91**	.06	.03	.31	−.29	**.43**	−.14	−.28	.07	**.43**	.01	−.20	.14	−.12
R				−.00	.11	.36	−.28	.24	−.05	−.27	.09	**.47**	.08	−.18	.22	−.08
K					−.01	.39	−.39	**.53**	−.16	.08	.09	−.03	−.12	−.24	.12	.00
DBP						.38	.38	.11	−.17	.05	.23	.06	.35	.31	.39	.10
DBC							**−.71**	**.47**	−.01	.14	.16	.10	.10	−.19	.18	.08
DBD								−.39	−.12	−.10	.02	−.05	.16	**.43**	.11	−.01
RH									−.17	.00	−.03	.22	.23	−.23	−.06	−.03
RC										**.57**	.04	.03	−.09	−.06	−.04	−.00
RQ											.18	−.06	−.08	.01	.04	.22
MN												.28	.36	.28	**.45**	.24
MH													**.41**	.02	.33	.09
MA														.17	.23	.10
MP															.32	.37
MSt																.21

Table 9, cont...

TABLE 9, cont. – Correlation Matrices of Decision-making Variables, by Stage

Correlation Matrix – **PREPARATION**

	R2	R3	R	K	DBP	DBC	DBD	RH	RC	RQ	MN	MH	MA	MP	MSt	MSe
R1	.56	.70	.93	−.27	.40	.07	.26	−.07	.35	.19	.37	.34	.23	−.08	.16	−.11
R2		.52	.79	−.14	.57	.02	.41	.01	.44	.19	.55	.25	.50	.13	.37	−.02
R3			.85	−.04	.07	−.01	.13	−.03	.14	.21	.19	.05	.30	.07	.12	.02
R				−.21	.52	.18	.26	.01	.30	.17	.47	.28	.34	.10	.26	−.01
K					.00	.26	−.25	.47	−.16	.13	.03	−.03	.00	.02	.12	.20
DBP						.40	.45	.03	.19	.03	.65	.25	.53	.43	.57	.27
DBC							−.64	.34	−.00	.00	.20	−.00	.19	−.02	.16	.16
DBD								−.31	.16	.02	.35	.21	.27	.38	.32	.08
RH									−.15	.15	.18	.11	.07	−.18	.11	.19
RC										.38	.24	.13	.26	−.17	.12	.06
RQ											.14	.22	.16	−.27	−.13	.12
MN												.23	.52	.29	.50	.05
MH													.25	−.11	.38	.19
MA														.30	.52	.30
MP															.40	.37
MSt																.48

The nature and magnitude of these correlations is what will determine the significance of the overall (omnibus) test statistic in analysis of variance or regression models - high correlations between variables in the same group but low correlations between groups will produce separation of groups. If this is of sufficient distance to exceed the test alpha, then the test is said to show significant group differences. As noted earlier, an advantage of multivariate analysis over univariate analysis is its ability to incorporate these intercorrelations in its tests of differences among groups. Multivariate analyses account for not only the univariate relationships between pairs of variables, but the comparison of variable matrices. Thus, the homogeneity assumption applies to both the variance and the covariance among variables in the matrices being compared.

True homogeneity of the covariance requires that all corresponding elements be equal. As this is extremely unlikely to occur in real samples, it is only necessary to determine whether the heterogeneity present significantly affects error rates. There is no program in the SAS program for determining this. However, as noted above, Stevens comments that one of the best rules of thumb is whether ratio of the largest to the smallest group size exceeds 1.5. As the ratio of the number of subjects in the three stage groups does not exceed this number, and as each group has more than 30 subjects, their variances should not be vastly different.

Another indicator is whether there is a pattern of increase by group in the ratio of the mean to the standard deviation. When the largest variances are found in the group with the smallest sample size, the F statistic is said to be liberal, that is, the Type I error rate is inflated. On the other hand, when the largest variances are associated with the largest group size, the F statistic is conservative (actual α < nominal α), and power is decreased (Stevens, p.239). Although it is preferable to compare the determinants of the variance-covariance matrices, a comparison of the univariate variances may give an indication of whether a violation of homogeneity is present. In this sample, there was no pattern of the variances by group size - the largest variances did not fall within one group, nor were they consistently associated with either the largest- or the smallest-sized group. Therefore, the assumption of equal variances was probably not significantly violated.

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