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THE IMPACT OF BEHAVIOR AND ADDICTION ON PSYCHOLOGICAL MODELS OF CIGARETTE AND ALCOHOL USE DURING PREGNANCY

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Abstract — This prospective study of 241 women investigated the impact of past behavior and psychological factors on cigarette and alcohol use during pregnancy. Smokers' cigarette use was compared with their alcohol consumption during pregnancy, and drinking among smokers was compared with that of nonsmokers. Only prior smoking directly predicted smokers' cigarette use later in pregnancy, whereas smokers' alcohol use was related to both their previous drinking and their drinking self-efficacy. Among nonsmokers, neither drinking before nor early in pregnancy was related to alcohol use later in pregnancy; only subjects' self-efficacy and their beliefs about the consequences of drinking during pregnancy predicted their subsequent alcohol use. These results are consistent with the notion that greater addictive potential lessens the direct impact of psychological factors on substance use during pregnancy. Further implications of these findings for interventions and other health-related behaviors are also discussed.

INTRODUCTION

This study examined the psychological and behavioral precursors to cigarette and alcohol consumption among pregnant women. In addition to the usual health risks associated with cigarette smoking and prolonged excess use of alcohol, these behaviors are especially dangerous during pregnancy (see Anderson, Cremona, Paton, Turner, & Wallace, 1993, for a review). For example, infants whose mothers smoked during pregnancy have significantly higher rates of congenital deformities, perinatal mortality, and sudden infant death syndrome (SIDS) (e.g., Raymond & Mills, 1993; Young, 1992; Zhang & Radcliffe, 1993). Although the effects of more moderate drinking are less clear, maternal consumption of as little as one drink per day during pregnancy has been linked to babies with abnormally low birth weights (Mills, Graubard, Harley, Rhoads, & Berendes, 1984). Due to a lack of a discernible dose threshold for these effects, pregnant women are urged to abstain from drinking alcohol during pregnancy (Kolata, 1981; U.S. Surgeon General, 1981).

Many women reduce their cigarette and/or alcohol use during pregnancy (Bolumar, Rebagliato, Hernandez-Aguador, & Florey, 1994; Ihlen, Amundsen, Sander, & Daaer, 1990), but a significant number continue to engage in one or both of these behaviors

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after conception (Rubin, Krasilnikoff, Leventhal, Berget, & Weile, 1988). Given the enormous personal and social costs associated with these behaviors, the current research sought to clarify some of the determinants of cigarette and alcohol use during pregnancy.

Developing predictive models of these behaviors during pregnancy is an important initial step toward devising effective interventions. The model used in the present research incorporates both psychological variables and past behavior to predict cigarette and alcohol use during pregnancy. The psychological components of this model are based on the Theory of Reasoned Action (Ajzen & Fishbein, 1977) and Self-Efficacy Theory (Bandura, 1977); they include (1) women's beliefs about the consequences of cigarette and alcohol use during pregnancy, (2) their perceptions of the social norms regarding cigarette and alcohol use, and (3) their feelings of self-efficacy regarding their ability to refrain from smoking and drinking while pregnant.

Role of past behavior

Although psychological variables derived from Self-Efficacy Theory and the Theory of Reasoned Action have been used to predict substance use in general (Chassin, Presson, Sherman, Corty, & Olshavsky, 1984; Lawrence, 1989) and during pregnancy in particular (Hussey, Gilchrist, Gillmore, & Lohr, 1992; Quinn, Mullen, & Ershoff, 1991), they have rarely been tested with regard to past behavior. One of the best predictors of health-related behaviors—including cigarette and alcohol use—has been the extent to which individuals have previously engaged in these behaviors (Bolumar et al., 1994; Stacy, Bentler, & Flay, 1994). Surprisingly, previous research has generally failed to evaluate simultaneously the impact of past behavior and psychological variables on subsequent health-related behaviors. Because previous behavior may influence concurrent psychological measures as well as ensuing behavior, a question remains regarding the independence of these variables from past behavior. This may be particularly true for addictive behaviors, where past behaviors are closely linked to later behavior, and where, as a result, psychological variables may reflect, rather than direct, behavior. The present research examined the extent to which the psychological factors help to predict maternal cigarette and alcohol use during pregnancy, independent of their association with these behaviors prior to pregnancy.

Addictive potential

In addition to the multitude of research attesting to the addictive quality of cigarettes (e.g., Henningfield & Keenan, 1993; Ochoa, 1994) and alcohol (e.g., Carroll, Stitzer, Strain, & Meisch, 1990) individually, studies have also examined the relative addictive potential of these two substances (see Jasinski, 1991, for a review). Results of these comparisons suggest that the addictive potential—also referred to as “abuse liability” or “dependence potential”—of cigarettes (i.e., nicotine) is greater than that of alcohol (i.e., ethanol) (Woody, Cottler, & Cacciola, 1993).

Evidence also shows that women have greater difficulty abstaining from smoking than from drinking during pregnancy. Among women who consumed both cigarettes and alcohol, Waterson and Murray-Lyon (1989) found that a greater percentage continued to smoke during pregnancy than continued to drink, suggesting that these behaviors may differ in their addictive quality among pregnant women. If cigarettes are more addictive than alcohol during pregnancy, the link between past and present behavior may be especially strong—and the role of psychological variables relatively weak—for cigarette smoking. In turn, past behavior might be expected to have greater

influence on smoking than on drinking during pregnancy, and psychological variables might be expected to exert less influence on cigarette use than on alcohol use.

Mutability of addictive potential

Although cigarettes and alcohol appear to be differentially addictive during pregnancy, the addictive potential of these (and other) substances may vary widely depending on the setting or population being considered. For example, Walpole, Zubrick, and Pontre (1989) found that women who smoked more were less likely to reduce their alcohol consumption during pregnancy than were those who smoked less. It may be that smoking increases the addictive potential of alcohol (perhaps by creating more cues for its use), or it could be that those inclined to smoke are also less inclined to reduce their alcohol consumption. In either case, such an association between cigarette and alcohol use illustrates the mutability of addictive potential, and it has implications for the ability of psychological measures to predict maternal drinking during pregnancy. If smoking makes drinking more resistant to change, the influence of psychological variables on drinking during pregnancy may be weaker for smokers than for nonsmokers.

The preceding suggests that cigarette smoking among pregnant women is more addictive than alcohol use, and that drinking among pregnant smokers is more addictive than drinking among pregnant nonsmokers, either because of its being combined with another addictive behavior or because of underlying individual differences. As such, alcohol use among smokers may be influenced more by previous drinking and less influenced by psychological factors than drinking among nonsmokers.

Hypotheses

To address these questions, the present study investigated the determinants of cigarette and/or alcohol use—including prior use and psychological measures—among two groups of pregnant women: smokers and nonsmokers. Smokers' cigarette use during pregnancy was compared with their alcohol use, and smokers' alcohol use was compared with that of nonsmokers to test the following hypotheses:

1. That past behavior will have less influence on smokers' alcohol use during pregnancy than on their cigarette use;
2. That psychological variables will have a greater influence on smokers' alcohol use during pregnancy than on their cigarette use;
3. That past behavior will have less influence on alcohol use during pregnancy among nonsmokers than among smokers;
4. That psychological factors will have a greater influence on alcohol use during pregnancy among nonsmokers than among smokers.

M E T H O D

Participants

Participants were 241 pregnant women ranging in ages from 16 to 43 years, with an average age of 29. Of these, 180 (75%) were Caucasian, 24 (10%) were African-American, 21 (9%) were Latino, and the remaining 6% included a mix of various other ethnic backgrounds. Seventeen of the subjects had yet to complete a high school education, 34 had completed high school but had not attended college, while the majority of subjects had either attended some college courses (101), graduated from college (61), or received a graduate degree of some kind (28). Although 10% of subjects reported

household incomes of less than \$10,000 per year, the average yearly income was approximately \$35,000. The majority of subjects (165) were married, 63 were single, and 13 were either separated or divorced.

Procedure

Participants were pregnant women recruited from eight different prenatal clinics throughout the San Francisco Bay Area. Subjects were approached at the time of their first prenatal visit by either a research assistant or a clinic staff member who gave potential participants a brief description of the study and a short questionnaire to fill out indicating whether they were interested in participating.¹ Only those who were at least 16 years old, able to read and speak English, and who had received no more than one prenatal visit prior to the first study interview were considered for participation.

The present study included two interviews; the first (Time 1) interview was conducted approximately 1 month after the pregnancy was confirmed, and the second (Time 2) interview was conducted during the 7th month of pregnancy. Within the pool of potential subjects, 17% were smoking near the time of their pregnancy confirmation. By comparison, the 1988 National Health Interview Survey (Mainous & Hueston, 1994) found that 31% of women smoked prior to pregnancy. Smokers (those who reported having smoked at least once within 2 weeks of pregnancy confirmation) were thus over-sampled in the present study to obtain an adequate number of smokers, and they constituted approximately 34% (116) of the initial (Time 1) research sample. Saliva samples, later analyzed for cotinine, were collected for all subjects at the time of the first interview. To encourage honest self-reports, subjects were informed of this before answering any questions concerning cigarette use. These efforts appeared to be successful, in that the cotinine levels of only 5 of the 226 self-reported nonsmokers were above the cutoff of 14.2 mg/ml, suggesting that they had inaccurately reported their smoking status. The data from these subjects were dropped from subsequent analyses.

Attrition

Of the initial sample of subjects, 37 (32%) smokers and 36 (16%) nonsmokers did not return for the second interview, either because of miscarriage, abortion, early delivery, their moving to a new geographical location, or their declining to continue with the study (see Fig. 1). The vast majority (90%) of both smokers and nonsmokers reported drinking to some degree (i.e., consuming some alcohol at least once a week) 3 months before their last menstrual period. To minimize potential extraneous differences between the models being compared (i.e., between drinkers and nondrinkers), the 27 (10%) nondrinkers were excluded from subsequent analysis, as were the data from the one self-reported nonsmoker whose cotinine level indicated she had smoked near the time of the second interview. As a result, the final sample on which the present analyses were conducted included 72 smokers and 169 nonsmokers.

Instrument: Independent measures (Time 1 interview)

Beliefs. In a pilot study with a different sample, open-ended interviews were conducted to obtain salient beliefs about the positive and negative consequences of cigarette and alcohol use during pregnancy. Responses to these interviews were then used

¹The women were told that the study was on "pregnancy and health," so there was no specific focus on either smoking or drinking.

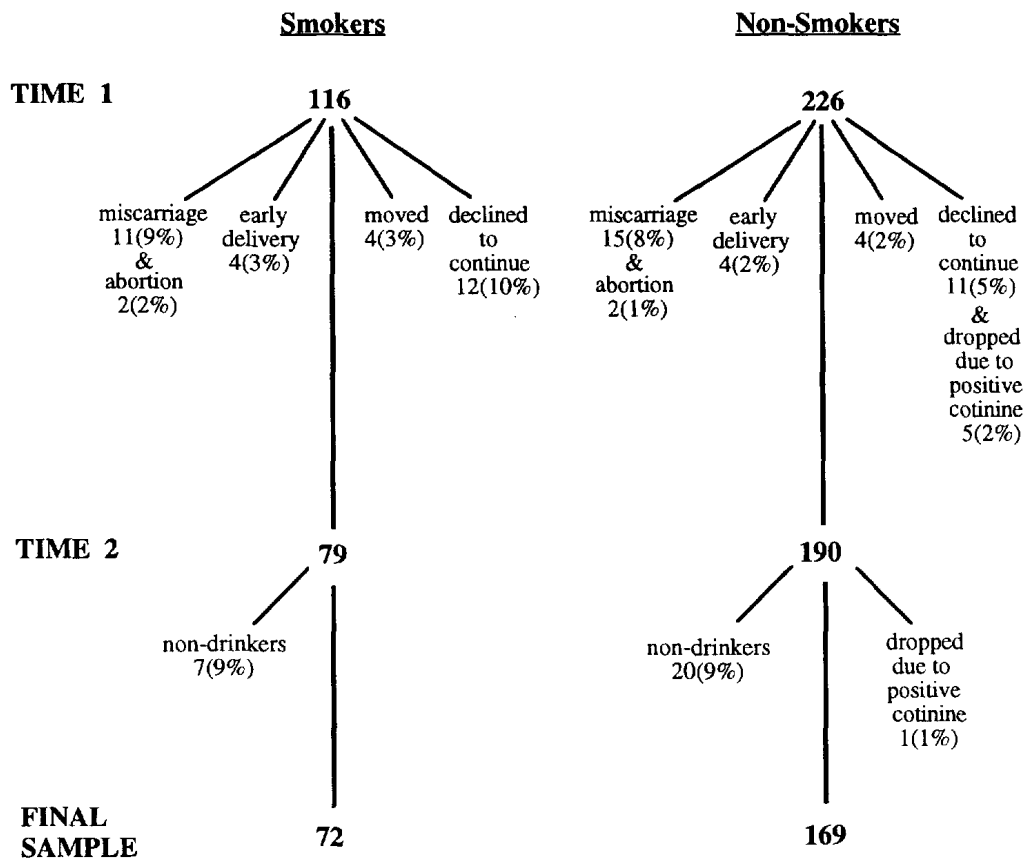


Fig. 1. Attrition of smokers and nonsmokers over the course of the study.

to derive 23 outcome items used in the final study. Only self-reported smokers completed the items concerning cigarette use. The measure of subject's beliefs about smoking and drinking during pregnancy was the summed product of two components: beliefs about the likelihood of each outcome, and beliefs about the outcome's desirability.

For smoking, the first component was comprised of each subject's estimates of how likely (on a scale from 1–7, "very unlikely—very likely") that each outcome would occur to her if she smoked the same number of cigarettes during the remainder of her pregnancy as she had before she became pregnant. These items included a comparable number of both positive outcomes (e.g., "If I smoke during pregnancy, I will be less stressed and more relaxed") and negative ones (e.g., "If I smoke during pregnancy, I will be nauseous and sick"). The second component consisted of each subject's evaluation of how good or bad each outcome would be (on a scale from –3 to +3, "bad—good") if it were to happen. These likelihood and evaluation ratings were then multiplied and their products combined for each subject to create an overall measure of that subject's beliefs toward cigarette smoking during pregnancy. A higher score indicates that the individual held more positive beliefs toward smoking.

Beliefs concerning drinking during pregnancy were derived in the same way as for smoking: Each subject indicated how likely she thought each outcome would be to occur if she consumed the same number of drinks during pregnancy as she had before

pregnancy. The likelihood score for each outcome was then multiplied by the subject's evaluation of that outcome, and the resulting scores were totaled for each subject.

Norms. As with beliefs, the items used to evaluate subjective norms were derived from open-ended pilot interviews, and the overall measure was constructed by summing the products of two scales. The first scale indicated the extent to which subjects perceived that various significant others (e.g., mother, father, partner) felt that the subject should or should not continue to smoke and/or drink during her pregnancy. Responses were on a 7-point scale ranging from "definitely should" (7) to "definitely should not" (1) engage in the behavior. The second scale indicated subjects' motivation to comply with the opinions of each of these individuals, ranging from "want to" (7) to "don't want to" (1) do what the individual wants them to do. A high overall score indicated that the subject perceived her normative environment to be favorable to the behavior being considered, and a low score meant that she perceived her immediate social environment to be unfavorable to the behavior.

Measurements of beliefs and norms were developed using the standardized procedure in assessing components of the Theory of Reasoned Action. Because individual beliefs and referents were combined to create overall indices, the extent to which these psychological variables are either positively or negatively related to substance use during pregnancy are based on the overall scale rather than their individual components.

Self-efficacy. To develop a measure of smoking self-efficacy, the pilot subjects were asked open-ended questions about what things would make it easier to decrease smoking, and what would make it more difficult. The 24 most frequent responses comprise the current self-efficacy items, in which each subject indicated how confident she was that she would not smoke in each circumstance (e.g., "When I am worried about gaining weight"). Each subject rated how confident she was (on a 0–4 scale, "not at all confident—extremely confident") that she would not smoke between the interview at Time 1 and her 7th month of pregnancy. These confidence ratings were averaged to create an overall measure of smoking self-efficacy.

The self-efficacy measure for alcohol use included seven situations related to drinking during pregnancy (e.g., "When I want to go out and have a good time"). Otherwise, the confidence rating scales and time frames for drinking self-efficacy were identical to those used for smoking self-efficacy, and mean scores were obtained in the same way.

Past behavior. Subject reports of their previous cigarette consumption (in cigarettes per day) were obtained for two time periods: (1) the 3 months prior to their last menstrual period (LMP), and (2) early pregnancy (i.e., between the pregnancy confirmation and Time 1 interview). Each subject also indicated how many drinks per week she had consumed during these two time periods. One drink was equal to 12 oz of beer, 5 oz of wine, or 2 oz of hard liquor.

Dependent measures (Time 2 interview)

Cigarette smoking. During the second interview, subjects reported their average daily consumption of cigarettes from the time of the initial interview through the first 6 months of pregnancy.

Alcohol use. Three indices of subjects' alcohol consumption during pregnancy were also obtained at the second interview. First, subjects reported the number of days per week since the first interview in which they did not drink at all.² Second, they indicated how frequently they had consumed enough alcohol to become drunk.³ Third, subjects reported how often they had had four or more drinks on any given day. Because relatively few subjects continued to drink during pregnancy (leading to significant skews in the distributions of these measures), these three scales were then normalized and combined to form a single index (Cronbach's alpha = .66).

Primary analyses

Multiple regression and path analyses were conducted to investigate the interrelationships between the behavioral and psychological measures at Time 1, and to determine their relative impact during pregnancy on (1) smokers' cigarette use, (2) smokers' alcohol use, and (3) alcohol use among nonsmokers. For each model, a path analysis was first conducted, which included substance use before and during early pregnancy, as well as subjects' beliefs, perceived norms, and self-efficacy regarding these behaviors. Substance use later in pregnancy (measured at Time 2) was then regressed on these prior behavioral and psychological measures. Together, these analyses enabled us to identify the relationships between the variables in each model while controlling for the influence of all other variables in the analysis.

R E S U L T S

Overview of substance use during pregnancy

Sixty-five percent of self-reported smokers reported smoking during the first 6 months of pregnancy, and 29% continued to drink alcohol during this period. Among self-reported (and confirmed) nonsmokers, 21% continued to drink to some degree through the first 6 months of pregnancy.

Preliminary analysis

The zero-order correlations between the variables in each model are shown in Table 1. For smokers' cigarette use, all of the variables in the model were significantly correlated except smokers' beliefs about the consequences of smoking during pregnancy and the degree of smoking prior to pregnancy. The strongest psychological predictor of subsequent cigarette during pregnancy was subjects' self-efficacy concerning their ability not to smoke during this period ($r = -.63, p < .001$).

As with cigarette use, smokers' previous alcohol use—both before and during early pregnancy—was predictive of their drinking later in pregnancy ($r = .41, p < .001$, and $r = .74, p < .001$, respectively), as was smokers' self-efficacy regarding abstaining from alcohol use ($r = -.65, p < .001$). Unlike cigarette use, smokers' drinking during the second trimester was not related to their beliefs about the consequences of drinking or their perceptions of its acceptability in their immediate social environment. In fact, social norms were unrelated to any other aspect of smokers' alcohol use before or during pregnancy.

²This scale had five points: 1 indicated "never," 2 indicated "1–2 days/week," 3 indicated "3–4 days/week," 4 indicated "5–6 days/week," and 5 indicated "7 days/week."

³This scale had eight points: 1 indicated "every day," 2 indicated "3–6 times/week," 3 indicated "1–2 times/week," 4 indicated "a few times/month," 5 indicated "once/month," 6 indicated "once every couple of months," 7 indicated "once/year," and 8 indicated "never."

Table 1. Correlation matrices for each model of substance use during pregnancy

| | Behavior prior to pregnancy | Behavior at start of pregnancy | Time 1 beliefs | Time 1 norms | Time 1 self-efficacy | Behavior later in pregnancy |
|-----------------------------------|-----------------------------------|--------------------------------------|-------------------|-----------------|-------------------------|-----------------------------------|
| Smokers' Cigarette Use | | | | | | |
| Behavior prior to pregnancy | 1.000 | .56** | .14 | .32** | -.53** | .58** |
| Behavior at start of pregnancy | | 1.000 | .27* | .34** | -.71** | .83** |
| Time 1 beliefs | | | 1.000 | .25* | -.27* | .27* |
| Time 1 norms | | | | 1.000 | -.38** | .30* |
| Time 1 self-efficacy | | | | | 1.000 | -.63** |
| Smokers' alcohol use | | | | | | |
| Behavior prior to pregnancy | 1.000 | .29 | .21 | -.10 | -.23 | .41** |
| Behavior at start of pregnancy | | 1.000 | .32* | .01 | -.65** | .74** |
| Time 1 beliefs | | | 1.000 | .27 | -.21 | .17 |
| Time 1 norms | | | | 1.000 | .03 | -.03 |
| Time 1 self-efficacy | | | | | 1.000 | -.65** |
| Nonsmokers' alcohol use | | | | | | |
| Behavior prior to pregnancy | 1.000 | .36** | .29** | .07 | -.23** | .15 |
| Behavior at start of pregnancy | | 1.000 | .22** | .11 | -.53** | .11 |
| Time 1 beliefs | | | 1.000 | .15 | -.26** | .28** |
| Time 1 norms | | | | 1.000 | -.09 | .09 |
| Time 1 self-efficacy | | | | | 1.000 | -.70** |

*Indicates significance at .05 level.

**Indicates significance at .01 level.

Nonsmokers' beliefs and self-efficacy regarding alcohol use during pregnancy were highly associated with their drinking prior to and early in their pregnancies. These psychological measures were also related to nonsmokers' subsequent alcohol use in the second trimester ($r = .28, p < .001$, and $r = -.70, p < .001$, respectively). In contrast to smokers' alcohol and cigarette use during pregnancy, alcohol use among nonsmokers in the second trimester was unrelated to previous use. Nonsmokers' perceived norms concerning drinking during pregnancy were unrelated to other aspects of their alcohol use during pregnancy, as they were with alcohol use among smokers.

Models of substance use

Three path analyses were conducted to examine the influence of the behavioral and psychological variables on cigarette use among smokers and alcohol use among smokers and nonsmokers.

Smokers' cigarette use. As can be seen in Figure 2, the only factors that exerted a direct influence on smokers' cigarette use through the first 6 months of pregnancy were

their level of smoking prior to pregnancy ($\beta = .17, p < .05$) and at the start of pregnancy ($\beta = .70, p < .001$). The greater the number of cigarettes subjects smoked before and early in pregnancy, the more they smoked later during pregnancy. Greater cigarette use prior to pregnancy was also related to more smoking in early pregnancy ($\beta = .37, p = .01$), which in turn was associated with lower smoking self-efficacy ($\beta = -.55, p < .001$). Neither of the other psychological variables (i.e., norms or beliefs) were related to any of the other aspects of cigarette use before or during pregnancy. Despite the zero-order correlation between self-efficacy and smoking in the second trimester, self-efficacy was not related to later smoking once previous measures of cigarette use were included in the model.

Smokers' alcohol use. As with cigarette use, the more alcohol smokers consumed prior to pregnancy, the more they drank later during pregnancy ($\beta = .22, p < .05$).⁴ Smokers' drinking in early pregnancy was also directly related to their alcohol use later in pregnancy ($\beta = .52, p < .001$). Smokers' alcohol consumption in the second trimester of pregnancy was also influenced by their feelings of self-efficacy about drinking; those who were more confident at the first interview that they would not drink during pregnancy later reported drinking less later in pregnancy than those who were initially less confident ($\beta = -.27, p < .05$). The two measures of previous alcohol use were also associated with each other ($\beta = .33, p < .05$), and drinking during early pregnancy was significantly related to smokers' drinking self-efficacy ($\beta = -.62, p < .001$). However, self-efficacy was linked to later drinking even when prior behavior was included. Neither smokers' beliefs about the consequences of drinking nor their perceived social norms about drinking during pregnancy were related to other components of this model.

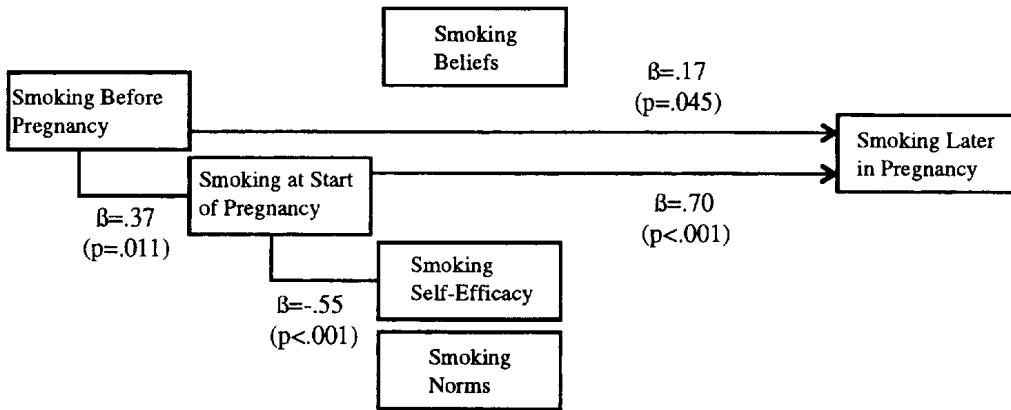
Nonsmokers' alcohol use. In contrast to both cigarette and alcohol use among smokers, drinking in later pregnancy among nonsmokers was not significantly related to their drinking prior to pregnancy or early in pregnancy. However, consistent with smokers, nonsmokers who had greater confidence that they wouldn't drink during pregnancy drank less later in pregnancy than did those with less confidence ($\beta = -.32, p < .01$). In addition to self-efficacy, alcohol use among nonsmokers was also directly related to their beliefs about the effects of drinking while they were pregnant; those with more negative beliefs about the consequences of drinking during pregnancy drank less during pregnancy than did those with less negative beliefs ($\beta = .20, p < .05$).

Model comparisons

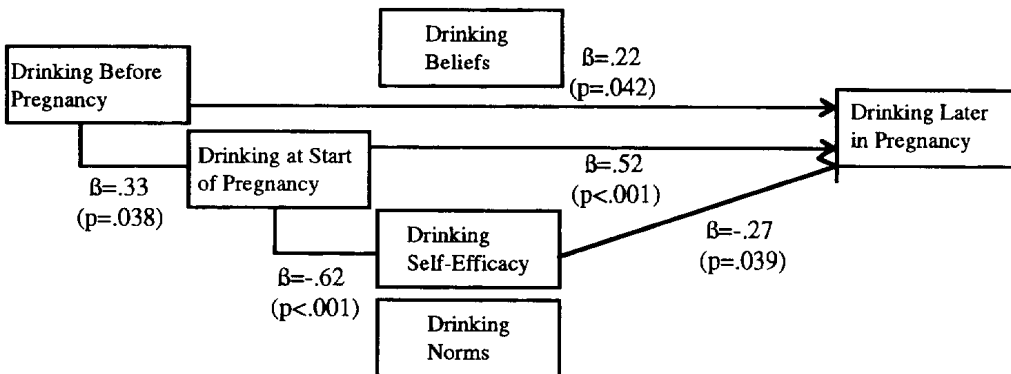
Cigarette vs. alcohol use among smokers. For both cigarette and alcohol use among smokers, substance use through pregnancy was significantly and directly influenced by the extent to which subjects had engaged in the behavior previously. In addition, substance use prior to pregnancy in both models exerted a direct influence on use in early pregnancy, which was associated in both models with subjects' self-efficacy regarding the behavior. These results suggest that self-efficacy may impact smokers' subsequent cigarette and alcohol use during pregnancy through its association with previous behavior. While none of the psychological measures were associated with cigarette use,

⁴Because of a clerical error, the questions regarding Time 2 alcohol use were not included in the first 27 smoker questionnaire packets. As a result, the model of smokers' alcohol use was calculated using the data from the remaining 45 subjects.

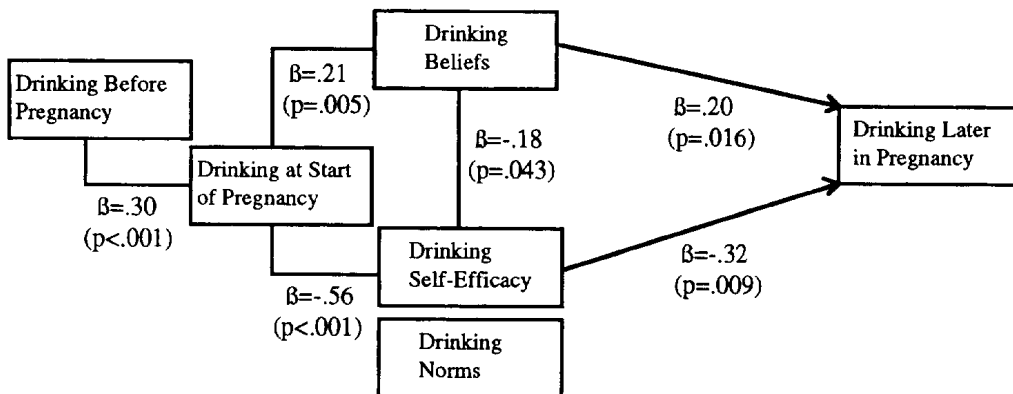
(a)



(b)



(c)



smokers' self-efficacy regarding their ability not to drink was directly related to their drinking later in pregnancy, above and beyond the significant effects of their previous drinking. These results suggest that smokers' cognitions had a more direct influence on their drinking during pregnancy than on their smoking.

Smokers' vs. nonsmokers' alcohol use. Greater subject self-efficacy regarding the ability to abstain from drinking during pregnancy was directly associated with alcohol use among both smokers and nonsmokers. These two models also contain significant relationships between substance use before and early in pregnancy, and between behavior in early pregnancy and subjects' self-efficacy regarding the behavior. However, unlike smokers (whose cigarette and alcohol use were both related to past behavior), nonsmokers' alcohol consumption later in pregnancy was not a function of their alcohol use either prior to or early in pregnancy. Also, while smokers' beliefs about the consequences of drinking during pregnancy exerted no detectable influence on their alcohol use later in pregnancy, these perceptions were significantly related to Time 1 self-efficacy and drinking, and they directly predicted alcohol use later in pregnancy. These results indicate that while self-efficacy has direct (and potentially indirect) impact on smokers' and nonsmokers' alcohol use through pregnancy, beliefs about the consequences of substance use during pregnancy appear to be more relevant to alcohol use among nonsmokers than to either cigarette or alcohol use among smokers.

DISCUSSION

Past behavior became an increasingly weaker predictor of substance use during pregnancy when moving from cigarette use to alcohol use among smokers, and from alcohol use among smokers to alcohol use of nonsmokers. The opposite was true for psychological factors, which played an increasingly prominent role in predicting substance use across both behaviors and groups. These findings suggest that behavioral factors may exert greater influence on pregnant women's cigarette smoking than on their alcohol consumption, and that psychological factors may have a greater impact on nonsmokers' alcohol use than on drinking among smokers.

Reported substance use prior to pregnancy was directly related to use at the start of pregnancy in each of the three models. Also, self-efficacy regarding their ability to refrain from these behaviors was negatively associated with subjects substance use at the start of pregnancy in each model. Because these relationships are cross-sectional, we cannot tell whether higher self-efficacy contributed to less substance use early in pregnancy or whether less substance use enhanced feelings of self-efficacy. Some mutual causation is likely. What is more important is that greater self-efficacy in early pregnancy led directly to less drinking—independent of past behavior—later in pregnancy among both smokers and nonsmokers. This suggests that self-efficacy guides subsequent drinking.

In contrast, the failure to find an association between self-efficacy and cigarette use suggests that self-efficacy may play a less important role in determining subsequent behavior despite significant zero-order relationships between self-efficacy with past and present smoking. This is consistent with the view that tobacco is more addictive

Fig. 2. Path models of predicting (a) cigarette use, (b) alcohol use among smokers, and (c) alcohol use among nonsmokers during pregnancy. Solid lines indicate the unique linear relationships significant to a .05 level. The top number associated with each line represents the standardized regression coefficient associated with that relationship, and the number in parentheses represents its corresponding *p*-value.

and that self-efficacy may be more closely tied to previous behavior and less able to influence future smoking. For smoking, past behavior indicates habit strength; one's self-efficacy regarding abstinence is likely to reflect her awareness of the difficulty of changing this habit. If alcohol has a lower addictive potential than tobacco, smoking prior to pregnancy would not be expected to be as strongly associated with self-efficacy regarding abstinence later in pregnancy.

Although self-efficacy regarding abstaining from alcohol use played a similar role in both smokers and nonsmokers, beliefs about the consequences of drinking contributed to subsequent use only among nonsmokers. This could reflect the larger sample size of nonsmokers, making it easier to find a significant relationship. However, this would not explain the significant impact of past behavior on drinking among smokers but not among nonsmokers, despite the smaller sample size of smokers. It also does not explain the fact that the strength of the relationship between beliefs and subsequent alcohol use was almost three times greater among nonsmokers ($\beta = .20$) than among smokers ($\beta = .07$). Rather, it may be that smoking provides cues for drinking, or that smokers possess characteristics that make it more difficult for them to quit drinking despite their beliefs about its consequences during pregnancy. In either case, alcohol may have a greater addictive potential for smokers than for nonsmokers, such that alcohol use later in pregnancy is associated with past behavior but not with beliefs.

Contrary to expectations, subjective norms were of no predictive value in any of the present models. Previous studies that have found such an association have not controlled for the influence of previous behavior. Although the initiation of health-risk behaviors may be significantly influenced by an individual's perceived social expectations, once adopted, these behaviors may be less influenced by such externally focused constructs than by those factors—such as beliefs and self-efficacy—more specific to the individual.

The potential limitations of this study include the fact that the behavioral data relied on self-reports. As such, the reports of both cigarette and alcohol use during pregnancy may have been biased. However, Fox, Sexton, Hebel, and Thompson (1989) found self-reports of cigarette and alcohol use by pregnant women to be largely reliable. In addition, every effort was made in the current study to encourage accurate reporting, including verification of cigarette use by cotinine; analysis of the cotinine results indicated that only a few women underreported their smoking.

Second, we obtained a relatively low percentage of smokers within the original pool of potential participants compared to the percentage found for the United States. This may have been a result of placing the criterion for smoking near the time of pregnancy confirmation; some women may have been smokers earlier but quit in anticipation of pregnancy. Smokers may also have been less willing to fill out informational forms related to smoking while in a medical setting, where our subjects were recruited. Finally, the difference in smoking rates between our sample and those found for the United States may reflect other differences (e.g., in health-related attitudes) between these two populations. To the extent that U.S. smoking rates have declined since the national data were collected, the present results may be more representative of the country as a whole. However, we must be cautious in generalizing our findings to broader populations.

Third, because cigarette and alcohol use differ in many respects other than apparent addictive potential (e.g., mode of administration, impact on the central nervous system), we must be cautious when comparing these behaviors directly. Although consis-

tent with our hypotheses, differences in the determinants of these behaviors might also reflect differences in their other characteristics. Similarly, the measures of alcohol use differ somewhat between the Time 1 and Time 2 interviews. The former measured the absolute consumption and the latter measured the extent to which subjects abstained from drinking. Differences in measurement would be expected to reduce the observed relationship between past and present alcohol use. This may explain, in part, why past behavior was a better predictor of smokers' cigarette use than of their alcohol use, since cigarette use was measured in the same way at both interviews. On the other hand, it does not explain why self-efficacy influenced smokers' Time 2 alcohol use but not their subsequent use of cigarettes.

Fourth, the model of smokers' alcohol use included only 45 subjects—27 fewer than in the model of cigarette use—which would make it more difficult to detect associations between alcohol use and other variables. Although this might otherwise help explain why past behavior was a weaker predictor of smokers' drinking than of their smoking, we also found that previous drinking had a significant impact on subsequent alcohol use among the smaller set of smokers, but not among the larger group of non-smokers.

That psychological measures did not directly impact cigarette use later in pregnancy suggests that approaches focused on beliefs and norms (and perhaps self-efficacy) regarding smoking may be of limited use in reducing smoking during pregnancy. In contrast, such psychological factors (particularly self-efficacy) appear to have a significant influence on alcohol use during pregnancy, especially among nonsmokers. The fact that psychological variables had greater predictive power for drinking among non-smokers than among smokers also suggests the importance of considering potential differences between subject populations as well as their health-risk behaviors.

Results of this study illustrate the importance of controlling for past behavior when attempting to discern the influence of psychological factors on cigarette and alcohol use. Conversely, these findings also suggest that psychological factors may play an important role in helping to understand and reduce certain health-risk behaviors during pregnancy, especially those that are less addictive.

Finally, these findings also suggest further research on the influence of psychological and behavioral factors on cigarette and alcohol use during pregnancy within (and between) other subject populations. A broader range of addictive behaviors (e.g., caffeine, cocaine, amphetamine use) might also be used to further test the extent to which the relative impact of behavioral and psychological measures varies with the addictive potential of the substance being considered. Supportive findings would suggest that psychologically based approaches might be most effective for less addictive behaviors, and that more behavioral interventions need to be developed for more addictive behaviors, as well as for groups whose behaviors are less strongly linked to psychological factors. In this way, a more complete understanding of addictive potential may enable us to develop more effective approaches to reducing the consumption (and consequences) of these and other health-risk behaviors.

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