# CHANGES OVER TIME IN WEIGHT CONCERNS AMONG WOMEN SMOKERS ENGAGED IN THE CESSATION PROCESS

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## ABSTRACT

*Weight concerns have been reported by women smokers to be barriers to initial cessation and to sustained abstinence. This article examines the temporal patterns of weight concerns and self-efficacy for cessation among three groups of women smokers: non-quitters, short-term quitters, and long-term quitters. Subjects were 417 women aged 20–64 who had participated in a randomized smoking cessation intervention trial. Over the twelve-month follow-up, long-term quitters reported greater increases in weight gain, pain and worry related to weight, dieting behaviors, and self-efficacy for maintaining cessation in eating-related situations compared to non-quitters and short-term quitters. In multivariate analyses, increases in pain and worry about weight and in self-efficacy in eating-related situations were significantly associated with sustained abstinence. Cessation-specific weight concerns and dieting were not associated with sustained abstinence. Implications of these results for intervention design are discussed.*

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## INTRODUCTION

Weight gain is a common sequela of smoking cessation. The majority of smokers who quit will gain 5 to 10 pounds with a small proportion (up to 15%) gaining 25 or more pounds (1–3). Some research suggests that women who quit smoking may be at greater risk of gaining weight and may gain more weight than their male counterparts (2,4). The high prevalence of concern about weight gain, desire to lose weight, dissatisfaction with appearance, and active weight control efforts among women across age and ethnic groups (5–10) indicates the ubiquity of weight concerns in women's lives. Thus, it is not surprising that concern about weight gain has been widely reported by women as a barrier to both attempts to quit smoking and to sustained abstinence (11–16). However, the consistent positive association between weight gain and sustained abstinence (2,3,11,17,18) and the lack of evidence that weight gain precipitates initial smoking episodes among relapsers (19) suggest that it is subjective weight concerns, not weight gain alone, that may inhibit cessation. Moreover, the failure of well-designed weight control adjuncts to enhance cessation rates or prevent weight gain has led many to conclude that intervention efforts should focus on diminishing weight concerns rather than preventing weight gain (20–23).

The few empirical studies of the association between subjective weight concerns and success at smoking cessation have been mixed. French and her colleagues (9) found that history of dieting and lean personal weight standards, indicative of high weight concerns, were positively associated with smoking cessation for women in a large work-site based sample. Klesges and colleagues (14) found high baseline smoking-specific weight concerns to be negatively associated with smoking cessation in their work-site sample of 44 adult smokers. These inconsistent results may be due to reliance on unidimensional indicators of weight concerns, often represented by a single question, that differed across the studies (11). In addition, these studies assessed weight concerns at a single point in time to predict distal smoking outcomes. One study that examined temporal patterns of weight concerns among smokers who were attempting to quit reported that weight concerns diminished over time among continuous abstainers (24). This small study ($N$ = 48) included only twelve weeks of follow-up and did not examine changes in weight concerns among long-term abstainers who are at the greatest risk of significant weight gain. The question of whether diminishing weight concerns enable quitters to sustain abstinence or, alternatively, whether increases in weight concerns precipitate return to smoking remains largely unexplored. Examining long-term temporal patterns of weight concerns among smokers engaged in the quitting process could help researchers to plan weight-related adjunctive programs that address the weight concerns of smokers as they move through the cessation process.

To this end, we describe changes over time in a comprehensive set of general and cessation-specific weight concerns and smoking-related self-efficacy measures among three groups of women smokers: non-quitters, short-term quitters, and long-term quitters. Subjects were women who took part in a randomized smoking cessation trial designed specifically for women who were concerned about gaining weight while quitting smoking. Two questions guided our analyses: (a) Do temporal patterns in weight concerns and self-efficacy in avoiding cessation-related weight gain differ among non-, short-, and long-term quitters? and (b) Do these patterns suggest a "best" time to offer weight-related intervention adjuncts for smokers engaged in the cessation process?

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## METHODS

### Study Population

Subjects were 417 women aged 20–64 who had participated in a randomized smoking cessation intervention trial (20). The intervention trial compared the efficacy of nicotine replacement therapy and behavioral weight control instruction for smoking cessation among weight-concerned women. Women smokers were recruited from a list of previous participants in a cardiovascular risk factor screening and via newspaper advertisements. Women who expressed a desire to gain weight ($N$ = 69), were currently pregnant or nursing an infant ($N$ = 18), or had medical conditions which contraindicated Nicorette gum use (e.g. history of gastric ulcer or temperomandibular joint disease; $N$ = 78) were determined to be ineligible for the study in the initial telephone screening. An additional eleven women were determined to be medically ineligible at the baseline screening clinic.

Women who participated in the trial were on average 42 years of age, 26% were college graduates, and over 90% were White. The women averaged 107% of the median recommended weight for height, and the average body mass index was 24 kg/m$^2$. The women smoked an average of 26 cigarettes per day, and 75% smoked within 30 minutes of waking.

### Randomized Trial Intervention

The trial was a 2 × 2 factorial design that crossed nicotine replacement therapy with a behavioral weight control program. All women in the trial received the American Lung Association's Freedom From Smoking Program (FFS), an eight-week group program with an orientation meeting plus seven treatment sessions. The control group received only the FFS program. In addition, a second group received Nicorette gum to assist with weight maintenance while quitting smoking. A third group received a behavioral weight control program incorporated as part of their eight group sessions. A fourth group received both Nicorette gum and the behavioral weight program. Results of the randomized trial indicated that cessation rates were significantly higher among the Nicorette-only group at the end of treatment and at six- and twelve-month follow-ups (20). There was no impact of the interventions on postcessation weight gain.

## MEASURES

### Timing of Measurement

Women completed a battery of questionnaires at baseline and at the six- and twelve-month clinic follow-ups. A detailed smoking history, weight history, sociodemographic profile, weight, height, and saliva and expired air samples were collected during these clinic visits. Weight, saliva and expired air samples, and smoking status were also collected at the final session of the treatment. In addition, a set of cessation-specific weight concern questions that were not asked in the baseline assessment were included in a questionnaire women completed at the final treatment session.

### General Weight Concerns

Measures of general weight concerns included in the baseline and six- and twelve-month questionnaires are described below.

*Three Factor Eating Questionnaire:* The Three Factor Eating Questionnaire (TFEQ) (25) assesses three subdimensions of weight and eating-related concerns: (a) Cognitive restraint, the degree to which a person consciously monitors and controls food and caloric intake; (b) Disinhibition, vulnerability to disruption of eating control (e.g. by the sight or smell of food or due to emotional upset); and (c) Hunger awareness and sensitivity to feelings of hunger. The TFEQ has been widely used in studies of obesity, eating disorders, and general weight-related behavior and is reliable and valid (25,26).

*Emotions Related to Weight:* These measures were adapted from the Health Insurance Study (27). Three questions assessed the extent to which weight had caused the woman emotional pain or worry or kept her from doing things other people her age do. Responses for the first two questions were coded on five-point Likert scales ranging from "not at all" to "a great deal." The third question was scored on a five-point scale ranging from "none of the time" to "all of the time."

*Satisfaction with Body Image:* This was assessed using Furnham and Alibhai's picture scale (28) on which women indicated their current body shape and their ideal body shape from a series of body silhouettes. The numeric difference between the woman's ideal body shape and her perceived current body shape was calculated to indicate body image satisfaction. A greater difference between the woman's ideal and current body shape indicated greater body image dissatisfaction.

*Dieting Behaviors:* These were measured with three Yes/No questions about whether the woman was currently: (a) exercising to lose weight, (b) on a diet to lose weight, or (c) attending a formal weight control program to lose weight (27).

### Cessation-Specific Weight Concerns

*Self-Efficacy to Resist Smoking in Eating Situations:* This was assessed as a subset of a larger series of high-risk relapse situations (29). Women rated their confidence on an eleven-point scale (0 = would not be able to resist smoking to 10 = would be able to resist smoking) that they could abstain from smoking in four eating-related situations: when they wanted something in their mouth, wanted to keep slim, wanted to eat sweets, or had finished a meal. The four items were summed (Cronbach's alpha = .71).

*Cessation-Specific Weight Gain Concern:* Women were asked how concerned they would be if they quit smoking and gained five pounds and how concerned they would be if they quit smoking and gained ten pounds. The two questions were scored on eleven-point scales ranging from "not at all concerned" (value = 0) to "very concerned" (value = 10) and added together to indicate overall concern. The two items were highly correlated ($R^2$ = .77) and were summed.

*Self-Efficacy to Resist Cessation-Specific Weight Gain:* Women were asked to rate their confidence that they could keep from gaining weight in the next six weeks and in the next year if they did not smoke cigarettes. Women also rated their confidence that they could lose a five- and a ten-pound weight gain without smoking. Response options ranged from "not at all confident" (value = 0) to "very confident" (value = 10). A composite measure of these four confidence items was created by adding the responses to each question (Cronbach's alpha = .90).

### Other Measures

Body weight was measured at baseline and at six and twelve months to the nearest .25 lb using a balance beam scale.

Height was measured at baseline to the nearest centimeter using a wall-mounted ruler. Body mass index (BMI) was calculated as weight in kgs/height in meters squared. Nicotine dependence was based on the number of cigarettes smoked per day in the previous seven days and time to the first cigarette of the day (1 = within 30 minutes of waking, 0 = greater than 30 minutes) (30). Smoking status was measured at each treatment session and at six- and twelve-month clinic follow-ups with a question concerning the number of cigarettes smoked in the previous seven days. Those who reported smoking 0 cigarettes at any of the follow-ups were asked at subsequent follow-ups if they had smoked any cigarettes since they were last contacted. Because two of the intervention groups received Nicorette gum, a combination of biochemical analyses of expired air carbon monoxide, saliva cotinine, and thiocyanate at standard cutpoints that indicated non-smoking were used to validate smoking status at each follow-up (see reference 20 for a detailed description). Self-reported smoking status was invalidated for only one person in the primary intervention outcome analyses (20). Thus, smoking status was based solely on self-report.

### Smoker Group Definitions

In defining our groups, we assumed that different weight gain experiences would be associated with varying lengths of abstinence. Weight gain is positively associated with duration of abstinence from smoking, and significant weight gain generally occurs after two months of sustained abstinence (31). Thus, we anticipated that those who quit smoking very briefly or not at all would experience little or no weight change over the twelve-month follow-up; those who sustained abstinence for at least 30 days would have the potential to have gained some cessation-related weight; and those who sustained abstinence longer would potentially gain enough cessation-related weight that substantial changes in their weight concerns over time might be observed.

Three groups of quitters were defined: (a) Non-quitters ($N$ = 201), women who smoked one or more cigarettes at any of the five treatment sessions following the quit date (session 2 of the treatment program); (b) Short-term quitters ($N$ = 94), those who smoked no cigarettes after the quit date through the end of treatment (four weeks) but had smoked one or more cigarettes by the six-month follow-up; and (c) Long-term quitters ($N$ = 122), those who smoked no cigarettes at any of the treatment sessions following the quit date and smoked no cigarettes between the end of treatment and the six-month follow-up. Of those abstinent at six months, 80% ($N$ = 97) remained abstinent through the twelve-month follow-up.

### Statistical Analysis

*Factor Analyses:* A principal components analysis with orthogonal rotation was conducted to identify common underlying constructs in the weight concern measures. In order to maintain temporal consistency across weight concern measures, these principal component analyses did not include the cessation-specific concerns and confidence questions that were first collected at the end of treatment. Each of the weight variables described above were included in factor analyses as individual items. The three subdimensions of the TFEQ were included as three individual summative scores.

Based upon an inspection of the scree plot, number of eigenvalues greater than one, and Thurstone's (32) criteria of simple structure, a three-factor solution was selected. Criteria for item retention on a factor consisted of a loading of .54 or greater on the primary factor and a loading less than .36 on a secondary factor (see Table 1 for item loadings).

**TABLE 1**
**Items and Factor Loadings for Dimensions of Weight Concerns at Baseline**

| Items | Factor 1: Weight, Pain, and Worry | Factor 2: Eating-Related Self-Efficacy | Factor 3: Dieting Behavior |
|---|---|---|---|
| Weight has caused you worry | .73 | | |
| Weight has caused you pain | .74 | | |
| Weight has kept you from doing things | .75 | | |
| Disinhibition Scale[a] (16 items) | .59 | | |
| Satisfaction with body image | .78 | | |
| Self-efficacy can resist smoking when: | | | |
| You want something in your mouth | | .68 | |
| You want to keep slim | | .78 | |
| You want to eat sweets | | .79 | |
| You finished a meal | | .61 | |
| Dieting to lose weight | | | .68 |
| Exercising to lose weight | | | .80 |
| Participating in a formal weight control program | | | .66 |
| Restrained Eating Scale[b] (21 items) | | | .65 |
| Eigenvalue | 4.2 | 1.7 | 1.8 |
| Cronbach's Alpha | .80 | .71 | .67 |
| Percent of variance explained | 20.5 | 17.0 | 17.2 |

[a] [e.g. When I feel blue, I often overeat; When I feel lonely, I console myself by eating; (25)].
[b] [e.g. I consciously hold back at meals in order not to gain weight; I pay a great deal of attention to changes in my figure; (25)].

Factor one was labeled as "emotional pain or worry about weight" and included the extent to which weight had caused the woman emotional pain, worry, or restricted her normal activities; the Disinhibition subscale; and body image satisfaction scores. Although the Hunger subscale loaded on the first factor, it did not fit conceptually with the other items in the factor. The Disinhibition subscale, which assesses negative affect associated eating, was judged by the authors to be consistent conceptually with the other items. Since the Hunger and Disinhibition subscales were highly correlated (r = .57), the Hunger subscale score was dropped from the factor-based scale. A second factor labelled "eating-related self-efficacy" comprised items relating to confidence to resist smoking in four eating-related situations. Factor three was labelled "dieting behaviors" and included the questions about current dieting, exercising to lose weight, participation in a formal weight program, and the Restraint subscale score.

Factor-based scores were created by summing items loading on each factor. Cronbach's alpha coefficients are shown for each factor scale in Table 1. Factor scale intercorrelations were modest (r = −0.32, F1 and F2; r = 0.21, F1 and F3; and r = −0.16, F2 and F3, $p < .001$) indicating that the selected factors represent distinct dimensions of weight concerns.

*Repeated Measures Analysis of Variance (ANOVA):* Repeated measures ANOVA (PROC GLM) (33) was used to test

TABLE 2
Demographic and Smoking History Characteristics by Group

| Characteristics | Non-Quitters ($N$ = 201) | Short-Term Quitters ($N$ = 94) | Long-Term Quitters ($N$ = 122) | Significance |
|---|---|---|---|---|
| Mean age | 44.5 (s.e. = .67) | 45.7 (s.e. = .98) | 45.5 (s.e. = .86) | .54 |
| Percent college graduate | 23% (47) | 28% (26) | 30% (36) | .44 |
| Percent employed full- or part-time | 62% (124) | 60% (56) | 61% (74) | .94 |
| Percent married | 61% (122) | 67% (63) | 69% (84) | .28 |
| Mean weight at baseline (lbs) | 143 (s.e. = 1.6) | 143 (s.e. = 2.0) | 142 (s.e. = 2.0) | .90 |
| Mean cigarettes per day at baseline | 28 (s.e. = .89) | 26 (s.e. = 1.1) | 25 (s.e. = 1.4) | .23 |
| Percent who smoke within 30 minutes of waking | 80% (161) | 80% (75) | 65% (79) | .004 |
| Mean quit attempts in the past year | 1 (s.e. = .10) | 1 (s.e. = .16) | 1.7 (s.e. = .82) | .43 |

for significant differences in patterns of weight concern over time among non-quitters and short-term and long-term quitters. Separate models were tested that included smoking outcome group as the independent variable and each of the weight concerns factor scores at each time point as repeated dependent measures. The time by group coefficient indicates whether the observed patterns of weight concern and self-efficacy differ significantly by group.

Separate models were run for the cessation-specific concern and self-efficacy composite scores that were not collected at baseline. Because self-efficacy and cessation-related weight gain may have been influenced by success at quitting smoking, these analyses excluded those who were not abstinent at the end of treatment (i.e. non-quitters). The model tested for significant differences in the pattern of posttreatment cessation-specific weight concerns and self-efficacy.

*Logistic Regression:* Logistic models were run to examine the association between each of the weight concern measures and long-term abstinence among the quitters (PROC LOGIST) (33). Change in weight concern was examined as an independent variable by entering the baseline and six-month follow-up scores for each of the three general weight concern factors and the cessation-specific confidence and concerns measures. Smoking group was the dichotomous dependent measure (1 = long-term quitter, 0 = short-term quitter). A chi square value for the six-month coefficient was interpreted as the measure of change for each of the weight concern domains (34,35).

## RESULTS

### Demographic Characteristics and Smoking History by Group

There were no significant baseline differences between the three groups in age, socioeconomic status, number of cigarettes smoked, or baseline weight (see Table 2). However, long-term quitters were significantly less likely to smoke their first cigarette within 30 minutes of waking than the other two groups.

### Changes in Weight Over Time by Group

After controlling for treatment group and nicotine dependence, long-term quitters gained the most weight, averaging about 10.1 pounds (SE = .93) over the twelve-month follow-up; short-term quitters gained 3.5 pounds (SE = 1.0) and non-quitters gained 2.3 pounds (SE = .81). Closer examination of the temporal pattern of weight gain indicated that long-term quitters gained weight steadily in the six months following treatment (8.9 pounds), but their weight stabilized between six and twelve months posttreatment. In contrast, short-term quitters gained about five pounds in the six months after treatment (the time during which they relapsed to smoking) and then began to lose weight between six- and twelve-month follow-ups, losing an average of 1.5 pounds by the twelve-month follow-up. As anticipated, non-quitters' weight remained relatively stable over the twelve-month follow-up period. Repeated measures results indicated that the Time by Group interaction was significant ($p < 0001$).

TABLE 3
Mean Weight Concern Scores by Group Over Time

| | Baseline | 6 Months | 12 Months | Significance Level Time × Group Interaction |
|---|---|---|---|---|
| Pain/Worry[a] | | | | .0005 |
| Non-quitter | 11.1 | 9.5 | 9.9 | |
| Short-term | 11.2 | 10.7 | 10.5 | |
| Long-term | 10.9 | 11.5 | 11.3 | |
| Eating-Related Self-Efficacy[b] | | | | .0001 |
| Non-quitter | 16.5 | 21.7 | 21.7 | |
| Short-term | 17.0 | 27.0 | 24.1 | |
| Long-term | 16.4 | 37.3 | 35.6 | |
| Dieting[c] | | | | .002 |
| Non-quitter | 10.0 | 10.5 | 10.4 | |
| Short-term | 10.3 | 11.7 | 11.2 | |
| Long-term | 10.9 | 12.6 | 13.2 | |

[a] Scale range 0–25.
[b] Scale range 0–40.
[c] Scale range 0–23.

### Changes in Weight Concerns and Confidence by Group

Emotional pain and worry related to weight increased from baseline to six-month follow-up in long-term quitters and decreased from baseline to six-month follow-up among non-quitters and short-term quitters (Table 3; Time × Group effect $p <$ .0002). Pain and worry stabilized between six- and twelve-month follow-ups for all groups.

Dieting behaviors increased steadily among long-term quitters from baseline to twelve-month follow-up (Table 3; Time × Group $p < .002$). Among short-term quitters, dieting behaviors increased between baseline and six-month follow-up but decreased between six and twelve months. There was no change in dieting behaviors among non-quitters.

Eating-related self-efficacy increased from baseline to six-month follow-up among all three groups, although the long-term quitters experienced the most dramatic increase (Table 3; Time × Group $p < .0001$). Eating-related self-efficacy stabilized between six- and twelve-month follow-ups among long-

TABLE 4
**Mean Cessation-Related Weight Concern and Self-Efficacy Among Quitters Over Time**

| | End of Treatment | 6 Months | 12 Months | Significance Level Time × Group Interaction |
|---|---|---|---|---|
| Concern[a] | | | | .02 |
| Short-term | 14.2 | 16.3 | 15.1 | |
| Long-term | 14.5 | 17.5 | 17.4 | |
| Weight-Related Self-Efficacy[b] | | | | .0001 |
| Short-term | 23.6 | 17.0 | 17.4 | |
| Long-term | 26.2 | 25.4 | 27.0 | |

[a] Scale range 0–20.
[b] Scale range 0–40.

TABLE 5
**Logistic Regression Model for Sustained Abstinence Among Quitters**

| Variables | OR (95% CI) | *p* |
|---|---|---|
| Weight, Worry, and Pain | 1.21 (1.06, 1.38) | .004 |
| Eating-Related Self-Efficacy | 1.26 (1.17, 1.36) | .0001 |
| Dieting Behavior | 1.03 (0.93, 1.14) | .59 |
| Cessation-Specific Weight Gain Concern[a] | 1.01 (0.90, 1.14) | .81 |
| Confidence Can Lose Weight[a] | 1.03 (0.99, 1.08) | .16 |
| Treatment Group[b] | 0.67 (0.29, 1.56) | .35 |
| Nicotine Dependence | 0.46 (0.19, 1.12) | .09 |
| Weight Change[c] | 1.07 (1.03, 1.10) | .0002 |

*Note:* OR = Odds ratio CI = Confidence interval.
* Weight concerns are six-month scores adjusted for baseline values. Odds ratios predict sustained abstinence.
[a] Six-month scores adjusted for end of treatment values.
[b] Nicorette-only group versus other treatment groups.
[c] Weight change between baseline and six-month follow-up.
$N$ = 216 Quitters.

term quitters and non-quitters and decreased slightly in short-term quitters.

Although there were no significant differences at the end of treatment, concern about cessation-specific weight gain increased significantly ($p < .02$) between the end of treatment and six-month follow-up among both short- and long-term quitters (Table 4). The greatest increase in concern was among the long-term quitters, but their concern stabilized between the six- and twelve-month follow-ups. In contrast, short-term quitters' concerns began to decrease between the six- and twelve-month follow-ups. Short-term quitters' self-efficacy that they could keep from gaining weight or lose the weight they gained while quitting smoking also decreased significantly between the end of treatment and six-month follow-up ($p < .0002$) but stabilized between six- and twelve-month follow-ups. There was no change in self-efficacy among long-term quitters between the end of treatment and the twelve-month follow-up.

### Factors Associated with Sustained Abstinence at Six-Months Follow-Up

Results of the main effects multivariate logistic regression model for sustained abstinence at six-months follow-up are shown in Table 5. The model included treatment group assignment, weight change between baseline and six-month follow-up, smoking within 30 minutes of waking, baseline and six-month follow-up scores for the three weight concern factors, and end of treatment and six-month cessation-specific concern and self-efficacy.

Increase in the pain/worry factor and in eating-related self-efficacy were significantly associated with sustained abstinence. Increase in weight was also positively and significantly related to sustained abstinence at six-months follow-up.

In order to assess whether the association between increased weight concerns and long-term abstinence was mediated by actual weight gain, we ran a second model that added a term for the interaction of pain/worry and weight gain. The interaction term was not significantly associated with long-term abstinence. Thus, the positive association of increased weight concerns and sustained abstinence appears to be independent of actual weight gain.

### Weight Gain and Weight Concerns at Six-Months Follow-Up

We tested three additional regression models to determine whether the changes we observed in weight concern, dieting, and self-efficacy were associated with weight gain. Weight gain between baseline and six-month follow-up was trichotomized to categorize women into low (mean = −1.71 lbs, SD = 5.7), medium (mean = 6.6 lbs, SD = 1.5), and high (mean = 17.0 lbs, SD = 13.6) weight gain groups. Weight gain group (represented as two dummy variables), smoking outcome group, and baseline weight pain/worry were tested in a model with pain/worry at six-months follow-up as the dependent variable. A second model that included weight gain group and smoking outcome group but replaced the pain/worry construct with baseline dieting was tested with dieting at the six-month follow-up as the dependent variable. Similarly, a third model tested the association of weight gain group, smoking group, and baseline self-efficacy with self-efficacy at six-months follow-up as the dependent variable.

After controlling for smoking status and baseline pain/worry, weight gain between baseline and six-months follow-up was significantly associated ($p < .0001$) with pain/worry at six months. Women who gained the most weight experienced the greatest increase in pain and worry about their weight. In contrast, weight gain was not associated with changes in dieting ($p < .77$) or self-efficacy ($p < 26$). Thus, those who gained the most weight did not necessarily increase their dieting behavior. In fact, among those continuously abstinent at six-months follow-up, high-gainers were significantly ($p < .003$) less likely to be dieting than low- or medium-gainers [mean dieting scores = 9.8 (SD = 4.8), 13.0 (SD = 5.7), and 12.7 (SD = 5.1), respectively]. Moreover, among the long-term quitters, there was no significant difference in eating-related self-efficacy among the high-, medium- and low-gainers at six-months follow-up [mean self-efficacy scores = 33.3 (SD = 9.0), 32.2 (SD = 8.4), and 30.9 (SD = 9.8), respectively; $p = .19$]. Thus, weight gain was not associated with diminished self-efficacy to keep from smoking in eating-related situations.

## DISCUSSION

Concerns about weight and cessation-related weight gain significantly increased over time among long-term quitters. De-

spite their increasing concern, long-term quitters remained confident that they could keep from gaining weight or lose the weight they gained with cessation. In contrast, short-term quitters' weight concerns and confidence to keep from gaining weight or to lose the weight gained during cessation decreased. Interpretation of these associations is limited because the changes among short-term quitters are confounded with their return to smoking. Moreover, due to the timing of the follow-up measurements, brief increases or decreases in concerns or self-efficacy could have occurred between measurement points but would not have been detected. It is possible that short-term quitters were hyperresponsive to small increases in weight concerns and returned to smoking immediately to allay their concerns. Swan and colleagues (16) found among young unmarried women that reporting weight concerns as a reason for relapsing in the past was highly associated with early relapse in subsequent quit attempts. Alternatively, decreased weight concerns and self-efficacy may have been a response to relapsing to smoking. Disentangling the temporal order of these associations would require more frequent assessment of these measures in a much larger sample.

It is noteworthy that short-term quitters reported increased self-efficacy in their ability to avoid smoking in eating situations. Short-term quitters may have experienced increased self-efficacy as a result of having been abstinent a month, a significant quit attempt, albeit unsuccessful. However, short-term quitters' self-efficacy subsequently decreased between the six- and twelve-month follow-up.

Our results and others (24) indicate that dieting behaviors may be effective coping strategies for some weight-concerned smokers. In the present study, long-term quitters who dieted gained less weight than those who did not diet. While dieting behaviors did not prevent weight gain entirely, dieting may have helped some women maintain their confidence that they could ultimately get their weight under control. Over time, compared to short-term quitters, long-term quitters showed a greater increase in dieting and exercising and also gained greater confidence that they could resist smoking in eating-related situations. However, results of multivariate analyses indicated that change in eating-related self-efficacy was significantly associated with sustained abstinence but not changes in dieting. Thus, the influence of dieting on success at smoking cessation needs further research.

Our earlier analyses (36) indicated that baseline weight concerns, dieting, and exercising were not associated with abstinence at six-months follow-up. However, these results illustrate the dynamic nature of weight concerns and thus the potential importance of appropriate timing for weight adjuncts to smoking cessation interventions. Moreover, our results indicate that weight concern is not a unidimensional construct and that different dimensions of weight concerns may play different roles at various points in the cessation process. While we measured three discrete and internally consistent indicators of weight concerns, the reliability and validity of these measures have not been established. More rigorous psychometric work is needed to define a set of comprehensive measures of weight concerns that are valid and reliable. Standardization of such measures across studies would also enable meta-analytic approaches that could provide the sample size needed to further explore the temporal patterns of weight concern and smoking cessation.

Like others (17,24,37,38), we found that average postcessation weight gain among quitters was modest and stabilized within six months of cessation. We concur with others (23,38) that for many women smokers intensive weight-related adjuncts may not be necessary and may possibly be counterproductive during the initial cessation process. However, the inevitability of some weight gain (23), the pattern of increasing weight concerns, and the non-negligible risk of relapse six months post-treatment and beyond (4,16) suggest a need to further evaluate the necessary content and timing of interventions for weight-concerned smokers.

## REFERENCES

(1) Rodin J, Wack JT: The relationship between cigarette smoking and body weight: A health promotion dilemma? In Matarazzo JJ, Herd JA, Miller NE, Herd SM (eds), *Behavioral Health, A Handbook for Health Enhancement and Disease Prevention.* New York: Wiley, 1984, 671–692.

(2) Williamson DF, Madans J, Anda RF, et al: Smoking cessation and severity of weight gain in a national cohort. *New England Journal of Medicine.* 1991, *11:*739–745.

(3) Swan GE, Carmelli D, Robinette D: Characteristics associated with excessive weight gain following smoking cessation. *Annals of Behavioral Medicine.* 1993, *15:*51.

(4) U.S. Department of Health and Human Services: *The Health Benefits of Smoking Cessation,* DHHS Publication No. (CDC) 90-8416. Washington, DC: U.S. Government Printing Office, 1990.

(5) Williamson DF, Serdula MK, Anda RF, Levy A, Byers T: Weight loss attempt in adults: Goals durations and rate of weight loss. *American Journal of Public Health.* 1992, *82:*1251–1257.

(6) Rodin J, Silberstein L, Striegel-Moore R: Women and weight: A normative discontent. *Nebraska Symposium on Motivation.* 1984, *32:*267–307.

(7) Wooley SC, Wooley OW: Should obesity be treated at all? In Stunkard AJ, Stellar EJ (eds), *Eating and Its Disorders.* New York: Raven Press, 1984, 185–192.

(8) Morbidity and Mortality Weekly Report: Body-weight perceptions and selected weight-management goals and practices of high school students—United States, 1990. *Journal of the American Medical Association.* 1991, *266*(20):2811–2812.

(9) French SA, Jeffery RW, Klesges LM, Forster JL: Weight concerns and smoking behavior over two years in a working population. *American Journal of Public Health.* 1995, *85*(5):720–722.

(10) Dawson DA: Ethnic differences in female overweight: Data from the 1985 National Health Interview Survey. *American Journal of Public Health.* 1988, *78*(10):1326–1329.

(11) French SA, Jeffery RW: Weight concerns and smoking: A literature review. *Annals of Behavioral Medicine* (in press, 1996).

(12) Weekley CK, Klesges RC, Reylea G: Smoking as a weight-control strategy and its relationship to smoking status. *Addictive Behaviors.* 1992, *17:*259–271.

(13) Pirie PL, Murray DM, Luepker RV: Smoking and quitting in a cohort of young adults. *American Journal of Public Health.* 1991, *81:*324–327.

(14) Klesges RC, Brown K, Pascale RW, et al: Factors associated with participation, attrition, and outcome in a smoking cessation program at the workplace. *Health Psychology.* 1988, *7:*575–589.

(15) Sorensen G, Pechacek TF: Attitudes toward smoking cessation among men and women. *Journal of Behavioral Medicine.* 1987, *10:*129–137.

(16) Swan GE, Ward MM, Carmelli D, Jack LM: Differential rates of relapse in subgroups of male and female smokers. *Journal of Clinical Epidemiology.* 1993, *46:*1041–1053.

(17) Gritz ER, Berman BA, Read LL, Marcus AC, Siau J: Weight change among registered nurses in a self-help smoking cessation

program. *American Journal of Health Promotion.* 1990, *5*(2):115–121.
(18) Perkins KA: Weight gain following smoking cessation. *Journal of Consulting and Clinical Psychology.* 1993, *61*(5):768–777.
(19) Killen JD, Fortmann SP, Newman B: Weight change among participants in a large sample minimal contact smoking relapse prevention trial. *Addictive Behaviors.* 1990, *15:*323–332.
(20) Pirie PL, McBride CM, Hellerstedt W, et al: Smoking cessation in women concerned about weight. *American Journal of Public Health.* 1992, *82*(9):1238–1243.
(21) Gritz ER, Klesges RC, Meyers AW: The smoking and body weight relationship: Implications for intervention and postcessation weight control. *Annals of Behavioral Medicine.* 1989, *11:*144–153.
(22) Hall SM, Tunstall CD, Vila KL, Duffy J: Weight gain prevention and smoking cessation: Cautionary findings. *American Journal of Public Health.* 1992, *82*(6):799–803.
(23) Perkins KA: Issues in the prevention of weight gain after smoking cessation. *Annals of Behavioral Medicine.* 1994, *16*(1):46–52.
(24) Streater JA, Sargent RG, Ward DS: A study of factors associated with weight change in women who attempt smoking cessation. *Addictive Behaviors.* 1989, *14:*523–530.
(25) Stunkard AJ, Messick S: The three-factor eating questionnaire to measure dietary restraint, disinhibition, and hunger. *Journal of Psychosomatic Research.* 1985, *29:*71–83.
(26) Pirke KM, Laessle RG: Restrained eating. In Stunkard AJ, Wadden TA (eds), *Obesity: Theory & Therapy* (2nd Ed.). New York: Raven Press Ltd, 1993, 151–162.
(27) Stewart AL, Brook RH, Kane RL: *Conceptualization and Measurement of Health Habits for Adults in the Health Insurance Study* (R2374-HEW). Santa Monica, CA: Rand Corporation, 1980.
(28) Furnham A, Alibhai N: Cross-cultural differences in the perception of female body shapes. *Psychological Medicine.* 1983, *13*(4):829–837.
(29) Condiotte MM, Lichtenstein E: Self-efficacy and relapse in smoking cessation programs. *Journal of Consulting and Clinical Psychology.* 1981, *49*(5):648–658.
(30) Fagerstrom KO: Measuring degree of physical dependence to tobacco smoking with reference to individualization of treatment. *Addictive Behaviors.* 1978, *3:*235–241.
(31) Stamford BA, Matter S, Fell RD, Papanek P: Effects of smoking cessation on weight gain, metabolic rate, caloric consumption, and blood lipids. *American Journal of Clinical Nutrition.* 1986, *43:*486–494.
(32) Harmon HH: *Modern Factor Analysis.* Chicago, IL: University of Chicago Press, 1976.
(33) SAS Institute Inc.: *SAS User's Guide. Version 6.03.* Cary, NC: SAS Institute Inc., 1988.
(34) Cohen J, Cohen P: *Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences.* Hillsdale, NJ: Erlbaum, 1975, 72–73; 413–423.
(35) Cronbach LJ, Furby L: How should we measure "change"—or should we? *Psychological Bulletin.* 1970, *74:*68–80.
(36) French S, Jeffery R, Pirie P, McBride C: Do weight concerns hinder smoking cessation efforts? *Addictive Behaviors.* 1992, *17:*219–226.
(37) Chen Y, Horne SL, Dosman JA: The influence of smoking cessation on body weight may be temporary. *American Journal of Public Health.* 1993, *83*(9):1330–1332.
(38) Hall SM, Ginsberg D, Jones RT: Smoking cessation and weight gain. *Journal of Consulting and Clinical Psychology.* 1986, *54:*342–346.