

Running Head: Demographic Variables, Smoking Variables, & Outcome

Demographic Variables, Smoking Variables, and Outcome Across Five Studies

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Abstract

Objective: Intervention effectiveness can be potentially affected by membership in different demographic subgroups (Race, Ethnicity, Gender, Age and Education Level) or smoking behavior variables (Time to First Cigarette, Longest Previous Quit Attempt, Number of Attempts in the Last Year, Number of Cigarettes, and Stage of Change). Previous research on these two sets of variables has produced mixed results.

Design: This secondary data analysis combined data from five effectiveness trials (a random digit dial sample (N = 1358), members of an HMO (N = 207), parents of students recruited for a school-based study (N = 347), patients from an insurance provider list (N = 535), and employees (N = 175)) where smokers were all proactively recruited from a defined population and all received the same expert system intervention. The intervention produced a consistent 22-26% point prevalence cessation rate across the five studies.

Main Outcome Measures: The main outcome variables were 24 Hour Point Prevalence, 7 Day Point Prevalence, 30 Day Prolonged Abstinence, and 6 Month Prolonged Abstinence.

Results: There were no significant differences in outcome across Gender, Race, and Ethnicity subgroups. There were significant differences with small effect sizes for Age and Education subgroups. There were significant differences and large effect sizes for all five smoking behavior variables.

Discussion: Demographic variables are static variables while the smoking variables are more dynamic, i.e., open to change. Given the dynamic nature of the smoking variables and the large effect sizes, interventions tailored on the smoking variables should be more successful.

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One of the most widely researched questions for smoking cessation is determining what pre-intervention variables will predict outcome. Knowledge of these variables can be used as a basis for tailoring intervention materials. The two most widely researched variables sets are demographic variables, such as race, ethnicity, gender, age, and education level, and smoking behavior variables, such as time to first cigarette, longest previous quit attempt, number of attempts in the last year, number of cigarettes, and stage of change. Previous research involving these two variable sets has produced mixed results. Gender differences in cessation outcomes have been strongest for interventions that include pharmacological components such as Bupropion, Fluoxetine, and the Nicotine Patch (Bohadana, Nilsson, Rasmussen, & Martinet, 2003; Borelli, Papandonatos, Spring, Hitsman, & Niaura, 2004; Collins, Wileyto, Patterson, Rukstalis, Audrain-McGovern, Kaufmann, Pinto, Hawk, Niaura, Epstein, Lerman, 2004; Dale, Glover, Sachs, Schroeder, Offord, Croghan, & Hurt, 2001; Ferguson, Patten, Schroeder, Offord, Eberman, & Hurd, 2003; Perkins, 2001; Swan, McAfee, Curry, Jack, Javitz, Dacey, & Bergman, 2003) but these differences are less apparent for behavioral interventions (Etter, Prokhorov, & Perneger, 2002). Ethnic and racial differences in smoking outcomes have been less widely reported, but are increasingly important as our population grows more diverse and as we move towards wider dissemination of effective programs (Leischow, Ranger-Moore, & Lawrence, 2000; Mazas & Wetter, 2003; Vander, Cummings & Coates, 1990). Ethnic and racial differences in smoking outcomes may also be causally related to third variables, such as access (Ahluwalia, Dang, Choi & Harris, 2002; Ahluwalia,

Harris, Catley, Okuyemi, & Mayo, 2002) or differential training/status of health care providers (Bach, Pham, Schrag, Tate, & Hargraves, 2004).

There are several additional potential explanations for the mixed results. First, different studies have employed different recruitment strategies. The different strategies may produce very different samples and the subgroups from one sample could be very different or even excluded from the sample. Second, the studies have included a wide variety of different behavioral and pharmacological interventions. The importance of subgroup differences could be large for one type of intervention but have no impact for a second type of intervention. Third, the differences could be due to the method of analysis. The classic test of significance employs the probability of a Type I Error as the central basis for decision making. However, the probability value is strongly influenced by the sample size. Differences between subgroups could be significant with a large sample size and fail to reach significance with small sample sizes, resulting in contradictory findings.

In this paper we will conduct a secondary data analysis to examine the potential influences of all these variables on cessation outcomes following treatment with an effective behavioral tailored smoking cessation intervention. The data combines the intervention group from five studies to produce a combined sample of 2972. The sample for each of the studies used the same recruitment method. The intervention employed was the same for each study. The focus will be on the effect size rather than the test of significance. In this way, this analysis holds constant three of the potential sources of differences across studies.

Proactive Recruitment

The most common approach employed for recruitment in efficacy trials has been a *reactive* approach, i.e., subjects are informed about the availability of an intervention program and must initiate contact to participate. This produces a volunteer sample of smokers who are typically highly motivated to quit and who are very likely to be compliant with the treatment protocol. Volunteer samples are also more likely to be female, white, and well educated (Velicer, Keller, Friedman, Fava, Gulliver, Ward, Ramelson, Prochaska, Robins, & Cottrill, 2005). In contrast, effectiveness trials typically rely on a *proactive* recruitment approach, i.e., the subjects are contacted directly and the services are offered to them. These samples are more representative of the general population. Two recent smoking cessation effectiveness studies (Prochaska, , Velicer, Fava, Rossi, & Tsoh, 2001; Velicer, Prochaska, Fava, Laforge, Rossi, 1999) achieved recruitment rates of 82% and 85% and the samples were demographically similar to the defined population. In contrast, efficacy studies typically recruit 1-5% of the population at best (Schmid, Jeffrey, & Hellerstedt, 1989).

Expert System Intervention

All smokers in this secondary analysis received the same computer-generated *expert system intervention*. This involved a series of three computer reports at 0, 3, and 6 months or 0, 6 and 12 months. An initial test was performed to determine if the two different intervention schedules produced different results. There was no significant difference so both schedules were combined for all subsequent analyses (see the results from the GEE analysis in the results section below).

All interventions begin with an assessment of basic demographic variables, smoking variables, and the fifteen core measures from Transtheoretical Model. The three to five page feedback reports were divided into five sections, based on the specific measures from the Transtheoretical Model: (1) Stage of Change (DiClemente, Prochaska, Fairhurst, Velicer, Rossi, & Velasquez, 1991), involving feedback on their readiness to change the behavior; (2) Pros and Cons from the Decisional Balance (Velicer, DiClemente, Prochaska, & Brandenburg, 1985), including feedback about under-evaluating the pros of changing and/or over-evaluating the cons; (3) Processes of Change (Prochaska, Velicer, DiClemente, & Fava, 1988) which provided feedback on participants' use of up to six change processes relevant to their stage of change; (4) Situational Temptations (Velicer, DiClemente, Rossi, & Prochaska, 1990) which provided feedback on how to enhance self-efficacy in the most tempting situations; and (5) Change Strategies which consisted of suggestions for taking small steps towards progress to the next stage.

Participants were compared normatively on each change variable with the most successful self-changers in the first feedback report. For the second and third reports, a new assessment was performed and a new feedback report was generated. For the two follow-up assessments, smokers were also compared both normatively and ipsatively to their prior assessment. The progress reports also referred participants to specific sections of a stage-matched self-help manual that were most relevant to their individual progress. The manual provides more detail and teaches users about their particular stage of change and the processes they can use to progress to the next stage. The reports were mailed immediately upon completion of their telephone survey or receipt of their mailed survey.

More details about the expert system and manual are available elsewhere (Velicer, Prochaska, Bellis, DiClemente, Rossi, Fava, & Steiger, 1993; Velicer & Prochaska, 1999; Velicer, Prochaska, & Redding, 2006).

Effect Size Estimates

A large number of effect size estimators have been developed (Kirk, 1996; Kline, 2004). Many of these effect size estimates can be classified by two broad dimensions (Fidler, & Thompson, 2001) as (a) standardized difference versus variance accounted for and (b) uncorrected versus corrected effect sizes. An effect size can be as familiar as a mean or correlation. It can be expressed in original measurement units, or standardized, for example Cohen's d expressed in SD units. Standardized effect sizes such as Cohen's d are most appropriate when two groups are being compared. An important class of effect sizes are measures of variance accounted for, including R^2 , η^2 and ω^2 , which is the proportion of variance attributable to an effect, for example in an ANOVA (Hays, 1981). The latter are the most appropriate when more than two groups are involved. Uncorrected variance-accounted-for indices are positively biased overestimates of the effect in the population. In this paper, all effect sizes were calculated as Cramer's Φ^2 that is a measure of association analogous to Omega squared (ω^2). Effect size interpretations were based on Cohen's (Cohen, 1988) descriptive guidelines for Omega squared (ω^2). A "small" effect is about 1% of the variance, a "medium" effect is about 6% of the variance, and a "large" effect is about 14% or more of the variance. Cohen emphasized that his guidelines are arbitrary and that any effect size should be interpreted within its research context.

Method

Five Samples

This study involves a secondary data analysis that combined the data from five studies. Each study involved multiple intervention and comparison groups. These data combine only the groups that received the three expert system feedback reports. Of the five samples above, two (*RDD* and *HMO*) focused only on smoking cessation, while three of the studies (*Parent*, *Patient*, and *Worksite*) focused on multiple risk behaviors in addition to smoking, including diet and sun exposure.

RDD Sample. This study employed Random Digit Dial (RDD) survey methodology to recruit a sample of 4144 smokers. This study was part of a larger study and smokers were randomly assigned to one of two conditions: Assessment Only and Expert System (ES). Assignment followed a 2 to 1 ratio. A total of 1708 were assigned to the ES condition and 1,358 subjects were retained at 24 months and are included in this analysis. A total of 82% of approximately 5000 eligible smokers were recruited. The Point Prevalence Smoking Cessation rate at 24 Months was 26% and this was significantly different than the Assessment Only group. Additional details about the sample and recruitment are available elsewhere (Fava, Velicer, & Prochaska, 1995; Prochaska et al., 2001).

HMO Sample. This study contacted all members of a large New England Health Maintenance organization (HMO). A health risk survey was performed and a more extensive survey was completed for all members who identified as smokers. 85.3% of the smokers were recruited. The study recruited a final sample of 2,882 smokers. Smokers were randomly assigned to 1 of 8 treatment conditions. The sample that received the

comparable expert system intervention investigated here was N=353. The Point Prevalence Smoking Cessation rate at 24 Months for the expert system intervention condition was 23%. Additional details about the recruitment and outcome are reported elsewhere (Prochaska, Velicer, Fava, Ruggiero, Laforge, Rossi, Johnson, & Lee, 2001).

Parent. The sample consisted of the parents of adolescents who were subjects in a School-based study. The 22 schools involved provided a list of parents. Based on the records provided by the schools in Rhode Island, a total of 3507 eligible households of students were identified. Households were contacted by phone and a total of 2931 respondents were contacted. One parent was recruited from each eligible household. Of these, 2460 parents agreed to participate and completed the baseline survey. Parents had to be at risk for at least one of the three risk factors to be eligible. 83.6% of eligible participants were recruited. A total of 707 respondents were identified as smokers, and then the complete assessment necessary to generate the expert system progress report was completed as part of the baseline assessment. N=347 were randomly assigned to the expert system intervention group. The Point Prevalence Smoking Cessation rate at 24 Months for the expert system intervention condition was 22%. %. Additional details about the recruitment and outcome are available elsewhere (Prochaska, Velicer, Rossi, Redding, Greene, Rossi, Sun, Fava, Laforge, & Plummer, 2004).

Patient. A health insurance provider provided a list of 19,696 patient names for an expert system intervention study. The participants were patients of physicians that were part of a multiple risk behavior (smoking, diet, sun, mammography) physician and home intervention study. There was no interaction between home and physician interventions. Initial screening identified a total of 12,978 eligible households, who were contacted by

phone. One patient was recruited from each eligible household. A total of 4439 patients refused participation. 65% of eligible participants were recruited. Of the 8539 patients who agreed to participate, 3157 were screened out, leaving a final sample of 5382 participants. A total of 1136 subjects were identified as smokers, and then the complete assessment necessary to generate the expert system progress report was completed as part of the baseline assessment. N=535 of them were randomly assigned to the expert system intervention group. The Point Prevalence Smoking Cessation rate at 24 Months for the expert system intervention condition was 25.4%. Additional details about the recruitment and outcome are available elsewhere (Prochaska, Velicer, Redding, Rossi, Goldstein, DePue, Greene, Rossi, Sun, Fava, Laforge, Rakowski, & Plummer, 2005).

Worksite. The worksite sample was part of a larger multiple risk behavior study where smoking was one of four risk factors that were intervened upon. A total of 22 worksites provided subjects for this study. There was no interaction between home and worksite interventions. 85.7% of the eligible smokers were recruited into this study. A total of N = 330 subjects were identified as smokers, and then the complete assessment necessary to generate the expert system progress report was completed as part of the baseline assessment. N = 175 of them were randomly assigned to the expert system intervention group. The Point Prevalence Smoking Cessation rate at 24 Months for the expert system intervention condition was 22.1%. Additional details about the recruitment and outcome are available elsewhere (Linnan, Emmons, Klar, Fava, Laforge & Abrams, 2002; Velicer, Prochaska, Redding, Rossi, Sun, Rossi, Greene, Fava, Abrams, Linnan, & Emmons, 2004).

Subjects

A description of demographic and smoking history variables for these five baseline samples is presented in Table 1. All subjects in *RDD* and HMO samples were followed up at 6 month, 12 month, 18 month and 24 month after baseline, while subjects in *Parent*, *Patient*, and *Worksite* samples were followed up at 12 month and 24 month after baseline. For the purpose of comparison, only data from baseline, 12 month and 24 month were used in these analyses.

Measures

All variables were designed to be assessed during a phone survey. All measures involved self-report. In addition to the measures described here, the survey included other variables that could be used to detect inconsistent or incorrect patterns of responding. Among the demographic variables, *Age* ('What is your current age?') and *Education* ('How many years of school have you completed?') involved open ended responses. *Gender*, *Race* and *Ethnicity* involved multiple-choice responses with the following categories: Gender (Male/Female), Hispanic or Latino (Yes/No), and Race (Asian/Black or African American/White/Native Hawaiian or Other Pacific Islander/American Indian or Alaskan Native).

Among the smoking variables, *Time to First Cigarette* ('How soon after you awake do you usually smoke your first cigarette?'), *Longest Previous Quit Attempt* ('How long did you stay off cigarettes during your longest previous quit attempt?'), *Number of Attempts in the Last Year* ('In the last year, how many times have you quit for at least 24 hours?'), and *Number of Cigarettes* ('During the past 7 days how many cigarettes did you smoke on a typical day?'), involved open ended responses. *Stage of Change* was assessed using the algorithm method, which consists of 5 yes/no questions

and a screening question to determine if there is a smoking history. The first question assesses current smoking status ('Are you currently a cigarette smoker?'). If currently smoking, subsequent questions focus on intention to quit ('Are you seriously considering quitting within the next six months?' and 'Are you planning to quit in the next 30 days?'). If currently not smoking, questions focus on the length of the quit ('Have you smoked any cigarettes within the last 6 months?'). The choice of question asked depends on the response to previous questions. The questions classify the respondent into one of five Stages of Change for Smoking Cessation (Precontemplation (PC), Contemplation (C), Preparation (PR), Action (A), or Maintenance (M)).

Results

This report will focus on Point Prevalence Abstinence at 12 Months and 24 Months post baseline. The analysis focused on the individual variables rather than the development of a multivariate prediction model. The goal was to assess the degree of relationship between each of the variables and outcome at 12 Months and 24 months after initial recruitment into the studies. Table 2 presents the proportion of the smokers who were abstinent in each category for each of the 10 variables along with effect size estimates (Cramer's Φ^2) for each variable. Chi-squared tests are reported in the text.

The original studies report the outcome analysis for different outcome variables including: 7 Day Point Prevalence, 30 Day Prolonged Abstinence, and 6 Month Prolonged Abstinence. A similar pattern of results was observed for all four variables, as would be expected given the extremely high correlation between these four measures (Velicer, & Prochaska, 2004). The original studies also report alternative missing data estimates. Again, the same pattern of results occurred for each method. All statistical

methods (maximum likelihood, regression, and multiple imputation) produced near identical estimates, indicating that a Missing at Random missing data mechanism was appropriate. Effect size estimates based on other missing data estimates produced nearly identical effect size estimates to those reported here.

Three multivariate analyses were also performed, one for each variable set and one for the combined variable set to test for interactions between the demographic and smoking variables. The SAS PROC GENMOD (SAS Institute, 1997) was used to perform the GEE analyses (Zeger & Liang, 1986) for all five variables included in both the Demographic and Smoking variable sets. For each analysis, three different analyses were performed: (a) only available cases, (b) complete case with multiple imputation used for missing observations (Schafer & Graham, 2002), and (c) pattern mixture model. For variables where there was a significant result, the GEE analysis involving the five variables was employed to interpret the results. Only subgroup differences at the $\alpha > .01$ were interpreted.

Demographic Variables

Univariate Analysis. At the 12 Month Assessment, there were no significant differences for three of the demographic variables and each had a corresponding effect size estimate that was near zero, Gender ($\chi^2 (1) = 0.27$; Cramer's $\Phi^2 = 0.012$), Race ($\chi^2 (1) = 0.13$; Cramer's $\Phi^2 = 0.009$), and Ethnicity ($\chi^2 (1) = 0.76$; Cramer's $\Phi^2 = 0.022$). There were significant differences for age ($\chi^2 (5) = 12.49$; Cramer's $\Phi^2 = 0.083$) and education ($\chi^2 (3) = 8.25$; Cramer's $\Phi^2 = 0.067$) and these effect sizes were moderate.

At the 24 Month Assessment, the same pattern of results was observed. There were no significant differences for three of the demographic variables and each had

corresponding effect size estimates near zero, Gender ($\chi^2 (1) = 0.25$; Cramer's $\Phi^2 = 0.012$), Race ($\chi^2 (1) = 0.02$; Cramer's $\Phi^2 = 0.003$), and Ethnicity ($\chi^2 (1) = 1.12$; Cramer's $\Phi^2 = 0.028$). There was a significant difference for education ($\chi^2 (3) = 8.35$; Cramer's $\Phi^2 = 0.072$) and the effect size was moderate. The difference for age was no longer significant but the effect size was still moderate ($\chi^2 (5) = 6.69$; Cramer's $\Phi^2 = 0.065$). Figure 1 illustrates the results for the five demographic variables at both Month 12 and Month 24.

Multivariate Analysis. For the GEE analysis on abstinence rates, there was a significant effect for Time, with higher smoking cessation rates at the 24 Month Assessment and for those with more Education. The Less Than 12 Years Education was employed as the reference group and the Greater Than or Equal to 16 Years Education group was significantly different from the reference group. There were no significant differences for Gender, Race, Ethnicity, and Age. The nonsignificant GEE result for age was interpreted to be the result of overlap with the other variable included in the GEE analysis, primarily education. The analysis also tested to see if there was any difference in outcome between the two projects that sent the expert system intervention reports every three months and the three projects using a six-month schedule and found no difference.

Smoking Variables

Univariate analysis. At the 12 Month Assessment, there were significant differences for all five of the smoking variables and the corresponding effect size estimate were moderate to large. The largest effect sizes were for the Time to First Cigarette ($\chi^2 (4) = 50.70$; Cramer's $\Phi^2 = 0.153$), Number of Cigarettes ($\chi^2 (3) = 54.42$;

Cramer's $\Phi^2 = 0.173$), and Stage ($\chi^2 (2) = 42.31$; Cramer's $\Phi^2 = 0.152$). The effect sizes were moderate to large for the Longest Quit ($\chi^2 (4) = 18.13$; Cramer's $\Phi^2 = 0.105$) and Number of Quit Attempts in the Last Year ($\chi^2 (4) = 22.96$; Cramer's $\Phi^2 = 0.112$).

At the 24 Month Assessment, there were again significant differences for all five of the smoking variables and the corresponding effect size estimates were moderate to large. The effect sizes were large for Number of Cigarettes ($\chi^2 (3) = 50.02$; Cramer's $\Phi^2 = 0.177$) and Stage ($\chi^2 (2) = 44.41$; Cramer's $\Phi^2 = 0.167$). The effect sizes were moderate to large for the Longest Quit ($\chi^2 (4) = 24.23$; Cramer's $\Phi^2 = 0.130$), Time to First Cigarette ($\chi^2 (4) = 37.37$; Cramer's $\Phi^2 = 0.105$), and Number of Quit Attempts in the Last Year ($\chi^2 (4) = 18.35$; Cramer's $\Phi^2 = 0.107$). Figure 2 illustrates the results for the five demographic variables at both Month 12 and Month 24.

Multivariate analysis. For the GEE analysis on abstinence rates, there was again a significant effect for Time, with higher smoking cessation rates at the 24 Month Assessment. There was a significant effect on outcome for the Longest Time Quit in the Last Year. One Day or Less served as the reference group. Significant differences were found for the 82-183 Day Group and the More Than 184 Day group. There was also a significant effect for Baseline Stage. Here, Contemplation served as the reference group. Smokers who were initially in the Precontemplation group were significantly less successful in quitting. Smokers who were initially in the Preparation group were significantly more successful in Quitting. There was also a significant difference for Number of Cigarettes per Day. Here, 10-19 Cigarettes per Day was the reference group. The group that was smoking 9 or Fewer Cigarettes per Day was significantly more successful in quitting. The groups that were smoking 20-29 Cigarettes per Day or More

Than 30 cigarettes per Day were significantly less successful in quitting. Time to First Cigarette and Number of Quit Attempts were not significant in this analysis. The nonsignificant results for these two variables was interpreted to be the result of overlap with the other variable included in the GEE analysis.

Combined Variable Set Analysis

A GEE analysis was performed on the combined smoking and demographic variable sets to determine if there were any significant interactions between the demographic and smoking variables with respect to abstinence rates. None of the interactions were significant.

Discussion

Demographic Variables

The lack of differences for gender is consistent with the literature for behavioral interventions. The recent Surgeon General's Report (US DHHS, 2001) concluded that "...cessation interventions are generally of similar effectiveness for women and men and, to date, few gender differences...have been identified." (p. 8). While some clinical trials have reported lower cessation rates among women, many others have not. One potential explanation is that some of the previously reported differences are the result of recruitment differences, a factor held constant in this study. Reactive recruitment typically results in a higher proportion of female volunteers than male volunteers. It is possible that this resulted in non-comparable samples in other studies. For example, the reactive recruitment could have included more females than males who are in the early stages or who are heavier smokers. Another potential explanation is that the behavioral intervention that was implemented in these five studies did not produce gender

differences but other types of interventions, such as a pharmacological intervention, would result in gender differences. The lack of significant results cannot be attributed to sample size issues since both gender subgroups in this study had very large sample sizes and good statistical power and the effect size estimates were small.

Another interesting and somewhat surprising result was the lack of a significant relationship for both Race and Ethnicity, suggesting that this tailored behavioral intervention is about equally effective across racial and ethnic subgroups. The effect sizes were near zero for Race and small for Ethnicity. (The description of these as ‘racially and ethnically classified social groups’ (King, Polednak, Bendel, Vilsaint, & Nahata, 2004) is our preferred description. We do not want to imply a ‘race biology’ imputation.) The existence of health disparities with respect to smoking cessation is well established for these populations (Mazas & Wetter, 2003; Lawrence, Graber, Mills, Meissner, & Warnecke, 2003; US DHHS, 1998; Vander, Cummings, & Coates, 1990) but not consistently reported (Ahluwalia, 1996; Kiefe, Williams, Lewis, Allison, Seker, & Wahrenknecht, 2001). The absence of differences in this study is very promising since this study controlled recruitment methods and type of intervention. The findings of differences in previous research may be the result of more limited access to existing cessation services for African American and Hispanics or access to limited services rather than any difference in the ability of these subgroups to benefit from such services.

The results with respect to Education and Age were not surprising, except with regard to the effect sizes associated with these variables. The Age 65 and Older were the most successful in quitting and the most highly educated group (16+) were also the most successful. However, the effect sizes associated with these two variables were medium.

Smoking Variables

Unlike the results for the demographic variables, the results for the smoking variables were consistent with previous findings (Ferguson, Patten, Schroeder, Offord, Eberman, & Hurd, 2003). Two of the large effects involved two variables that are commonly employed to measure addiction level or severity of the problem. Time to First Cigarette and Number of Cigarettes are widely studied variables and are two variables commonly included in many measures of dependence (Fagerstrom, 1978; Heatherton, Kozlowski, Frecker, & Fagerstrom, 1991; Heatherton, Kozlowski, Frecker, Rickert, & Robinson, 1989).

Stage of change has also been employed as a central organizing construct for this tailored smoking cessation intervention. The results of this study demonstrate that it is one of the strongest predictors of smoking status at both 12 and 24 Months. Other studies have found stages of change to be predictive of outcomes at 6-month time points (Spencer, Pagell, Hallion, & Adams, 2002). These results strongly refute the claim that stage of change is descriptive but not predictive (Abrams, Herzog, Emmons, & Linnan, 2000; Herzog, Abrams, Emmons, Linnan, & Shadel, 1999; Herzog, Abrams, Emmons, & Linnan, 2000).

The effect size for the two variables involving previous quit attempts were of a smaller magnitude but were still moderate to large. Variables involving previous quit attempts have been identified (Farkas, Pierce, Zhu, Rosbrook, Gilpin, Berry, Kaplan, 1996) as being one of the most important variables for predicting successful quitting but it was of smaller magnitude than the addiction and stage variables in this analysis.

Limitations

The strength of this study can also be viewed as a weakness. Only a single behavioral intervention was studied and the results may not generalize to other types of smoking cessation interventions, such as telephone counseling or pharmacological interventions. It should also be noted that, even with the combined samples, the size of these subgroups remained very small, thus these analyses may have limited statistical power. The results of this study may not hold for other aspects of smoking such as smoking prevention interventions and harm reduction approaches.

Implications for Interventions

From an intervention viewpoint, these results are very encouraging. Since demographic variables are static variables and are not potentially modifiable, they can serve only as moderator variables and not as direct causal variables. In contrast, the three smoking variables with the largest effect sizes are all dynamic variables and are subject to manipulation. These are variables that can be used to guide the design of an intervention. For example, given the strong relationship of number of cigarettes, a focus on smoking reduction as a first step for a smoking cessation intervention could increase the efficacy of an intervention. An intervention of this type has been developed for early stage smokers (Carpenter, Hughes, Solomon, & Callas, 2004). Likewise, the strong relationship between stage of change and outcome supports the Transtheoretical model's focus on stage and stage progress in the initial phase of an intervention.

One of the most promising new approaches to population smoking cessation has been computer-based or tailored interventions (Prochaska, J. O. & Velicer, W. F. (2004). Several large clinical trials have demonstrated the effectiveness of such interventions.

Tailored interventions that focus on the dynamic variables with the largest effect sizes, such as stage of change, number of cigarettes, and time to first cigarette, should demonstrate more effectiveness. The other two smoking variables are not as directly relevant to intervention design, and could function as moderators. To some extent, Previous Quit Attempts represents an historic variable and, as such, is not open to manipulation. It is a circular argument to say that the way to get a smoker to quit is get a smoker to quit. However, the history of previous quit attempts can be considered important when viewed as an intermediate variable. Any intervention that affects these five smoking variables can be viewed as somewhat efficacious since it has increased the chances that a future quit attempt will be successful, even if the current attempt was not. In this way, an intervention that promotes stage progress, reducing the number of cigarettes smoked or making a quit attempt has brought the smoker closer to successful cessation on future occasions.

References

- Abrams, D. B., Herzog, T. A., Emmons, K. M., & Linnan, L. A. (2000). Stages of change versus addiction: A replication and extension. *Nicotine & Tobacco Research*, 2, 223-229.
- Ahluwalia, J. S. (1996). Smoking cessation in African Americans. *American Journal of Health Behaviors*, 20, 220-226
- Ahluwalia, JS, Dang, KS, Choi, WS & Harris, KJ (2002). Smoking behaviors and regular source of health care among African Americans. *Preventive Medicine*, 34, 393-396.
- Ahluwalia, JS, Harris KJ, Catley D, Okuyemi, KS, & Mayo, MS. (2002). Sustained-release bupropion for smoking cessation in African-Americans: A randomized controlled trial. *Journal of the American Medical Association*, 288, 468-474.
- Bach, PB, Pham, H.H., Schrag, D, Tate, R.C., & Hargraves, J.L. (2004). Primary care physicians who treat blacks and whites. *New England Journal of Medicine*, 351, 575-584.
- Bohadana A, Nilsson F, Rasmussen T, & Martinet Y. (2003). Gender differences in quit rates following smoking cessation with combination nicotine therapy: Influence of baseline smoking behavior. *Nicotine and Tobacco Research*, 5, 111-116.
- Borelli B, Papandonatos G, Spring B, Hitsman B, & Niaura R. (2004). Experimenter-defined quit dates for smoking cessation: Adherence improves outcomes for women but not for men. *Addiction*, 99, 378-385.
- Carpenter, M. J., Hughes, J. R., Solomon, L. J. & Callas, P. W. (2004). Both Smoking Reduction With Nicotine Replacement Therapy and Motivational Advice Increase

Future Cessation Among Smokers Unmotivated to Quit. *Journal of Consulting and Clinical Psychology*, 72, 371-381.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd Edition). Hillsdale, NJ: Lawrence Erlbaum.

Collins BN, Wileyto EP, Patterson F, Rukstalis M, Audrain-McGovern J, Kaufmann V, Pinto A, Hawk L, Niaura R, Epstein LH, Lerman C. (2004). Gender differences in smoking cessation in a placebo-controlled trial of bupropion with behavioral counseling. *Nicotine and Tobacco Research*, 6, 27-37.

Dale LC, Glover ED, Sachs DP, Schroeder DR, Offord KP, Croghan IT, & Hurt RD (2001). Bupropion for smoking cessation: Predictors of successful outcome. *Chest*, 119, 1357-1364.

DiClemente, C.C., Prochaska, J.O., Fairhurst, S., Velicer, W.F., Rossi, J.S., & Velasquez, M. (1991). The process of smoking cessation: An analysis of precontemplation, contemplation and contemplation/action. *Journal of Consulting and Clinical Psychology*, 59, 295-304.

Etter, JF, Prokhorov, AV, & Perneger, TV (2002). Gender differences in the psychological determinants of cigarette smoking. *Addiction*, 97, 733-743.

Fagerstrom, KO. (1978). Measuring the degree of physical dependence to tobacco smoking with reference to individualization of treatment. *Addictive Behaviors*, 3, 235-240.

Farkas, A. J., Pierce, J. P., Zhu, S. H., Rosbrook, B., Gilpin, E. A., Berry, C., Kaplan, R. M. (1996). Addiction versus stages of change models in predicting smoking cessation. *Addiction*, 91, 1271-1280.

- Fava, J.L., Velicer, W.F., & Prochaska, J.O. (1995). Applying the Transtheoretical model to a representative sample of smokers. *Addictive Behaviors, 20*, 189-203.
- Ferguson JA, Patten CA, Schroeder DR, Offord KP, Eberman, KM, & Hurd, RD. (2003). Predictors of 6-month tobacco abstinence among 1224 cigarette smokers treated for nicotine dependence. *Addictive Behaviors, 28*, 1203-1218.
- Fidler, F. & Thompson, B. (2001). Computing correct confidence intervals for ANOVA fixed- and random-effects effect sizes. *Educational and Psychological Measurement, 61*, 575-604.
- Hays, W. L. (1981). *Statistics* (3rd. Edition). New York: Holt, Rinehart, & Winston.
- Heatherton, TF, Kozlowski, LT, Frecker, RC, & Fagerstrom, KO. (1991). The Fagerstrom test for Nicotine dependence: a revision of the Fagerstrom Tolerance Questionnaire. *British Journal of Addiction, 86*, 319-332.
- Heatherton, TF, Kozlowski, LT, Frecker, RC, Rickert, W, & Robinson, J. (1989). Measuring the heaviness of smoking: using self-reported time to first cigarette of the day and number of cigarettes smoked per day. *British Journal of Addiction, 84*, 791-800.
- Herzog, T. A., Abrams, D. B., Emmons, K. M., & Linnan, L. A. (2000). Predicting increases in readiness to quit smoking: A prospective analysis using the contemplation ladder. *Psychology and Health, 15*, 369-381.
- Herzog, T. A., Abrams, D. B., Emmons, K. M., Linnan, L. A., & Shadel, W. G. (1999). Do processes of change predict smoking stage movements? A prospective analysis of the Transtheoretical model. *Health Psychology, 18*, 369-375.

- Kiefe, C. I., Williams, O. D., Lewis, C. E., Allison, J. J., Seker, P., & Wahlenknecht, L. E. (2001). Ten year changes in smoking cessation among young adults: Are racial differences explained by socio-economic factors in the CARDIA study? *American Journal of Public Health, 91*, 213-218.
- King, G., Polednak, A., Bendel, R. B., Vilsaint, B. A., & Nahata, S. B. (2004). Disparities in smoking cessation between African Americans and Whites: 1990-2000. *American Journal of Public Health, 94*, 1965-1971.
- Kirk, R. E. (1996). Practical significance: A concept whose time has come. *Educational and Psychological Measurement, 56*, 746-759.
- Kline, R. B. (2004). *Beyond significance testing: Reforming data analysis methods in the behavioral sciences*. Washington, DC: American Psychological Association.
- Lawrence, D, Graber, JE, Mills, SL, Meissner HI, & Warnecke, R. (2003). Smoking cessation interventions in US racial/ethnic minority populations: An assessment of the literature. *Preventive Medicine, 36*, 204-216.
- Leischow, SJ, Ranger-Moore, J., & Lawrence, D. (2000). Addressing social and cultural disparities in tobacco use. *Addictive Behaviors, 25*, 821-831.
- Linnan, L. A., Emmons, K. M., Klar, N., Fava, J. L., Laforge R. G., & Abrams, D. B. (2002). Challenges to improving the impact of worksite cancer prevention programs: Comparing reach, enrollment, and attrition using active versus passive recruitment strategies. *Annals of Behavioral Medicine, 24*, 157-66.
- Mazas CA & Wetter DM (2003) Smoking cessation interventions among African-Americans: Research Needs. *Cancer Control, 10*, 87-89.

- Perkins KA. (2001). Smoking cessation in women: Special considerations. *CNS Drugs*, *15*, 391-411.
- Prochaska, J. O. & Velicer, W. F. (2004). Integrating Population Smoking Cessation Policies and Programs. *Public Health Reports*, *119*, 244-252.
- Prochaska, J.O., Velicer, W.F., DiClemente, C.C., & Fava, J.L. (1988). Measuring processes of change: Applications to the cessation of smoking. *Journal of Consulting and Clinical Psychology*, *56*, 520-528.
- Prochaska, J. O., Velicer, W. F., Fava, J. L., Rossi, JS, & Tsoh, JY (2001) Evaluating a Population-based Recruitment Approach and a Stage-based Expert System Intervention for Smoking Cessation. *Addictive Behaviors*, *26*, 583-602.
- Prochaska, J.O., Velicer, W. F., Fava, J.L., Ruggiero, L., Laforge, R.G., Rossi, J.S., Johnson, S.S., & Lee, P.A. (2001) Counselor and stimulus control enhancements of a stage-matched expert system intervention for smokers in a managed care setting. *Preventive Medicine*, *32*, 23-32.
- Prochaska, J. O., Velicer, W. F., Redding, C. A., Rossi, J. S., Goldstein, M., DePue, J., Greene, G. W., Rossi, S. R., Sun, X., Fava, J. L., Laforge, R., Rakowski, W., & Plummer, B. A. (2005). Stage-based Expert Systems to Guide A Population of Primary Care Patients to Quit Smoking, Eat Healthier, Prevent Skin Cancer and Receive Regular Mammograms. *Preventive Medicine*, *41*, 406-416.
- Prochaska, J. O., Velicer, W. F., Rossi, J. S., Redding, C. A., Greene, G. W., Rossi, S. R., Sun, X., Fava, J. L., Laforge, R. G., & Plummer, B. A. (2004). Impact of simultaneous stage-matched expert system interventions for smoking, high fat diet and sun exposure in a population of parents. *Health Psychology*, *23*, 503-516.

SAS Institute, Inc. (1997). *SAS/STAT software: changes and enhancements through release 6.12*, Cary, NC.

Schafer, J.L. & Graham, J.W. (2002) Missing data: Our view of the state of the art. *Psychological Methods*, 7, 147-177.

Schmid, T. L., Jeffrey, R. W., & Hellerstedt, W. L. (1989). Direct mail recruitment to house-based smoking and weight control programs: A comparison of strengths. *Preventive Medicine*, 18, 503-517.

Spencer, L., Pagell, F., Hallion, M. E., & Adams, T. B. (2002). Applying the Transtheoretical Model to Tobacco Cessation and Prevention: A Review of the Literature. *American Journal of Health Promotion*, 17, 7-71.

Swan GE, McAfee T, Curry SJ, Jack LM, Javitz J, Dacey S, & Bergman K. (2003). Effectiveness of bupropion sustained release for smoking cessation in a health care setting: a randomized trial. *Archives of Internal Medicine*, 163, 2337-2344.

US DHHS. (1998). *Tobacco Use Among US Racial/Ethnic Minority Groups—African Americans, American Indians, and Alaska Natives, Asian Americans and Pacific Islanders: A Report of the Surgeon General*. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health.

US DHHS. (2001). *Women and smoking. A report of the surgeon general*. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health.

- Vander, MR, Cummings, SR & Coates, TJ. (1990). Ethnicity and Smoking: Differences in White, Black, Hispanic, and Asian Medical Patients who smoke. *American Journal of Preventive Medicine*, 6, 194-199.
- Velicer, W.F., DiClemente, C.C., Prochaska, J.O., and Brandenburg, N. (1985). A decisional balance measure for assessing and predicting smoking status. *Journal of Personality and Social Psychology*, 48, 1279-1289.
- Velicer, W.F., DiClemente, C., Rossi, J.S., & Prochaska, J.O. (1990). Relapse situations and self-efficacy: An integrative model. *Addictive Behaviors*, 15, 271-283.
- Velicer, W. F., Keller, S., Friedman, R. H. Fava, J. L., Gulliver, S. B., Ward, R. M., Ramelson, H., Prochaska, J. O., Robins, A. G., & Cottrill, S. D. (2005). Comparing Participants and Non-participants Recruited for an Effectiveness Study of Nicotine Replacement Therapy. *Annals of Behavioral Medicine*, 21, 181-191.
- Velicer, W.F., & Prochaska, J. O. (1999). An expert system intervention for smoking cessation. *Patient Education and Counseling*, 36, 119-129.
- Velicer, W. F., & Prochaska, J. O. (2004). A Comparison of Four Self-report Smoking Cessation Outcome Measures. *Addictive Behaviors*, 29, 51-60.
- Velicer, W.F., Prochaska, J.O., Bellis, J.M., DiClemente, C.C., Rossi, J.S., Fava, J.L., & Steiger, J.H. (1993). An expert system intervention for smoking cessation. *Addictive Behaviors*, 18, 269-290.
- Velicer, W. F., Prochaska, J. O., Fava, J. L., Laforge, R. G., Rossi, J. S. (1999). Interactive versus non-interactive interventions and dose-response relationships for stage-matched smoking cessation programs in a managed care setting. *Health Psychology*, 18, 1-8.

Velicer, WF, Prochaska, JO, & Redding, CA. (2006). Tailored communications for smoking cessation: Past successes and future directions. *Drug and Alcohol Review*, 25, 47-55.

Velicer, WF, Prochaska, JO, Redding, C, Rossi, JS, Sun, X, Rossi, SR, Greene, GW, Fava, JL, Abrams, DB, Linnan, LA, & Emmons, KM. (2004). Efficacy of Expert System Interventions for Employees to Decrease Smoking, Dietary Fat, and Sun Exposure. *International Journal of Behavioral Medicine*, 11 (S 1), 277 (Abstract).

Zeger, S. L., & Liang, K.-Y. (1986) Longitudinal data analysis for discrete and continuous outcomes. *Biometrics*, 42, 121-130.

Table 1.

Description of Demographic and Smoking History Variables for Five Baseline Sample.

		Sample					Total (N=2972)
		RDD (N=1708)	HMO (N=207)	Parent (N=347)	Patient (N=535)	Employee (N=175)	
Date of First Baseline Assessment		9/10/90	2/20/92	6/13/96	5/1/96	12/5/95	9/10/90
Date of Last Baseline Assessment		6/18/91	4/5/93	1/13/97	7/1/97	9/9/96	6/18/91
Date of First Final Assessment		9/15/93	2/7/95	3/12/98	5/7/98	2/7/98	5/7/98
Date of Last Final Assessment		6/1/94	3/7/96	1/20/99	10/16/99	9/23/98	10/16/99
Gender (%)	Male	44.20	66.83	21.33	32.34	58.86	41.72
Age (%)	<=24	9.55	11.17	0.00	8.97	2.86	8.08
	25-34	26.07	26.70	9.28	18.69	21.14	22.59
	35-44	30.05	28.64	69.16	32.34	32.57	34.93
	45-54	16.99	21.84	18.86	23.93	32.00	19.68
	55-64	11.13	8.74	2.69	11.78	10.86	10.11
	65+	6.21	2.91	0.00	4.30	0.57	4.60
Ethnicity (%)	Hispanic	1.70	*	2.38	1.12	1.71	1.55
Race (%)	White	97.54	*	93.43	96.07	92.57	96.44
	African American	0.82	*	2.99	1.50	4.00	1.42
	Asian	0.47	*	0.00	0.19	0.57	0.36
	Other	1.17	*	3.58	2.24	2.86	1.78
Education (%)	<12	12.76	14.49	12.14	9.72	10.29	12.12
	12	40.52	49.28	50.00	40.37	47.43	42.61
	13-15	27.99	23.67	22.25	27.48	24.00	26.69
	16+	18.74	12.56	15.61	22.43	18.29	18.58
Cigarettes Per Day	Mean	20.46	18.62	18.08	16.52	14.66	18.79

SD	11.26	10.99	11.72	11.02	8.12	11.21
Time 1st Cigarette (min.)						
Mean	63.83	97.08	67.92	94.69	88.49	76.23
SD	112.8	113.38	107.07	157.93	149.28	125.45
# 24H Quit Att./Year						
Mean	2.22	1.96	2.05	2.53	1.89	2.2
SD	6.66	2.65	2.82	2.96	2.49	5.08
Longest Quit (days)						
Mean	210.87	321.21	322.01	369.46	315.21	241.22
SD	302.32	554.48	561.86	613.58	581.11	448.7
Stage of Change						
% Precontemplation	40.63	36.23	43.80	29.16	41.71	38.69
% Contemplation	42.62	46.86	41.79	48.04	42.86	43.81
% Preparation	16.74	16.91	14.41	22.80	15.43	17.50

*Information not available

Table 2. Abstinence Rates and Effect Size Estimates for Demographic and Smoking Variables

Variable	Subgroup	<u>Assessment Occasion</u>						Φ^2
		Month 12			Month 24			
		N	%	Φ^2	N	%	Φ^2	
<u>Part I. Demographics</u>								
I. Gender	Male	754	18.3	0.012	683	23.6	0.012	
	Female	1072	17.4		917	24.6		
II. Race	Black	25	20.0	0.009	19	26.3	0.003	
	White	1515	17.3		1342	24.9		
III. Ethnicity	Hispanic	20	10.0	0.022	20	35.0	0.028	
	Not	1553	17.5		1372	24.9		
IV. Age	<=24	137	21.2	0.083	124	21.8	0.065	
	25-34	410	16.6		353	26.1		
	35-44	645	18.3		566	23.5		
	45-54	366	16.4		324	22.2		
	55-64	178	13.5		155	23.2		
	65+	80	30.0		71	35.2		
V. Education	<12	209	12.9	0.067	174	21.8	0.072	
	12	794	18.6		698	21.9		
	13-15	477	15.7		426	24.6		

	16+	346	21.4		302	30.1	
Part II. Smoking Variables							
VI. Time/First Cig.	<=9	335	13.4	0.153	299	18.7	0.105
(Minutes)	10-19	304	11.2		273	16.1	
	20-39	332	15.7		302	21.9	
	40-89	411	15.8		357	26.3	
	90+	433	28.6		359	34.5	
VII. Longest Quit	<=1	303	11.9	0.105	256	16.0	0.130
(Days)	2-7	291	16.2		260	20.4	
	8-13	229	15.3		187	21.9	
	32-183	313	18.5		285	28.1	
	184+	505	23.0		457	30.6	
VIII. # Quit	0	778	13.5	0.112	691	21.3	0.107
Attempts	1	306	18.3		283	21.6	
(last year)	2	274	18.6		235	24.3	
	3-4	221	22.2		178	27.5	
	5+	238	25.6		206	35.0	
IX. # Cigarettes	<+9	289	31.5	0.173	238	39.5	0.177
	10-19	538	18.8		454	27.3	
	20-29	643	14.6		575	20.0	
	30+	350	10.6		324	16.0	
X. Baseline Stage	Precontemplation	688	10.9	0.152	599	16.4	0.167
	Contemplation	819	20.0		724	26.0	

Preparation	319	26.7	276	36.6
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Figure Captions

Figure 1. Demographic Variables and Point Prevalence Abstinence Rates for 12 and 24

Months

Figure 2. Smoking Variables and Point Prevalence Abstinence Rates for 12 and 24

Months





