Original Investigation

The role of nicotine replacement therapy in early quitting success

Nancy Amodei & R. J. Lamb

Abstract

Introduction: Nicotine replacement therapy (NRT) is an effective but underutilized smoking cessation aid despite being available over the counter. This exploratory study examined whether voluntary early use of NRT predicted cessation in a self-initiated quit attempt better than other commonly studied variables.

Methods: Data were collected from 99 adult smokers desiring to quit smoking in the near future over a 10-day baseline period prior to the implementation of a contingency management intervention. NRT use was neither encouraged nor discouraged during the study. Initial abstinence, biochemically verified using a criterion of CO level <4 ppm, was conceptualized in 2 ways: (a) any day of baseline abstinence and (b) the sum of baseline days abstinent. We examined the predictive value of NRT use as well as demographics, self-efficacy, motivational readiness, and nicotine dependence.

Results: While greater self-efficacy was predictive of initial abstinence, NRT use was the most consistent predictor. The odds of abstaining at least 1 day during baseline were 16.8 times greater for those who used NRT on Day 1 than nonusers. Self-efficacy and “any baseline NRT use” contributed significant amounts of variance to the “sum of days abstinent,” with the overall model explaining 29% of the variance ($p < .001$). The sum of baseline days of NRT use and use of NRT on Day 1 also predicted the “sum of days abstinent.”

Discussion: Given NRT’s effectiveness, but underutilization in real-world settings, the data support the need for interventions or strategies encouraging people to use NRT in their quit attempts.

Introduction

Cigarette smoking is the leading cause of preventable mortality in the United States, yet nearly one in five adults is a current smoker. According to the Centers for Disease Control and Prevention (CDC, 2008), the most important thing a person can do

if they smoke is quit. Each year, somewhere between 20% and 50% of smokers try to quit but only 4%–7% are successful (CDC; Fiore et al., 2008; Hughes, 2003). Increasing smoking cessation rates would reap tremendous personal and societal benefits.

Nicotine replacement therapy (NRT) represents an efficacious intervention for would-be quitters. It increases the odds of quitting relative to placebo by about 1.5- to 2-fold both in clinical trials (Silagy, Lancaster, Stead, Mant, & Fowler, 2004) and in trials designed to mimic over-the-counter (OTC) NRT use (Hughes, Shiffman, Callas, & Zhang, 2003). In the United States, NRT is now widely available through both OTC and prescription means. However, despite NRT’s widespread availability, it appears to be underutilized (Cummings & Hyland, 2005; Mooney, Leventhal, & Hatsukami, 2006) with only 11%–21% of smokers using it in a quit attempt (Pierce & Gilpin, 2002; Thorndike, Biener, & Rigotti, 2002; Zhu, Melcer, Sun, Rosbrook, & Pierce, 2000). Moreover, despite evidence to support its effectiveness from studies designed to mimic OTC conditions, these trials differ in important ways from actual real-world use. People participate knowing they might get placebo, often instructions on appropriate use are given and appropriate use encouraged, there is no choice of NRT product, NRT is not purchased, and so forth. Epidemiological studies not suffering from these problems also indicate that NRT typically results in higher cessation rates (Burton et al., 1997; Reed, Anderson, Vaughn, & Burns, 2005). These studies have other types of limitations; for example, many important subject variables that might result in better outcomes are either not measured or only measured retrospectively. In short, we still have a limited understanding of how effective NRT is when used under more real-world conditions, that is, when people are free to use or not to use NRT and no encouragement or advice on its use is given.

The present exploratory study sought to prospectively examine the role of NRT in self-quitting when controlling for other variables that are expected either on theoretical or empirical grounds to influence quitting success. These other variables have typically included demographics, motivational indicators, self-efficacy, and nicotine dependence. Demographic variables associated with success in quitting are male gender,

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older age, higher socioeconomic status (Honda, 2005; Hyland et al., 2004; Hymowitz et al., 1997), being White (King, Poldenak, Bendel, Vilsaint, & Nahata, 2004; Lee & Kahende, 2007), and being married (Lee & Kahende; Murray, Johnston, Dolce, Lee, & O'Hara, 1995; van Loon, Tijhuis, Surtees, & Ormel, 2005). Living with a nonsmoker has been shown to predict cessation success (e.g., Osler & Prescott, 1998), whereas living with a smoker predicts failure to quit (Pisinger, Vestbo, Borch-Johnsen, & Jorgensen, 2005; Senore et al., 1998).

Another explanatory variable, self-efficacy, is typically defined as the belief in one's ability to perform specific behaviors in specific situations necessary to achieve a desired outcome (Bandura, 1997). Perceived self-efficacy is associated with the inhibition of existing behaviors (e.g., decreasing or abstaining from cigarette smoking) as well as the acquisition of new behaviors (e.g., using relaxation to deal with cigarette cravings). According to Bandura (1977), perceived self-efficacy mediates behavior change whether through treatment or self-change efforts. Self-efficacy can predict initial quitting (Amodei & Lamb, 2005; Baldwin et al., 2006; Borland, Owen, Hill, & Schofield, 1991; Stuart, Borland, & McMurray, 1994) and cessation success (DiClemente, Prochaska, & Gibertini, 1985; Norman, Norman, Rossi, & Prochaska, 2006; Schnoll et al., 2002; Stuart et al.).

Both cognitive and behavioral indicators of motivation to quit have been shown to be predictive of smoking cessation success. The stages of change model (Prochaska & DiClemente, 1983) is often used to categorize motivation to change among individuals with addictive disorders. According to this model, smokers move along a continuum of stages from precontemplation to contemplation about quitting, to taking action to quit, and eventually to maintaining cessation. However, individuals may cycle through the stages several times before achieving permanent cessation. Evidence exists that individuals who show greater readiness to quit based on their stage subtype (e.g., contemplation vs. precontemplation) are more likely to make a successful quit attempt (e.g., DiClemente et al., 1991; Farkas et al., 1996; Prochaska, Velicer, Prochaska, & Johnson, 2004). Behavioral indicators of motivation to quit, such as a history of past quit attempts and length of past quit attempts, are also associated with successful quitting (Hellman, Cummings, Haughey, Zielesny, & O'Shea, 1991; Hyland et al., 2006; Hymowitz et al., 1997; West, Mcewen, Bolling, & Owen, 2001).

Level of nicotine dependence has frequently been investigated as a predictor of smoking cessation, whether the index of dependence is amount smoked, time to the first cigarette of the day, or a questionnaire measure of dependence such as the Fagerström Test for Nicotine Dependence (FTND; Heatherton, Kozlowski, Frecker, & Fagerstrom, 1991). Research has shown that those who are more dependent are less likely to be successful at quitting (e.g., Chandola, Head, & Bartley, 2004; Ferguson et al., 2003; Hyland et al., 2006; Rohren et al., 1994; West et al., 2001). Moreover, some evidence suggests that nicotine dependence may be a more powerful predictor of quitting success than the stages of change construct (Farkas et al., 1996).

To our knowledge, no study has examined whether voluntary early use of NRT predicts cessation in a self-initiated quit attempt better than these other variables. Elucidating the relative contribution of these variables can help guide research priorities, given the generally disappointing rates of NRT use

among smokers wishing to quit. For example, should we focus resources on finding ways to increase the likelihood that smokers use NRT in their next quit attempt or on designing interventions that enhance self-efficacy to quit without NRT?

This exploratory study extended the work of our earlier study (Amodei & Lamb, 2005) by examining the relative contribution of NRT in addition to the previously studied variables in predicting initial abstinence in a self-initiated quit attempt. We hypothesized that NRT would be the strongest predictor of initial abstinence. We chose to examine initial abstinence, that is, abstinence during the 10 study days prior to a formal intervention, because initial abstinence or quit date abstinence predicts long-term abstinence (Kenford et al., 1994; Westman, Behm, Simel, & Rose, 1997). However, from the outset, we also acknowledge the limited generalizability of our study findings to all self-initiated quit attempts given that our abstinence observation period occurred immediately prior to the commencement of a formal contingency management intervention.

Methods

Participants

Data in the present study were collected as part of a contingency management smoking study (Lamb, Morral, Kirby, Iguchi, & Galbicka, 2004). Adult male and female volunteers working at or near the University of Texas Health Science Center in San Antonio, who smoked at least 15 cigarettes/day and who were planning to quit in the near future, were recruited through flyers and by being told about the study by participants who were already enrolled. They were informed that the purpose of the study was to examine the benefit of providing various financial incentives for smoking cessation. One hundred and nineteen individuals were enrolled in the study; however, 17 did not complete a 10-day baseline period and were not randomized to one of the treatment conditions. Of the 102 individuals with 10 days of baseline data, 3 were excluded because they reported using bupropion. The local institutional review board approved the study, including the procedures for obtaining informed consent.

Procedure

After giving informed consent, each participant completed a 30-min questionnaire addressing demographic information and other variables of interest in the present study, including whether the participant planned on using NRT during the current quit attempt. Each participant then returned for 10 consecutive workdays (i.e., baseline) to deliver a breath CO sample. Participants were free to use or not to use NRT, and no encouragement or advice on its use was given. At each of these 10 weekday visits, participants reported on how many cigarettes they had smoked within the previous 24-hr period and whether they had used NRT during the same 24-hr period. We did not ask about quantity of use or how participants used the NRT product. Participants received \$2.50 for the delivery of a breath CO level <4 ppm the first day only and \$1.00 each day for attendance.

Measures

Initial abstinence. The dependent variable was measured in two ways: (a) a dichotomous variable, Any Day Abstinence, where "1" indicated both a breath CO level <4 ppm and self-reported

abstinence from cigarettes during the same 24-hr period on at least 1 of the 10 baseline days and (b) as a continuous variable, “sum of days abstinent,” where a score of 0–10 was assigned depending on the number of baseline days that occurred during which the participant both delivered a breath CO level <4 ppm and concurrently denied smoking during the previous 24 hr. Due to the exploratory nature of this study, we looked for convergence in outcomes across different operational definitions of the dependent variable in order to assess NRT’s potential importance. We can be more confident that a relationship exists between NRT use and initial abstinence if the relationship holds true with more than one operational definition of initial abstinence.

Demographic variables. These included age, gender, ethnicity, marital status, income, employment status, and whether or not the participant lived with a smoker.

Motivational, self-efficacy, and dependence variables. Stages of change were measured using the University of Rhode Island Change Assessment (URICA; McConaughy, DiClemente, Prochaska, & Velicer, 1989; McConaughy, Prochaska, & Velicer, 1983). The 32-item URICA consists of four subscales, each with eight items, corresponding to the four hypothesized stages of change: precontemplation, contemplation, action, and maintenance. Items were rated on a 5-point Likert-type scale (“1” = *strongly disagree* to “5” = *strongly agree*). Each subscale score could vary from 8 to 40. In addition, a readiness to change composite score, which could vary from –16 to 112, was derived by subtracting the precontemplation score from the sum of the contemplation, action, and maintenance scores. Higher scores suggest greater readiness to change. Participants also reported on the following behavioral indicators of motivation: (a) the longest time gone without smoking since starting to smoke on a regular basis, (b) days gone without smoking (for any reason) in the previous year, and (c) days intentionally not smoking within the past year. For each of the previous three questions, a dichotomous variable was also created such that if a participant had not been abstinent, a score of 0 was assigned; otherwise, a score of 1 was recorded.

Self-efficacy was measured using a single item: “How difficult would it be for you to not smoke for one day before you next come in?” Responses were assigned a value from 1 to 5 where a score of 1 corresponded to a rating of *extremely difficult* and score of 5 corresponded to a rating of *not difficult*. In other words, higher scores indicated higher self-efficacy with regard to not smoking.

Nicotine dependence was measured using the six-item FTND (Heatherton et al., 1991). Higher scores indicate higher nicotine dependence.

NRT variables. We employed four indices of NRT use: (a) a one-item question about self-reported intention to use NRT during this quit attempt (coded 0 = *no* or 1 = *yes*), (b) a dichotomous variable reflecting whether the participant actually used NRT on Day 1 of baseline (coded 0 = *no* or 1 = *yes*), (c) a dichotomous variable reflecting use of NRT on at least 1 day of baseline (0 = *no* or 1 = *yes*), and (d) the sum of days of NRT use (i.e., 0–10) during baseline. Due to the exploratory nature of the study, when more than one of these indices were associated at the univariate level with a particular variant of the dependent variable, a separate regression was performed to examine the unique contribution of that NRT variable in predicting initial abstinence.

Data analyses

We used linear tools including logistic and multiple regression. Variables were entered in the respective regression analyses if they were associated at the univariate level with initial abstinence at the $p < .1$ level. For continuous variables that were skewed and were included in either the logistic or the multiple regressions, various transformations (e.g., square root, log base 10, etc.) were tried in order to create variables with the least amount of skewness. Prior to performing log base 10 transformations or inverse transformations, we recoded variables that could include a score of “0” (e.g., sum of days NRT use) by adding “1” to each score. The transformations selected for continuous variables significant at the univariate level were as follows: square root of self-efficacy, log base 10 of URICA composite score, log base 10 “longest time in days gone without smoking in the past year,” log base 10 “sum of days NRT use,” and log base 10 “sum of days abstinent.” Finally, for both logistic and multiple regression, we converted continuous scores to Z-scores in order to make them comparable to the scores of the other variables.

Categorical variables entered in the logistic and multiple regression analyses were dummy coded. We used the block enter method for both logistic and multiple regression analyses. For all analyses, demographic variables were entered in Block 1 and motivational, self-efficacy, and dependence variables were entered in Block 2. To reiterate, in order to examine the unique contribution of the four NRT variables in relation to the other variables, those NRT variables that were significantly associated with a particular dependent variable at the univariate level were entered individually in the third block.

Results

Participant characteristics

Almost 60% of participants were female, and the mean age of the sample was 38.6 ($SD = 11.4$) years. The ethnic/racial breakdown of the sample was as follows: 75.5% non-Hispanic White, 17.3% Hispanic, 4.1% Black, 2% Native American, and 1% other. Almost half (48%) were married or living in common-law relationships; 31.3% were single and 20.2% were separated or divorced. Approximately one quarter of the sample earned less than \$15,000 per year; 53% earned between \$15,000 and \$34,999 and 21.4% earned \$35,000 or more. Approximately 38% had earned a high school diploma or its equivalent; 36.4% had completed an associate’s degree or had completed vocational, technical, or trade school, while 25.3% had earned a bachelor’s or advanced degree. Of the sample, 71.8% were employed full time, 22.4% were employed part time or were students, and 5.9% were unemployed. Approximately 41% lived with a smoker. The mean self-efficacy score for the sample was 2.1 ($SD = 1.1$), indicating a modest level of self-efficacy, the mean FTND score was 5.5 ($SD = 2.0$), indicating medium dependence, and the mean URICA composite score was 77.1 ($SD = 12.1$), suggesting a medium level of readiness to change.

Planned NRT use, actual use, and abstinence

Of the 27 who planned to use a NRT product, 74.1% intended to use the patch, 18.5% the gum, and the rest a nicotine inhaler. Eleven (11.3%) of the 99 participants used NRT on Day 1 of

baseline and 18 (18.2%) used it on at least 1 day. When abstinence was defined as “any day abstinence,” 29 of the 99 (29.3%) participants were abstinent. Using this definition of abstinence, 12 of the 29 abstainers (i.e., 41.4%) and 6 of the 70 nonabstainers (i.e., 8.6%) reported using NRT at least once during baseline. Four individuals achieved 10 days of continuous abstinence during baseline: one reported using NRT on each of the 10 days, another used it on 3 days, and the other two individuals never used it.

Univariate analyses

Any Day Abstinence. When examining univariate relationships with the variable, “any day abstinence,” males were more likely to be abstinent than females ($p < .10$) and those who were married or cohabitating were more likely to be abstinent on at least 1 baseline day than those who were single, divorced, or widowed ($p < .10$). “Any day abstinence” was associated with self-efficacy ($p < .01$) and the URICA composite score ($p < .10$). It was also associated with the longest period (in days) ever gone without smoking ($p < .10$) and making an intentional quit attempt in the past year ($p < .10$). Additionally, there were three NRT variables associated with “any day abstinence”: use of NRT on Day 1 ($p < .001$), use of NRT at least once during baseline ($p < .001$), and sum of days of using NRT ($p < .001$).

Sum of Days Abstinent. There was a significant univariate relationship between the dependent variable, “sum of days abstinent,” and race ($p < .01$). The sum of baseline days of abstinence was also associated at the univariate level with the following variables: age ($p < .10$), URICA composite score ($p < .10$), at least one intentional quit attempt in the past year ($p < .10$), longest period (in days) ever gone without smoking ($p < .01$), self-efficacy ($p < .05$), number of days of using NRT during baseline ($p < .001$), Day 1 use of NRT ($p < .001$), any baseline use of NRT ($p < .001$), and intention to use NRT during the current quit attempt ($p < .10$).

Multivariate analyses

Any Day Abstinence. Three logistic regressions were performed on this dependent variable because three NRT indicators were significant. The demographic variables entered each time in Block 1 were gender (where the reference group was female) and marital status (where the reference category for this dichotomously coded variable was single/separated/divorced). The four variables entered into Block 2 each time were the square root transformation of self-efficacy, the log base 10 transformation of URICA composite score, the log base 10 of the “longest time (in days) ever gone without smoking,” and “at least 1 day of intentionally not smoking in the past year” (where the reference group for this dummy coded variable was “no days of intentionally not smoking”). When “any day of NRT use” (where the reference group for the dummy coded variable was no baseline NRT use) was entered in Block 3, a test of the full model versus a model with intercept only was statistically significant, $\chi^2 (7, N = 88) = 28.8, p < .001$. Additionally, the block chi square for the addition of the NRT predictor variable to the model was statistically significant, $\chi^2 (1, N = 88) = 11.4, p < .01$. The model correctly classified 91.7% of nonabstainers and 50.0% of abstainers for an overall success rate of 78.4%. The odds of abstaining at least once during baseline were 9.9 times greater with any day of NRT use than in the absence of NRT use

when holding other variables constant. Greater self-efficacy also predicted at least 1 day of abstinence (see Table 1).

When the variable “NRT use on Day 1” was entered, a test of the full model versus a model with intercept only was statistically significant, $\chi^2 (7, N = 86) = 28.0, p < .001$. Additionally, the block chi square for the addition of the variable, NRT use on Day 1, to the model was statistically significant, $\chi^2 (1, N = 86) = 11.4, p < .01$. The model was able to classify correctly 87.9% of nonabstainers and 53.6% of abstainers for an overall success rate of 76.7%. Those who used NRT on Day 1 were 16.8 times more likely to abstain at least 1 day during baseline when controlling for other predictors. Having a partner (i.e., being married or having a common-law relationship) made one 3.3 times more likely to achieve at least 1 day of abstinence during baseline (see Table 1).

In the third logistic regression, the log base 10 of the “sum of days NRT use” was entered in Block 3. As noted previously, this transformation was performed to reduce the amount of skew in the continuous variable, “sum of NRT days.” A test of the full model versus a model with intercept only was statistically significant, $\chi^2 (7, N = 88) = 26.8, p < .001$. Additionally, the block chi square for the addition of the NRT variable to the model was statistically significant, $\chi^2 (1, N = 88) = 9.4, p < .01$. The model correctly classified 90.0% of nonabstainers and 46.4% of abstainers for an overall success rate of 76.1%. In the model, the higher the number of days of NRT use, the greater the likelihood that the participant had at least 1 day of abstinence when controlling for other variables (odds ratio = 2.1, $p < .01$). In addition, greater self-efficacy predicted at least 1 day of initial abstinence when holding other variables constant (see Table 1).

Sum of Days Abstinent. We used a transformed dependent variable (i.e., the log base 10 of the “sum of days abstinent”) for each of the four multiple regressions performed. For the first analysis, age and the dichotomously coded variable race (White vs. non-White), where non-White was the reference category, were entered in Block 1 and the log base 10 transformation of the URICA readiness to change composite scores, the square root transformation of self-efficacy scores, the log base 10 of “the longest period (in days) ever gone without smoking,” and the dichotomous variable, “at least 1 day of intentionally not smoking within the past year,” were entered in Block 2. The variable entered in the third block was a dichotomous variable—“plan to use NRT in the current quit attempt” where the reference category was “no plan to use NRT during the current quit attempt.”

In this analysis, the seven variables accounted for a significant 23% of the variance, $F(7, 78) = 3.1, p < .01$. The R^2 change (.03) for the addition of the variable, “intention to use NRT in the current quit attempt,” to the model was not significant, $F(1, 71) = 2.9, p > .05$. With standardized betas of .25 and .23, respectively, self-efficacy and the URICA composite score each contributed a significant amount of variance. In other words, higher self-efficacy and higher URICA readiness to change composite scores each predicted the number of days of initial abstinence when controlling for other variables (see Table 2).

The second multiple regression analysis was performed for NRT use on Day 1. The seven variables accounted for a significant 27% of the variance, $F(7, 84) = 4.1, p < .01$. The R^2 change (.11) for the addition of NRT use on Day 1 to the model was significant, $F(1, 77) = 11.9, p < .01$. With a standardized beta

Table 1. Summary of logistic regression for variables predicting any day abstinence with NRT variables entered separately (N = 99)

Variable ^a	Adjusted odds ratio	95% CI	Wald statistic
Any day NRT use entered			
Gender			
Female (reference)			
Male	2.63	0.84–8.24	2.73
Marital status			
Single/separated/divorced (reference)			
Married/common-law	2.63	0.86–8.17	2.89
Self-efficacy	1.96	1.05–3.64	4.52*
URICA composite	1.76	0.95–3.24	3.28
Longest time ever gone without smoking (days)	0.85	0.48–1.48	0.35
At least one intentional quit day past year			
No day (reference)			
At least 1 day	1.58	0.51–4.90	0.62
Use of NRT any day			
No day (reference)			
At least 1 day	9.24	0.51–4.90	9.85**
Day 1 NRT use entered			
Gender			
Female (reference)			
Male	2.18	0.70–6.83	1.79
Marital status			
Single/separated/divorced (reference)			
Married/common-law	3.25	1.03–10.28	4.04*
Self-efficacy	1.83	0.98–3.42	3.63
URICA composite	1.60	0.87–2.94	2.31
Longest time ever gone without smoking (days)	0.80	0.451–1.41	0.60
At least one intentional quit day past year			
No day (reference)			
At least 1 day	1.57	0.50–4.92	0.60
NRT Day 1			
No (reference)			
Yes	17.77	2.46–114.18	8.30**
Sum of days NRT use entered			
Gender			
Female (reference)			
Male	2.62	0.85–8.10	2.80
Marital status			
Single/separated/divorced (reference)			
Married/common-law	2.51	0.82–7.65	2.60
Self-efficacy	1.94	1.05–3.57	4.4*
URICA composite	1.70	0.93–3.10	2.96
Longest time ever gone without smoking (days)	0.88	0.50–1.54	0.21
At least one intentional quit day past year			
No (reference)			
Yes	1.48	0.48–4.51	0.47
Sum of NRT days	2.14	1.27–3.61	8.14**

Note. ^aContinuous predictor variables are expressed as transformed scores and converted to Z-scores.

* $p < .05$. ** $p < .01$.

of .35, Day 1 NRT use contributed significant variance when controlling for the other six variables (see Table 2).

In the third multiple regression analysis, use of NRT on any day was entered into Block 3. The seven variables accounted for a significant 29% of the variance, $F(7, 86) = 4.5$, $p < .001$. The R^2

change (.13) for the addition of “NRT use on any day” to the model was significant, $F(1, 79) = 14.6$, $p < .001$. With standardized betas of .21 and .38, respectively, the transformed variables relating to self-efficacy and the use of NRT on at least 1 baseline day each contributed significant amounts of variance to the criterion variable (i.e., transformed log base 10 of the sum of days

Table 2. Summary of multiple regression for predictors of Sum Days Abstinent with NRT variables entered separately (N = 99)

Variable ^a	B	SEB	β
Planning to use NRT entered			
Age	0.13	0.11	.14
Race			
Non-White (reference)			
White	−0.31	0.27	−.13
URICA composite	0.23	0.10	.23*
Longest period ever gone without smoking (in days)	−0.04	0.12	−.04
At least 1 day of intentionally not smoking in past year			
No (reference)			
Yes	0.36	0.22	.18
Self-efficacy	0.25	0.11	.25*
Planning NRT use			
No (reference)			
Yes	0.42	0.25	.20
Day 1 NRT use entered			
Age	0.05	0.11	.05
Race/ethnicity			
Non-White (reference)			
White	−0.40	0.24	−.17
URICA composite	0.16	0.10	.16
Longest period (days) ever gone without smoking	0.04	0.11	.04
At least 1 day of intentionally not smoking in past year			
No (reference)			
Yes	0.19	0.21	.10
Self-efficacy	0.19	0.10	.19
NRT use on Day 1			
No (reference)			
Yes	1.10	0.32	.35**
Any day NRT use entered			
Age	0.06	0.11	.06
Race			
Non-White (reference)			
White	−0.29	0.24	−.12
URICA composite	0.19	0.10	.19
Longest period ever gone without smoking (in days)	0.05	0.10	.05
At least 1 day of intentionally not smoking in past year			
No (reference)			
Yes	0.20	0.20	.10
Self-efficacy	0.22	0.10	.21*
Any day of NRT use			
No (reference)			
Yes	0.95	0.25	.38***
Sum of days of NRT use entered			
Age	0.05	0.11	.05
Race			
Non-White (reference)			
White	−0.27	0.24	−.11
URICA composite	0.18	0.10	.18

Table 2. Continued

Table 2. Continued

Variable ^a	B	SEB	β
Longest period ever gone without smoking (in days)	0.07	0.10	.07
At least 1 day of intentionally not smoking in past year			
No (reference)			
Yes	0.19	0.20	.10
Self-efficacy	0.22	0.10	.22*
Sum of days NRT used	0.36	0.10	.37***

Note. ^aContinuous predictor variables are expressed as transformed scores and converted to Z-scores.

* $p < .05$. ** $p < .01$. *** $p < .001$.

of initial abstinence). In other words, higher self-efficacy and the use of NRT on at least 1 day of baseline positively predicted the number of baseline days of abstinence (see Table 2).

In the fourth analysis, the NRT variable entered in Block 3 was the log base 10 transformation of the number of days of NRT use. The seven variables accounted for a significant 28% of the variance, $F(7, 86) = 4.4, p < .001$. The R^2 change (.13) for the addition of “sum of baseline days of NRT use” to the model was significant, $F(1, 79) = 13.7, p < .001$. With standardized betas of .22 and .37, respectively, the transformed variables relating to self-efficacy (i.e., square root) and the number of baseline days of NRT use (i.e., log base 10) each contributed significant amounts of variance (see Table 2).

Discussion

In this exploratory study, our primary purpose was to determine the relative importance of voluntary NRT use in initial abstinence. NRT use appeared to be the most consistent predictor of initial abstinence regardless of whether initial abstinence was defined as at least 1 day of abstinence during baseline or the “sum of days abstinent” during baseline. Moreover, while self-reported use of NRT predicted abstinence at the multivariate level, the self-reported intention to use NRT in the current quit attempt did not. Although NRT was not formally offered or recommended and no instructions were given on its use, it is not surprising that those who used NRT were more likely to achieve initial abstinence than those who did not as NRT doubles the odds of quitting compared with placebo (Silagy et al., 2004; U.S. Department of Health and Human Services, 2000).

That we never encouraged nor discouraged people from using NRT raises the question as to whether there was some other variable that influences both the actual use of NRT and initial abstinence. We attempted to control for this by including demographic, motivational, self-efficacy, and nicotine dependence variables. Compared with NRT use, the predictive role of these other variables, with the exception of self-efficacy, was not as robust.

Our finding regarding self-efficacy is consistent with other studies demonstrating that the greater a person’s confidence in their ability to quit or refrain from smoking, the greater the likelihood of initial success (e.g., Amodei & Lamb, 2005; Baldwin

et al., 2006; Borland et al., 1991; Stuart et al., 1994). Our study suggests that efforts to increase a person's confidence in his or her ability to stop smoking, particularly when used in conjunction with NRT, might be an effective component of smoking cessation interventions.

We also studied the predictive value of cognitive and behavioral indicators of motivation to quit. The URICA readiness to change composite score was a significant predictor of initial abstinence when intention to use NRT was the NRT-specific variable included in the model but not when indices of actual NRT use were included. While some studies have found measures derived from the stages of change model to predict smoking cessation (DiClemente et al., 1991; Farkas et al., 1996; Prochaska et al., 2004) as well as alcohol and drug abuse treatment outcomes (Field, Adinoff, Harris, Ball, & Carroll, 2009; Project MATCH Research Group, 1997), others have found either a weaker role relative to other predictor variables (e.g., Abrams, Herzog, Emmons, & Linnan, 2000; Amodei & Lamb, 2005; Farkas et al.) or a failure to predict outcome whether using stage subtypes or a continuous measure of readiness to change (e.g., Blanchard, Morgenstern, Morgan, Labouvie, & Bux, 2003). Although several behavioral indicators of motivation for change, including "at least one intentional quit attempt within the past year," were associated with abstinence at the univariate level in our study, contrary to previous research (e.g., Hellman et al., 1991; Hyland et al., 2006; West et al., 2001), they did not predict abstinence when controlling for other variables. The relatively weak predictive role of motivational variables observed in the present study suggests not only that other variables such as NRT use and self-efficacy may have a stronger predictive role but also that we may need to find better ways to define and measure motivational variables.

Although a number of studies (e.g., Chandola et al., 2004; Ferguson et al., 2003; Hyland et al., 2006; Rohren et al., 1994; West et al., 2001) found nicotine dependence to be a robust predictor of cessation, we did not find the FTND to be a predictor at the multivariate level. Despite the fact that the FTND has been validated against objective measures of tobacco use, self-report questionnaires generally do not correlate as well as objective measures of tobacco use with abstinence success (Jarvis, Tunstall-Pedoe, Feyerabend, Vesey, & Saloojee, 1987), leading some to advocate for the use of objective measures of tobacco use or dependence when trying to predict abstinence (Gorber, Schofield-Hurwitz, Hardt, Levasseur, & Tremblay, 2009; Kenford et al., 1994).

Consistent with prior research, we found that being married predicted quitting (Lee & Kahende, 2007; Murray et al., 1995; van Loon et al., 2005); however, in contrast to other researchers (e.g., Pisinger et al., 2005), we did not find living with a smoker to be predictive of failure to quit. It is possible that this difference in findings may be due to methodological differences. For instance, most of the studies addressing the negative impact of another smoker in the household did not examine whether the individual achieved initial abstinence, as we did, but rather examined abstinence more distally (e.g., 17 weeks, 1 year). It could be that these other studies actually demonstrated that having a smoker in the home predicted failure to sustain abstinence or relapse rather than failure to make an initial quit attempt.

Gender and race, although predictive of quitting at the univariate level, were not predictive of initial abstinence at the multivariate level. This is in contrast to a number of previous studies that found demographic factors such as gender, socioeconomic status (Amodei & Lamb, 2005; Honda, 2005; Hyland et al., 2004; Hymowitz et al., 1997), and race (King et al., 2004; Lee & Kahende, 2007) to predict abstinence.

The question arises as to why a number of variables in the present study such as dependence level, gender, salary, and living with a smoker were expected, based on the literature and/or our univariate findings, to predict abstinence but did not. While we have offered potential explanations for our failure to support the predictive role of some of these variables, it should also be noted that this is an exploratory study involving a relatively small sample of treatment seekers. While there should be sufficient power to detect robust predictive relationships such as that between NRT and abstinence or between self-efficacy and abstinence, the study is likely to have limited power to detect variables with weaker predictive influence.

Strengths of this study include the use of a biological marker of smoking status collected repeatedly and the use of a prospective design, which allowed us to examine NRT use under fairly real-world conditions. In addition to the issue of limited statistical power mentioned above, several other limitations should be considered in interpreting our results. First, this study constitutes a secondary analysis for which the original study was not primarily designed. Given that individuals were assessed for abstinence prior to participating in a study on contingency management, it is likely that they may have been more motivated to quit than individuals who would not volunteer for such a study, thereby limiting the generalizability of the study findings. It is also possible that a monetary contingency in place for initial abstinence, albeit rather small, along with social contingencies and rule-governed contingencies could have had an influential impact both on NRT use and on initial abstinence. We also employed a single-item indicator of self-efficacy rather than a multi-item indicator, which would have had stronger psychometric properties. Finally, there may also have been important predictor variables not included among our measures (e.g., participant's health status, personality characteristics).

In summary, these data show that NRT users are more successful in achieving initial abstinence than non-NRT users. The present findings extend our earlier work (Amodei & Lamb, 2005) by demonstrating that when we control for dependence, motivational, self-efficacy, and demographic variables, NRT use is a more consistent predictor of initial abstinence than these other variables. However, only 18.2% of individuals in this study actually used NRT at any point during the initial cessation phase. This figure is consistent with the estimates of other studies (e.g., Pierce & Gilpin, 2002; Zhu et al., 2000). Given that NRT is effective, but is underutilized despite its OTC availability for more than a decade, the data support the need for interventions or strategies encouraging people intending to quit to make use of NRT products in their quit attempts. Several authors (e.g., Amodei & Lamb, 2008; Cummings & Hyland, 2005) have addressed this issue. Strategies proposed include making NRT available at no or little cost to consumers, enhancing consumer's attitudes, knowledge, and beliefs about NRT and its efficacy and paying people to use NRT during the initial period of a quit attempt.

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Declaration of Interests

None declare.

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