Predicting Exercise and Smoking Behaviors in Diabetic and Hypertensive Patients

Age, Race, Sex, and Psychological Factors

John G. Spangler, MD, MPH, Joseph C. Konen, MD, MSPH

Objective: To predict exercise and smoking behaviors in primary care patients with chronic diseases (insulin-dependent diabetes mellitus [IDDM], non–insulin-dependent diabetes mellitus [NIDDM], and hypertension) using standardized measures of stress, affect, and family function.

Design: Survey by a self-administered health risk appraisal and the Family APGAR Scale (measuring family function), the Brief Encounter Psychosocial Instrument (measuring coping with psychological stress), and the Affect Balance Scale (measuring positive and negative affect).

Settings: Large family practice center, university medical center pediatrics clinic, and community health center.

Participants: Volunteers meeting World Health Organization criteria for IDDM (n=83) or NIDDM (n=322), and volunteers with documented hypertension (n=140).

Main Outcome Measures: Exercise levels at or above 2510 kJ/wk; smoking status; and number of cigarettes consumed per day.

Results: Smoking status in all groups was lower than that measured nationally. Stepwise logistic regression showed a correlation between positive affect and higher exercise levels among patients with IDDM and NIDDM, but lower levels among hypertensives. Psychological stress correlated with current smoking among patients with IDDM. In pooled models, whites were much more likely than blacks to exercise at higher levels and to be former or nonsmokers; however, among smokers, whites consumed more cigarettes per day. Among smokers with IDDM, males were much more likely to be moderate to heavy smokers.

Conclusions: Among patients with IDDM, NIDDM, and hypertension, psychosocial stress, affect, age, race, and sex differentially predict exercise and smoking behaviors. The lower-than-national prevalence of smoking in these groups may indicate increased responsiveness to the stop-smoking message. Black diabetic and hypertensive patients, in particular, may require increased health promotion efforts.

(Arch Fam Med. 1993;2:149-155)

THE 1990 Healthy People 2000 initiative proposes as one of its goals the national reduction of morbidity and mortality from chronic diseases, including insulin-dependent diabetes mellitus (IDDM), non–insulin-dependent diabetes mellitus (NIDDM), and hypertension.[1] For this goal to be achieved, behavioral changes such as increased physical activity and smoking cessation in these patients are important.[2] However, supporting preventive health behaviors in patients with diabetes and hypertension can be a difficult task for the family physician given the physical, psychological, and social barriers to life-style change.[3,4]

Many studies have investigated a variety of psychosocial variables influencing compliance with specific preventive health behaviors in the population at large[3,5-9] and in certain high-risk groups.[4,10] In general, these studies have linked such factors as social support, psychological stress, and mood disturbance to exercise, smoking cessation, and seat belt use. One study on diabetic patients[11] showed glycemic control to be related to specific measures of stress,

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From the Department of Family and Community Medicine, The Bowman Gray School of Medicine, Wake Forest University, Winston-Salem, NC.

MATERIALS AND METHODS

PATIENT SELECTION

Five hundred forty-five patients older than age 16 years with IDDM (n=83), NIDDM (n=322), or hypertension (n=140) were recruited from a large family medicine ambulatory care unit, a university medical center pediatric clinic, and a neighborhood community health center as described elsewhere.[12] With the research protocol having been approved by the institutional review board, informed consent was obtained from each participant. All diabetic patients met World Health Organization criteria[13] for IDDM or NIDDM. Hypertensive patients were defined as having a systolic blood pressure at or above 160 mm Hg or a diastolic blood pressure at or above 90 mm Hg on two or more occasions. Patients were also defined as hypertensive if they were currently being treated for hypertension detected on at least two previous examinations. Several patients with IDDM and NIDDM were found to have hypertension by this definition but were classified as diabetic. Thus, while some diabetic patients had hypertension, no hypertensive patients had diabetes.

MEASUREMENTS AND EXAMINATIONS

Patients were asked to complete a series of questionnaires, including a modification of the Healthier People Health Risk Appraisal,[14] which elicited (1) history of current or previous cigarette smoking; and (2) duration, type, and frequency of exercise. To link health practices to psychological variables, the following standardized psychometric instruments were also administered to patients: the Brief Encounter Psychosocial Instrument (BEPSI), a five-item questionnaire with a 10-point Likert-like scoring scale to measure coping with psychological stress[15]; the Affect Balance Scale (ABS), a 40-item questionnaire with a 5-point Likert-like scale to reflect positive and negative self-perceptions of affect[16]; and the Family APGAR Scale (Adaption, Partnership, Growth, Affection, and Resolve), a five-item screening tool with a 3-point Likert-like scale to measure family dysfunction.[17]

PREVENTIVE HEALTH BEHAVIORS

Two personal health practices that affect cardiovascular disease—exercise and smoking—were chosen as preventive health outcome variables in this study. Definitions of physical activity were developed by Caspersen et al,[18] and for each activity, an intensity code[19] was used to calculate approximate kilojoules expended per week by patients. A cut off level of 2510 kJ/wk was selected as the definition of exercise (approximately equivalent to walking 3.2 km three times per week). This is the minimum quantity of exercise for maintaining cardiovascular fitness as set forth by the American College of Sports Medicine.[20] Smoking status was divided into two groups: current smokers and nonsmokers (the latter category consisted of former smokers and those who had never smoked). Among current smokers, light smoking was defined as consumption of at least 12 cigarettes per day and moderate to heavy smoking was set above this limit.

family function, affect, and locus of control, suggesting that healthy behaviors such as exercise and glucose monitoring may also be related to these psychosocial variables.

However, none of these studies has specifically addressed differences in exercise and smoking among high-risk subgroups of the same population or linked these behavioral differences to psychosocial measurements. While IDDM, NIDDM, and hypertension share risks for common end-stage outcomes (eg, coronary artery and renal diseases), the epidemiologic factors and causes of these conditions differ. Due to these epidemiologic differences, should one also expect different sets of psychosocial profiles and preventive health behaviors to discriminate among patients with these disorders?

Knowledge of diabetic and hypertensive patients' affect, perceived stress, and family function may be useful for family physicians to determine who is likely to exercise or stop smoking. This knowledge may also aid in therapeutic attempts to encourage preventive behaviors, as in, for example, stress reduction therapy with smoking cessation efforts. The goals of this study were to (1) examine a variety of psychosocial factors among primary care diabetic and hypertensive patients; (2) determine what factors are most strongly associated with exercise and smoking behaviors; and (3) explore behavioral differences that may exist among patients with different chronic disorders.

RESULTS

PATIENT CHARACTERISTICS

Table 1 summarizes the demographic composition of each disease category. Groups differed significantly by age and race but not by sex. Compared with patients with NIDDM and hypertension, patients with IDDM were predominantly white and, not surprisingly, younger, with a mean±SD age of 35±14 years. While the groups did not differ significantly in regard to sex, there were more males among patients with IDDM and more females among patients with NIDDM.

The percentages of patients practicing preventive health behaviors are listed in **Table 2**. Exercise varied significantly among disease groups, with a higher percentage of patients with IDDM (27.8%) reporting exer-

DATA ANALYSIS

All data were entered into the Centers for Disease Control and Prevention's statistical software package, EpiInfo. Data from psychosocial instruments were keyed according to the directions of their authors. ILL and WELL ABS subscales were derived from responses to the anxiety/guilt/hostility/depression subscales and the joy/contentment/passion/vigor subscales, respectively. Using these ABS scores, we created another variable: positive affect. This was defined as present if patient's scores were below the 50th percentile for ABS (ILL) or above the 50th percentile for ABS (WELL). This indicates that patients with high positive affect scores had experienced joy/contentment/passion/vigor more frequently in the past month or anxiety/guilt/hostility/depression less frequently in the past month. The BEPSI was likewise dichotomized into at or above 30, with the higher level indicating poor coping with psychological stress. Scores derived from the Family APGAR Scale were divided into three categories, with 0 through 5 indicating severe family dysfunction; 6 and 7, mild family dysfunction; and 8 through 10, no dysfunction.

Statistical analyses were performed using EpiInfo and Statistical Package for the Social Sciences–Personal Computer, and were chosen to test two main hypotheses. First, "good" psychological profiles (healthy coping with psychological stress, functional family dynamics, and positive affect) would predict healthier preventive behaviors (increased exercise and decreased smoking status). Second, the three disease groups would have different sets of predictors. In particular, since psychological variables have been found to be important in predicting compliance with a diabetic regimen among patients with NIDDM,[21] stress, family function, and affect would be most important among our patients with NIDDM.

Differences between means were calculated using Student's t test, one-way analysis of variance, or Kruskal-Wallis' H if variances were nonhomogeneous by Bartlett's χ^2. Categorical data were analyzed using χ^2 or forward and backward stepwise logistic regression using the Wald statistic to select variables for entry or elimination. In the logistic regression analysis, two models were developed. In the first, exercise and smoking were entered as the dichotomized outcome variables with disease category, race, and sex as categorical predictor variables and age as a continuous predictor variable. In the second model, exercise and smoking were again entered as the dichotomized outcome variables with psychometric scores, race, and sex as categorical predictor variables and age as a continuous predictor variable. (We report psychometric scores as categorical variables for ease of interpretation of odds ratios. However, all models were also separately run with psychometric scores as continuous variables to allow full impact of their variability. This did not alter which variables remained in the equations, and conclusions were unchanged.) Forward and backward stepwise logistic regression agreed in all cases, except among current vs former smoking status in patients with IDDM. Due to small cell sizes, there was a spuriously high odds ratio for BEPSI as a categorical variable. In addition, backward stepwise analysis could not be solved because of a high correlation in this model between BEPSI and ABS (ILL) (Pearson's correlation coefficient, .585; $P<.001$). Thus, forward stepwise analysis with continuous psychometric scores is listed.

cise levels at or above 2510 kJ/wk compared with patients with NIDDM and hypertension (15.9% and 16.4%, respectively; $P=.040$). Interestingly, the percentage of current smokers, former smokers, and moderate to heavy smokers was relatively constant among the three groups. When examining health behaviors demographically in the three groups (data not shown), mean age did not differ significantly between exercisers and nonexercisers; however, a significant age difference was noted between current and former smokers in all groups ($P<.05$), with older mean age for former smokers.

Listed in **Table 3** are psychometric scores by disease group. Except for ABS (WELL), scores differed significantly, with patients with IDDM showing higher perceived stress (mean BEPSI, 26.4±12.2) and negative affect (mean ABS [ILL], 29.4±11.6), but lower family function (mean APGAR, 7.1±3.0) than patients with NIDDM or hypertension. While there was a tendency toward higher positive affect scores among hypertensive patients and a lower percentage of patients with IDDM with positive affect, these differences were not statistically significant.

DISEASE TYPES AS PREDICTORS

Table 4 shows odds ratios derived from the logistic regression models using disease type and demographic predictors of exercise and smoking. Disease type did not remain as a predictor in any of the models, while demographic variables did. Whites were more likely to exercise and less likely to smoke than were blacks. However, among those who smoked, whites had higher cigarette consumption. Also, younger individuals were more likely to smoke. There is one statistical note concerning the odds ratios for age in this study. Odds ratios for continuous variables in logistic regression have a slightly different interpretation than odds ratios one usually considers. For example, the odds ratio of 0.96 implies that for each year increase in age, there is a 4% reduction in smoking behavior. Thus, for a 10-year age difference, there is a 40% reduction in smoking.

PSYCHOSOCIAL VARIABLES AS PREDICTORS

Table 5 lists odds ratios from logistic regression models using psychosocial predictors of exercise and smoking among the three disease groups. Family function was not pre-

Table 1. Patient Characteristics by Disease Groups*

Characteristics	IDDM (n=83)	NIDDM (n=322)	Hypertension (n=140)	P†
Mean±SD age, y	35±14	58±12	58±13	<.001
Black, %	12.0	47.1	32.1	<.001
Female, %	47.0	58.7	53.6	.094

*IDDM indicates insulin-dependent diabetes mellitus, and NIDDM, non–insulin-dependent diabetes mellitus.

†χ^2 statistic to compare percentages between groups; analysis of variance to compare means.

dictive of exercise or smoking behavior in any of the models. Positive affect predicted exercise in all three groups, but in different ways. Patients with IDDM with positive affect were three times more likely than patients with IDDM without positive affect to exercise at 2510 kJ/wk or more; patients with NIDDM were twice as likely (odds ratios, 3.12 and 2.05, respectively). In contrast, hypertensive patients with positive affect were approximately 66% less likely than their counterparts without positive affect to exercise at this level (odds ratio, 0.34).

Poor coping with psychological stress (ie, high scores on BEPSI) significantly predicted current vs nonsmoking status (odds ratio, 7.31) in patients with IDDM, but not among patients with NIDDM or hypertension. Likewise, older age was negatively associated with being a current smoker (vs a nonsmoker) in patients with NIDDM with an odds ratio of 0.94.

In each specific group, when looking at current vs former smoking status, increased age as a continuous variable again was negatively associated with current smoking, with odds ratios of 0.65 in IDDM, 0.95 in NIDDM, and 0.96 in hypertensive patients. For each 10-year increase in age, these odds ratios translate into a 350% reduction in smoking behavior in IDDM, a 50% reduction in NIDDM, and a 40% reduction in hypertensive patients. In the moderate to heavy vs light smoking status model, male sex was the sole significant predictor, remaining only among patients with IDDM.

COMMENT

This survey of psychosocial predictors of exercise and smoking among a large number of diabetic and hypertensive patients has limitations inherent in any survey. Underreporting or overreporting of health behaviors and chronic disease is known to occur in interview surveys.[22] While examination measurements decreased this effect in disease group categorization, patients may not have accurately reported their exercise or smoking behaviors, possibly resulting in inflated exercise estimates or lower-than-actual smoking rates. Without observing the behavior of interest, which introduces its own biases, such a problem is difficult to eliminate from surveys that rely on self-report.

A second potential limitation of this study concerns its generalizability. These patients were volunteers, and may not represent the full spectrum of diabetes and hypertension seen in primary care practice. However, the demographic composition of the disease groups in this work reflects that found nationally for IDDM,[23] NIDDM,[24,25] and hypertension,[26] lending support to this study's generalizability.

These data uncover differences in exercise and smoking behaviors among patients with IDDM, NIDDM, and hypertension, as well as psychosocial predictors of those behaviors. While the percentage of exercising patients with NIDDM and hypertension seems low (15.9% and 16.4%, respectively), it is in keeping with previously published reports for American adults.[27,28] The percentage of exercising patients with IDDM is higher than that found among American adults and is likely related to an increased percentage of whites in this population. Others[29,30] have found that for any given age, whites engage in recreational exercise more often than blacks. White race is the only variable to remain in our disease type and demographic model in Table 4, and the IDDM group has a higher percentage of white patients. This finding should be interpreted cau-

Table 2. Preventive Health Behaviors by Disease Groups*

Preventive Behaviors	IDDM (n=83)	NIDDM (n=322)	Hypertension (n=140)	P†
Exercises ≥2510 kJ/wk, %	27.8	15.9	16.4	.040
Current smokers, %	22.8	20.2	19.3	.822
Former smokers, %	26.6	30.0	29.3	.097
Moderate to heavy smokers, %‡	50.0	48.5	51.8	.457

*IDDM indicates insulin-dependent diabetes mellitus, and NIDDM, non–insulin-dependent diabetes mellitus.

†χ^2 statistic.

‡Percentage of current smokers who consume more than 12 cigarettes per day.

Table 3. Psychometric Scores by Disease Groups*

Psychosocial Instrument	IDDM (n=83)	NIDDM (n=322)	Hypertension (n=140)	P†
BEPSI	26.4±12.2	20.8±13.2	19.7±13.0	<.001
Family APGAR Scale	7.1±3.0	72.±2.9	7.9±2.6	.043
ABS (ILL)	29.4±11.6	25.6±12.2	26.1±11.6	.043
ABS (WELL)	47.2±9.4	47.7±12.5	49.4±11.0	.188‡
Positive affect	55.4	65.0	66.4	.207

*IDDM indicates insulin-dependent diabetes mellitus; NIDDM, non–insulin-dependent diabetes mellitus; BEPSI, Brief Encounter Psychosocial Instrument; APGAR, Adoption, Partnership, Growth, Affection, and Resolve; and ABS, Affect Balance Scale. Data are expressed as mean±SD, except for positive affect, which is expressed as the percentage of patients with ABS (ILL) of 25 or less or ABS (WELL) above 50.

†χ^2 statistic to compare percentages between groups; analysis of variance to compare means, except where noted.

‡Kruskal-Wallis' H used because of nonhomogeneity of variances by Bartlett's χ^2.

Table 4. Disease Type and Demographic Predictors of Preventive Behaviors

Preventive Behavior	Predictor	Odds Ratio (95% Confidence Interval)*
Exercises ≥2510 kJ/wk	White race	2.77 (1.64-4.69)
Current smoker†	Age	0.98 (0.96-0.99)
	White race	0.61 (0.40-0.94)
Current vs former smoker‡	Age	0.96 (0.94-0.98)
	White race	0.55 (0.32-0.92)
Moderate to heavy smoker§	White race	2.56 (1.14-5.74)

**Derived from stepwise logistic regression models containing disease type and demographic variables.*
†Current vs nonsmokers dichotomized into 1 and 0, respectively.
‡Current vs former smokers dichotomized into 1 and 0, respectively.
§Moderate to heavy (>12 cigarettes per day) vs light smokers (≤12 cigarettes per day) dichotomized into 1 and 0, respectively.

tiously. The effect of white race may be due to socioeconomic status, occupation, or education, factors not evaluated in our study. It is interesting that age does not remain in the exercise models as increased levels of physical activity correlate with younger age in other populations.[29]

The lack of correlation between family function and exercise and smoking behaviors is surprising given that other studies[4,7,9] have noted social support to influence preventive health practices. While the Family APGAR Scale is a well-accepted measure of family function,[30] it may not capture those aspects of social support related to health. Recent data,[31] for example, have failed to find a relationship between the Family APGAR Scale and the health behavior of pregnant teenagers. On the other hand, family function may actually have no association with exercise or smoking among these individuals with chronic disease.

Positive affect has been shown in numerous studies to correlate with exercise participation as our diabetic data show.[32-36] Unexpectedly, the opposite was found in our hypertensive patients (Table 5), in whom positive affect is inversely related to exercise. We do not have a good explanation for this finding. This could be a chance association or the result of confounding by some variable not included in the model. Alternatively, it may be related to the nature of hypertension as a disease. Are people with positive affect who lead sedentary lives more likely to become hypertensive than those with positive affect who exercise? If further studies replicate this finding in hypertensive patients, it may have implications for clinical exercise counseling.

The prevalence of smoking among the three groups is remarkably similar (Table 2) and below that measured nationally in the early 1980s[37] or that projected for the year 2000.[38] This may signal that the stop-smoking message is particularly effective for these individuals with chronic disease and should encourage clinicians to be aggressive in telling their diabetic and hypertensive patients not to smoke.

The relationship between stress and smoking has been evaluated in other studies,[8,9] but is obvious here only among patients with IDDM. The presence of difficulty coping with stress as measured by BEPSI in the current vs nonsmoking model makes one appreciate the role of psychological stress in tobacco abuse. The absence of stress as a predictor variable in the NIDDM and hypertensive models may indicate that its influence in smoking is greatest among younger age groups.

In evaluating smoking behavior, we might have strengthened our study by including the Nicotine Tolerance Questionnaire by Fagerstrom.[39] However, a separate analysis (data not shown) revealed a strong correlation between male sex and white race (but not psychosocial variables) and smoking 26 or more cigarettes per day, one of Fagerstrom's criteria for nicotine dependence. Thus, white male diabetic and hypertensive smokers in our population may be more likely to be nicotine-dependent.

In agreement with national data,[40,41] younger patients with these chronic diseases, especially IDDM, are more likely than older patients to smoke. Whites are less likely than blacks to be current smokers, which corre-

Table 5. Psychosocial Predictors of Exercise and Smoking for Three Patient Groups*

Preventive Behavior	IDDM		NIDDM		Hypertension	
	Predictor	Odds Ratio (95% CI)	Predictor	Odds Ratio (95% CI)	Predictor	Odds Ratio (95% CI)
Exercises ≥2510 kJ/wk	Positive affect	3.12 (1.13-8.33)	Positive affect	2.05 (1.12-3.78)	Positive affect	0.34 (0.12-0.91)
			White race	2.43 (1.27-4.66)		
Current smoker†	BEPSI	7.31 (2.1-27.7)	Age	0.94 (0.89-0.99)	None	...
Current vs former smoker‡	Age	0.84 (0.76-0.94)§	Age	0.95 (0.93-0.98)	Age	0.96 (0.92-0.99)
Moderate to heavy smoker‖	Male sex	16.0 (1.31-19.4)	None	...	None	...

**IDDM indicates insulin-dependent diabetes mellitus; NIDDM, non–insulin-dependent diabetes mellitus; CI, confidence interval; and BEPSI, Brief Encounter Psychosocial Instrument. Odds ratios were derived from stepwise logistic regression analysis of psychosocial variables separately modeled for three patient groups.*
†Current vs nonsmokers dichotomized into 1 and 0, respectively.
‡Current vs former smokers dichotomized into 1 and 0, respectively.
§Forward stepwise analysis only using continuous psychometric scores.
‖Moderate to heavy smokers (>12 cigarettes per day) vs light smokers (≤12 cigarettes per day) dichotomized into 1 and 0, respectively.

sponds to data showing an increased national prevalence of smoking among blacks.[37] Again, this finding should be cautiously interpreted, as it may reflect socioeconomic factors not measured in this study.

CONCLUSIONS

In the absence of other factors, glucose intolerance increases a patient's risk of a serious cardiovascular event roughly 1½ times,[42] while mild hypertension doubles that risk.[43] Both smoking and lack of exercise increase these cardiovascular risks even further, but are modifiable in the motivated patient. Among diabetic and hypertensive patients, typical of their wider corresponding disease populations, this work reveals age, race, sex, and psychological factors associated with exercise and smoking behavior. Paralleling national trends, white diabetic and hypertensive patients less frequently smoke and more frequently exercise than their black counterparts. In the same way, older individuals (diabetic or hypertensive) are less likely than younger individuals to be current smokers. From a psychological standpoint, as others have found, positive affect is associated with higher levels of exercise among diabetics, while, unexpectedly, the opposite is true for hypertensives. Finally, coping with psychological stress plays an important role in the smoking behavior of patients with IDDM, the youngest of the three study groups.

These findings emphasize areas where family physicians need to concentrate their health promotion efforts for their diabetic and hypertensive patients. With a lower smoking prevalence than measured in American adults,[37] these individuals may be particularly responsive to the stop-smoking message, especially as they grow older. There are therapeutic implications as well. First, because of poor coping, insulin-dependent diabetic smokers may need stress reduction counseling or even anxiolytic therapy in their attempts to quit. Pharmacologic agents, such as buspirone hydrochloride, have had mixed success in smoking cessation.[44,45] Perhaps using anxiolytics among younger diabetic patients or among any patients who score high on stress measurements such as the BEPSI, may increase this intervention's effectiveness. Second, because white male smokers have increased daily cigarette consumption (and, in particular, an increased likelihood of smoking ≥26 cigarettes per day), these diabetic and hypertensive patients may be more likely to benefit from nicotine replacement[39,46] in smoking cessation attempts.

Physical, psychological, and social barriers to increased physical activity and smoking cessation make lifestyle changes difficult, even (or perhaps especially) for those with chronic disease. However, knowledge about the whole patient—his or her life's stressors, affect, and demographic profile—can guide the family physician in anticipating pitfalls and thus bring us closer to the goal of healthier people by the year 2000.

Accepted for publication November 19, 1992.

This research was supported by cooperative agreement U32/CCU 403318-03 from the Centers for Disease Control and Prevention, Atlanta, Ga.

The authors thank John Summerson, MS, for data retrieval, and Robert Michielutte, PhD, and Mark Dignan, PhD, for helpful comments.

Reprints not available.

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