

Implications of a Health Lifestyle and Medication Analysis for Improving Hypertension Control

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Background: National Health and Nutritional Examination surveys have documented poor rates of hypertension treatment and control, leading to preventable morbidity and mortality.

Objectives: To examine covariation in the medication and health lifestyle beliefs and behaviors of persons with hypertension to identify and profile distinct subgroups of patients.

Methods: A sample of 727 patients with hypertension, weighted to match the 1992 National Health Interview Survey age and sex distribution of patients with hypertension, was interviewed by telephone about their beliefs and behaviors regarding hypertension and its management. Cluster analysis of key variables was used to identify 4 patient types.

Results: Subgroups differed significantly. Group A members use an effective mix of medication and health lifestyle regimens to control blood pressure. Group B mem-

bers are most likely to depend on medication and have high adherence rates. Yet they also have high rates of smoking (29%) and alcohol use (average, 104 times per year) and are less likely to exercise regularly. Group C members are most likely to forget to take medication, are likely to be obese, and find it most difficult to comply with lifestyle changes (except for very low rates of smoking and alcohol use). Group D members are least likely to take medication, most likely to change or stop medication without consulting their physician (20%), most likely to smoke (40%), and least likely to control diet (29%). Group A and B members have better health outcomes than group C and D members.

Conclusions: Optimal management strategies are likely to differ for the 4 patient types. Further research should be conducted to validate these findings on a separate sample and to devise and test tailored management algorithms for hypertension compliance and control.

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THE SIXTH REPORT of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure indicates that the decades-long trend toward improved hypertension control reached an inflection point in recent years and has now declined.¹ For example, while the proportion of persons with hypertension who had been diagnosed and were aware of their condition rose substantially between 1976 and 1991, it declined slightly during the first half of this decade.^{1,2} The same pattern is evident with regard to blood pressure (BP) control rates. The proportion of persons with hypertension who have controlled BP ($\leq 140/90$ mm Hg) increased from 10% in 1976-1980 to 29% in 1988-1991, but dropped to 27% in 1991-1994, even though the proportion of persons with hypertension who are receiving medication has been rising steadily.^{1,2}

Recent lack of progress in control of hypertension is further evidenced by a flattened downward trend in cardiovascular disease mortality, an increased incidence of heart failure over the past 5 years, and an increased incidence of end-stage renal disease.¹⁻³ Although people with hypertension are living longer, inadequate rates of arterial pressure control have led to substantially greater morbidity, producing a major burden on society and the health care system. These trends suggest that we need to be more aggressive in achieving BP control.¹

Trends in dietary intake and low rates of physical activity over the past decade have likely contributed to the decline in control rates. Over the last 2 decades, the average weight of the US population has increased by almost 5.42 kg (12 lb). Much of this weight gain can be attributed to significant increases in total energy intake in the last decade,

PARTICIPANTS, MATERIALS, AND METHODS

A series of linked mail and telephone surveys were conducted from 1995 to 1997 to identify and assess a sample of patients with previously diagnosed hypertension.

IDENTIFICATION OF PATIENTS WITH HYPERTENSION IN THE US GENERAL POPULATION

Identification of patients with previously diagnosed hypertension was conducted through a 2-stage mail survey administered in 1995 and again in 1996. The first stage consisted of constructing a nationally representative quota sample of 5000 adults (aged ≥ 18 years) from a large panel of available respondents (approximately 750 000).¹ (Referred to as a "mail panel survey," this method has repeatedly been shown to generate prevalence estimates of consumer behaviors, health behaviors, and health conditions, similar to those generated by random digit dialing and other probability sampling methods.¹⁵) The sample was stratified for age, sex, marital status, race or ethnicity, income, region, household size, and population density. The survey assessed a variety of general lifestyle issues and was administered in March of both years; the response rate was 72% in 1995, and 75% in 1996. Due to a low response rate among minority and low-income respondents, a supplemental quota sample of 420 minority and low-income respondents was drawn and administered in May of both years. The response rates to the supplemental mailing were 53% in 1995 and 70% in 1996.

Respondents to the general lifestyle survey were sent a second mail survey assessing a variety of health beliefs, behaviors (including diet, exercise, cigarette smoking, and alcohol consumption), and conditions (including prior diagnosis of hypertension). The response rate to the second survey was 77% in both 1995 and 1996. A full description of this survey and its social-cognitive assessment measures is published elsewhere.¹² The current analysis used measures of behavior (eg, number of cigarette smoked on average each day), internal/personal factors (eg, self-efficacy, outcome expectancies, and motivation), and social/environmental factors (eg, social support and perceived peer norms) for each of 5 relevant domains: diet/nutrition, exercise, weight control, cigarette smoking, and alcohol consumption.

ASSESSMENT OF HYPERTENSION-SPECIFIC MEASURES

A total of 1186 patients with previously diagnosed hypertension were identified from the 1995 and 1996 mail surveys (yielding an unweighted prevalence estimate of 19.5%

for patients with previously diagnosed hypertension in the survey population). Of these, 871 patients (73%) were successfully recontacted during July 7 to July 27, 1997; 727 of those recontacted completed the 15-minute telephone interview. This represents a 61% response rate among all patients with previously diagnosed hypertension, or an 83% response rate among those recontacted.

The unweighted data from this sampling method underrepresented younger patients with hypertension and males (**Table 1**). As a result, these data were weighted in 6 age/sex categories (ie, males and females aged < 45 years, 45-64 years, and ≥ 65 years) to match the US adult population of patients with hypertension as ascertained by the 1992 National Health Interview Survey. The telephone survey assessed the following 7 general domains of attitudes and behaviors that are relevant to clinical management of hypertension: time since diagnosis; current and prior medication regimens prescribed for the condition; side effects associated with each medication regimen and reasons for switching medication; compliance measures (including medication, diet, and exercise habits); confidence in meeting prescribed weight, medication, and exercise goals; knowledge of the risks associated with high BP; and beliefs about the importance of medication and lifestyle regimens in the management of hypertension.

DATA ANALYSIS

Simple descriptive statistics were used to examine the characteristics of the respondent population as a whole. Cluster analysis—a statistical procedure that identifies respondents with similar patterns of response to the specified survey items—was used to identify distinct subgroups (or segments) within the respondent population. Specifically, 32 survey responses (drawn from both the mail and telephone surveys) were reduced to 3 composite factors using factor analysis. (A list of all survey items is available from one of us [E.W.M.]. A list of the 32 items used in the cluster analysis and their discriminatory power is given in **Table 2**.) These factors were then entered into a K-means cluster analysis, specifying 3- through 7-cluster solutions. Diagnostic statistics indicated that the 4-group solution yielded the most distinct and, therefore, potentially most useful, classification system. Responses to all survey items for the 3- through 5-cluster solutions were further examined to assess clinical relevance of the groupings. The judgment of investigators concurred with the diagnostic statistics in confirming the superiority of the 4-cluster solution. Predictive validity of the cluster solution was assessed against 2 health outcomes—respondents' BP at their last checkup and their body mass index (BMI) (computed from self-reported weight and height as the weight, in kilograms, divided by the height, in meters, squared).

since rates of physical activity have remained steady during this time.^{4,6}

It is ironic that hypertension control rates have declined even as newer tools to control hypertension have been developed. These tools include several classes of effective and well-tolerated drugs as well as behavioral interventions.^{3,7-11} Thus, the current downturn in control rates is less likely a function of inadequate tools for hypertension control than of inadequate application of these tools.

The current research was conducted to gain insight into the efforts of previously diagnosed persons with hypertension to control their high BP. An improved understanding of patients' beliefs and behaviors about pharmacological and behavioral treatment options may assist clinicians in developing more effective treatment strategies.

Although each patient must be evaluated and treated individually, previous research indicates that medica-

tion compliance and other health behaviors and beliefs intercorrelate in a manner that has been described as a "health lifestyle."¹² Patients' health lifestyles influence their medication compliance behavior as well as their beliefs about and involvement with other health behaviors including diet, exercise, weight control, alcohol consumption, and smoking.¹²⁻¹⁴ Consequently, the specific goal

of this research was to identify and profile distinct, clinically meaningful groups of patients with hypertension based on their health lifestyles. A valid, reliable, and easily administered "hypertension lifestyle" assessment instrument could greatly facilitate management of hypertension by guiding the direction of clinical efforts.

RESULTS

CHARACTERISTICS OF THE SAMPLE POPULATION

Demographic Description

Respondents were similar to the US adult population for current marital status, race/ethnicity, and income (**Table 3**). Predictably, respondents were older than the general population and, therefore, more likely to be retired (35% of the study sample was retired vs 14% of the US adult population).¹⁶ The only detectable bias in the sample was that respondents were slightly more likely to be better educated than the general adult population: 54% of respondents had at least some education beyond high school, while based on 1992 US Bureau of the Cen-

Table 1. Sample Characteristics: Sex and Age of Patients With Hypertension

Age Group, y	Study Sample (Unweighted Data), %	US Population of Patients With Hypertension, %*
Men		
<45	7	10
45-64	15	19
≥65	14	15
Women		
<45	7	10
45-64	27	21
≥65	30	25

*Figures based on the 1992 National Health Interview Survey. National Center for Health Statistics, Washington, DC.

Table 2. Items Used in the Cluster Analysis*

Items	Grand Means	Group†				F Ratio	Intraclass Correlation
		A	B	C	D		
Confidence in ability to exercise 3 times a week	61.79	89.13	30.49	45.94	51.53	195.90	0.53
I avoid foods high in fat	59.79	72.24	68.77	61.61	26.55	191.67	0.52
I avoid foods high in cholesterol	58.71	69.88	63.86	59.32	32.33	120.00	0.41
It is easy for me to exercise regularly	52.56	74.84	38.93	23.53	52.79	111.33	0.39
It is hard for me to follow recommended diet	45.27	34.89	23.01	78.94	45.32	99.95	0.36
I avoid fried foods	50.80	60.57	61.20	51.98	22.33	99.02	0.36
No. of times per week I do moderate activity	40.00	57.61	20.53	20.31	43.45	82.39	0.32
Confidence in ability to eat a low fat diet	67.86	84.09	61.35	60.20	50.25	79.16	0.31
Confidence in ability to stay thin, lose weight	56.43	75.61	39.03	42.79	48.40	77.64	0.31
I avoid food with high salt content	64.21	72.81	70.03	64.09	43.11	71.55	0.29
Nutrition labels determine what food I buy	46.15	55.29	53.50	45.93	22.89	67.53	0.28
I am careful about what I eat to control my weight	46.19	56.95	49.86	41.17	28.11	59.42	0.25
Confidence in ability to quit cigarette smoking (or not start)	86.25	93.96	79.41	94.75	67.24	35.15	0.16
No. of times per week I do strenuous activity	26.63	35.67	18.31	14.58	29.24	34.89	0.16
No. of cigarettes smoked per day	4.93	2.20	6.36	1.53	12.90	25.62	0.12
No. of servings of fruit and vegetables eaten per day	42.40	48.92	42.96	40.55	31.42	25.43	0.12
Confidence in ability to drink no more than 2 alcoholic drinks per day	91.09	94.72	80.69	98.27	84.30	19.57	0.10
No. of times per year drink alcoholic beverages	16.76	12.38	27.76	7.91	26.41	17.54	0.09
Regular exercise important for controlling high blood pressure (BP)	86.12	93.24	79.83	81.98	82.00	16.06	0.08
Proper diet important for controlling high BP	87.92	92.99	89.61	84.65	80.44	14.83	0.07
I am very knowledgeable about high BP	76.41	79.49	85.43	70.29	70.13	13.19	0.07
I am afraid of the consequences of not controlling my BP	83.08	88.33	79.12	85.61	73.22	10.50	0.05
I am confident I can take medication on schedule	94.15	97.43	93.38	95.59	89.62	5.86	0.03
Not taking medication is a threat to my health	86.13	93.72	87.33	84.95	81.06	5.28	0.02
Knowledge of high BP	79.61	81.01	77.97	82.48	74.80	5.10	0.02
Average measure of forgetting to take medication	19.80	15.51	23.61	18.54	21.38	4.14	0.02
Length of time taking current medication	41.82	48.35	41.65	43.22	34.12	4.13	0.02
I am pleased with myself if take medication as prescribed	88.48	90.93	86.70	90.14	85.31	3.04	0.01
Average noncompliance with medication	4.60	4.04	5.16	3.17	7.19	2.98	0.01
I do not feel any different with medication	10.12	6.14	11.48	8.96	14.02	2.96	0.01
No. of side effects experienced	4.52	4.15	5.36	4.60	3.73	0.94	-0.00
Average tolerance of side effects	31.66	29.65	33.45	31.63	31.33	0.49	-0.00

*All items have been rescaled to range from 0 to 100.

†Groups are defined as follows: A, medication and healthy lifestyle; B, medications/high adherence; C, forgetful, with medication difficult to comply with lifestyle changes; and D, least likely to take medications, smokers, poor diet.

Table 3. Sample Characteristics: Marital Status, Race, Education, and Income*

Demographic Characteristic	Study Sample (Weighted Data), %	Adult US Population, %
Sex		
Males	44	49
Females	56	51
Age, y		
<45	20	68
45-64	40	19
≥65	40	13
Marital status		
Married	60	61
Widowed	16	7
Divorced/separated	13	9
Never married	11	23
Race/ethnicity†		
White	80	84
Black	13	12
Hispanic	5	10
Other	2	4
Education		
Not high school graduate	8	20
High school graduate	37	35
Attended college	28	23
College graduate	11	15
Postgraduate	15	7
Income, \$		
<10 000	9	15
10 000-14 999	12	10
15 000-24 999	19	17
25 000-34 999	16	15
35 000-49 999	18	17
≥50 000	25	27
Employment status		
Employed or unemployed	48	67
Not in labor force	52	33

*Figures based on the 1992 US Bureau of the Census.

†The race category in the 1992 US Bureau of the Census totals more than 100% because the white and the black categories include whites and blacks of Hispanic origin. In the sample, these categories include only whites and African Americans who are not of Hispanic origin.

sus data, only 45% of the general adult population has education beyond high school.

Respondents to the telephone survey were compared with nonrespondents with hypertension on several dimensions to further examine potential bias in the sample selection (**Table 4**). The health attitudes, behaviors, and health status of nonrespondents were largely comparable with those of respondents; married males (41% of nonrespondents vs 26% of respondents) and young adults (aged 18-44 years: 23% of nonrespondents vs 15% of respondents) were, however, more likely to be nonrespondents.

BP Status

Fewer than one quarter (22%) of respondents were first diagnosed with hypertension in the past 5 years, while more than half (57%) were first diagnosed more than 10 years ago. Mean self-reported BP at last reading was 139/82 mm Hg. The oldest patients reported a slightly higher average systolic BP and a lower diastolic BP than younger patients (**Table 5**).

Table 4. A Comparison of Respondents and Nonrespondents to the Telephone Survey on Selected Demographic and Psychographic Variables

Sample Characteristics	Nonrespondents, % (n = 655)	Respondents, % (n = 727)
Demographics		
Marital status		
Married		
Male	41	26
Female	27	35
Single		
Male	10	10
Female	21	29
Married	68	59
Widowed	13	17
Divorced	5	6
Separated	6	7
Single	9	9
Race/ethnicity		
White	76	79
Black	15	14
Hispanic	7	5
Other	3	2
Age, y		
18-34	8	4
35-44	15	11
45-54	21	20
55-64	20	24
≥65	37	42
Education		
Some high school or less	9	10
Graduated high school	37	36
Some college	27	31
Graduated college or more	26	24

(continued)

Hypertension Management

Most respondents (60%) have their BP checked by a physician or physician's staff member at least every 3 months (22% monthly or more often, 38% once every 2 to 3 months). Older respondents (<60 years as compared with <45 years) and female respondents reported receiving more frequent BP examinations by a health professional. (Here and elsewhere in the article, all reported group differences are significant at the 95% confidence interval.) Less than half (40%) of the respondents monitor their own BP, although self-monitoring is more common among respondents who are younger (53% of those <45 years vs 34% of those >60 years) and better-educated (48% of college graduates vs 33% of high school or less). Among those who reported monitoring by someone other than a physician (most often self-monitoring), 77% reported monitoring frequency of at least once a month.

In response to an open-ended question ("What, if anything, are you doing to lower your blood pressure?"), nearly three quarters (71%) of the respondents indicated that they are taking prescription medicine, and 59% indicated that they have made lifestyle changes. These behaviors vary by age and education level; the youngest patients (<45 years) were more likely to report lifestyle changes (76%) and less likely to report taking medica-

Table 4. A Comparison of Respondents and Nonrespondents to the Telephone Survey on Selected Demographic and Psychographic Variables (cont)

Sample Characteristics	Nonrespondents, % (n = 655)	Respondents, % (n = 727)
Psychographics		% Agree
Living life in the best possible health is very important to me	83	88
Rate own health excellent or very good	36	32
Percentage advised to change diet	63	73
Percentage following advice	74	74
I really want to stay thin or lose weight	73	77
My current weight is a threat to my health	43	47
Most of my friends are careful to stay thin or try to lose weight	32	31
I really want to eat a diet low in fat	70	73
The amount of fat in my diet is a threat to my health	29	30
I enjoy getting regular exercise	53	53
I feel pleased with myself if I exercise regularly	70	71
My exercise habits (or lack of exercise) are a threat to my health	39	42
I enjoy drinking alcoholic beverages	25	18
The people who matter most to me are pleased if I drink alcoholic beverages	4	3
People who drink alcohol more fun to be with	8	5
My current use of alcohol is a threat to my health	11	8
Most of my friends drink alcoholic beverages regularly	24	19
Percentage drink alcohol every day or a few times per week	25	22
Percentage never drink alcohol	33	36
I enjoy smoking cigarettes	18	13
The people who matter most to me are pleased if I smoke cigarettes	5	3
People who smoke are attractive	4	3
My current use of cigarettes is a threat to my health	14	9
Most of my friends smoke cigarettes	17	15
Over the next month I intend to quit smoking (or refrain from starting)	62	67
	Mean	
Body mass index	28.63	28.95
Confidence in staying thin or losing weight	6.06	6.08
Confidence in eating low-fat diet	7.04	7.11
Confidence in exercising regularly	6.60	6.56
Confidence in limiting alcohol intake	8.82	9.20
Confidence in limiting cigarette smoking	8.36	8.76
Daily cigarette consumption	3.73	2.98

Table 5. Mean Systolic and Diastolic Blood Pressure by Age*

Age Group, y	Mean ± SD Blood Pressure, mm Hg	
	Systolic	Diastolic
All patients	139 ± 2	82 ± 1
<45	133 ± 5	87 ± 5
45-64	138 ± 2	83 ± 1
≥65	142 ± 2	78 ± 1

*Values include 95% confidence intervals.

tion (50%). College graduates were also somewhat more likely to report lifestyle changes (66%).

When questioned directly, 86% of the respondents indicated they are taking medication to control their BP. Among those not receiving medication, 52% of the male and 30% of the female respondents indicated they had previously taken medication. Almost half (46%) of the current medication-takers reported taking their current medication for 5 years or longer, while more than one quarter (27%) indicated a duration between 2 and 4 years.

When specifically asked whether they have ever tried lifestyle changes to control their BP, 88% of those surveyed indicated they had. Of those respondents attempting to control their BP through both medication and lifestyle, 32% indicated they implemented lifestyle changes before starting medication.

Knowledge, Attitudes, and Information Sources About Hypertension

A large majority of the respondents (87%) reported that they feel "very knowledgeable" about high BP, and 77% indicated they have all the information they need. Responses to a series of "true/false" questions indicated that respondents were well aware of the risks of having high BP. Virtually all respondents knew that high BP can lead to strokes (99%) and heart attacks (97%). A large majority knew that high BP can lead to kidney disease (84%) and cause hardening of the arteries (78%). Conversely, 29% of all respondents (and 38% of those with no more than a high school education) agreed that "a person can tell that they have high blood pressure because they experience many warning signs or symptoms."

Virtually all respondents (92%) agreed or strongly agreed with the statement "I am not going to let high blood pressure interfere with my life." Further, 86% agreed with the statement "I am afraid of the consequences of not controlling my high blood pressure."

More than two thirds (69%) of the respondents cited their physician as their primary source of information about high BP, and 87% indicated their physician takes time to discuss their condition with them. One third of the respondents mentioned that they also get information about health and high BP from written materials for laypersons, such as brochures, pamphlets, health books, and articles in the mass media, although only 19% of the respondents whose condition was diagnosed in the previous 5 years said they do so.

Table 6. Tolerance for Certain Common Side Effects Associated With Blood Pressure Medication

Side Effect	Patient Would Not Take Medication If Experienced Side Effect, %	Patient Would Take Medication If Side Effect Was a Little Unpleasant, %	Patient Would Take Medication If Side Effect Was Very Unpleasant, %
Fatigue	33	51	16
Ankle/face swelling	51	36	13
Cough	42	43	15
Dizziness	58	33	9
Rash	60	31	9

Table 7. Proportion of Patients With Hypertension Taking Each Class of Drugs*

Class of Drugs	Patient Receiving Current Medication, % (N = 632)	Patient Receiving Previous Medication, % (N = 167)
Diuretics/water pills	43	36
Calcium channel blockers	29	25
Angiotension-converting enzyme inhibitors	29	17
β -Blockers	25	21
α -Blockers	6	3
Central sympatholytics	4	9
Angiotensin receptor blockers	3	1
α - β -Blockers	1	
Direct vasodilators	1	2
Peripheral adrenergic neuron antagonists	<1	

*These drugs were being taken either alone or in combination with other classes of drugs.

Attitudes Toward Treatment Regimens

Only a small proportion (11%) of the respondents agreed with the statement "I don't really know why I need to take medication for high blood pressure," although agreement was more common among persons older than 65 years (17%). About half (53%) agreed with the statement "I don't feel any different when I take my high blood pressure medication," and only 14% agreed that "I feel worse when I take my high blood pressure medication than when I do not."

Almost all respondents (97%) were confident in their ability to "take medication according to the schedule recommended by [their] doctor," and only 11% indicated they "have difficulty remembering to take [their] high blood pressure medication." Male respondents (14%) were more likely than female respondents (8%) to indicate having difficulty remembering to take their medication, and those who had not attended college (13%) were more likely than college graduates (6%) to report difficulty.

Respondents' self-reported tolerance for common medication side effects is rather low (**Table 6**). A significant proportion of respondents indicated they would not take a medication if it caused fatigue (33%), ankle

Table 8. Reasons for Switching High Blood Pressure Medications

Reasons	Patient Switched to Current Medication, % (n = 318)	Patient Switched to Previous Medication, % (n = 121)
Experienced side effects	35	26
Blood pressure did not improve	30	43
Physician recommended switch	17	17
Changed physicians	4	6

or face swelling (51%), cough (42%), dizziness (58%), or rash (60%).

Although almost all respondents agreed that proper diet (96%) and regular exercise (93%) are important for controlling high BP, almost half also indicated it is hard for them to follow their recommended diet (48%) and exercise program (47%). Male respondents (60%) were more likely than female respondents (49%) to feel it is easy to exercise regularly and highly educated patients were less likely than others to indicate that they have difficulty adhering to diet and exercise regimens.

Medication History

On average, respondents reported having taken 3 different medications to control their high BP since they were first diagnosed. Patients who reported experiencing side effects with 1 or more high BP medications reported an average of 4 different medications, compared with only 2 taken by those who have not suffered side effects.

The most commonly reported current antihypertensive medications were diuretics (43%), calcium channel blockers (29%), angiotension-converting enzyme inhibitors (29%), and β -blockers (25%). Use of angiotensin receptor blockers, a newer class of medication, were reported by only 3% of the respondents receiving medication (**Table 7**).

Most (68%) of the respondents who take medication reported that they do not experience any side effects. Female respondents were more likely than (73%) male respondents (63%) to indicate no side effects from their current or most recent medication. Younger patients (<45 years) were more likely to report side effects from their current or most recent medication (54%). The most frequently mentioned side effects were dizziness (10% overall, 15% among those <45 years), fatigue (10% overall, 18% among those <45 years), and cough (4% overall, 8% among those <45 years).

Medication switching was most commonly a result of side effects or failure to control BP (**Table 8**). More recently diagnosed respondents were more likely to say that they switched to their current medication because they experienced side effects (51% of those diagnosed in the last 5 years vs 32% of those diagnosed \geq 5 years ago). Among respondents who switched to their most recent medication due to side effects, 20% experienced cough, 19% fatigue, 16% dizziness, 10% ankle swelling, 9% rash, 8% dry mouth, 8% headache, 7% face swelling, and 6% rapid heartbeat.

Table 9. The Predictive Validity of the Cluster Grouping

Predictor Variable	F Ratio	Hypothesis <i>df</i>	Significance of F
Cluster grouping			
Multivariate F	6.71	9	.000
Blood pressure			
Systolic	3.44	3	.017
Diastolic	2.79	3	.040
Body mass index	16.23	3	.000

Approximately 1 (12%) of 8 respondents have stopped taking or decreased their current medication without consulting a physician at some time since their diagnosis. Patients who experienced side effects were twice as likely to stop or decrease their medication compared with those who had not suffered side effects (20% vs 10%).

Just over half (53%) of the respondents indicated that they have forgotten to take their BP medication at least once. Those who have stopped or decreased their medication on their own reported a higher rate of forgetting to take medication (63%).

HYPERTENSIVE SUBGROUPS

Cluster analysis was used to identify 4 subgroups of patients with previously diagnosed hypertension (described here as groups A through D), on the basis of knowledge, attitudes, and behaviors about management of hypertension. To examine the predictive validity of the segmentation, between-group differences on 3 relevant health measures—systolic and diastolic BP and BMI—were tested using a multivariate analysis of variance. Groups differed overall and on each of the 3 health measures (multivariate $F = 6.71$; $P_{(F)}$, $<.001$; **Table 9**).

Table 10 presents demographic, health lifestyle, hypertension knowledge and attitudes, medication compliance and side effects, and BP control data for all subgroups. Upward and downward pointing arrows denote values that are significantly higher or lower than the others. Subgroup profiles are briefly described below.

Group A (39% of the Sample)

Demographically, this is the best educated and the most ethnically diverse subgroup. Group A members consistently strive to take care of their health and control their hypertension through regular medication and a healthy lifestyle. They are more likely than members of other groups to eat an appropriate diet and to exercise routinely. They are less likely than average to smoke cigarettes and are moderate in their consumption of alcohol.

Not surprisingly, group A members are in good health (as indicated by significantly lower diastolic BP readings and the lowest mean BMI) and they are more likely than others to rate their health as being “excellent” or “very good.” They are also the most knowledgeable about hypertension as indexed by the 6-item knowledge scale.

Group B (16% of the Sample)

Group B is composed of more women than men. Group B members are distinguished by their almost exclusive reliance on medication to control their high BP. They are more likely than the other subgroups to believe strongly that not taking their medication is a threat to their health, more likely than members of any other group to be receiving medication, and are least likely to report difficulty in taking their medication as prescribed.

Conversely, group B members are less likely than group A members to exhibit other health behaviors that facilitate BP control. Although average in their diet, members of this group are less likely to exercise regularly, and have less confidence in their ability to exercise regularly or lose weight. They also consume alcoholic beverages more frequently than group A and C members.

Group C (22% of the Sample)

Group C also has more women than men. Group C members have the highest mean BMI among the 4 groups, and nearly half of the group has a high-risk BMI. Group C members also have lower rates of BP control than group A and B members. Group C members are similar to group B members in that weight control and lack of exercise are important problems for them and they have little confidence in their ability to combat these problems. However, their hypertension is probably exacerbated by the fact that they are also more likely than other groups to forget to take their medication. On the positive side, group C members have the lowest rates of alcohol consumption and cigarette use.

Group D (23% of the Sample)

Group D members are demographically quite distinct from the other groups. They are more likely to be male, and their average age is younger than the other groups. This group also has the lowest hypertension knowledge scores, and significantly higher systolic BP readings than the other groups.

Group D members are the least likely to be afraid of the consequences of not controlling their hypertension and least likely to believe that not taking their BP medication is a threat to their health. Not surprisingly, they are least engaged in medical therapy for their hypertension: significantly fewer group D members are receiving hypertension medication and, of these, a greater proportion is likely to have changed or discontinued medication without consulting a physician.

Group D members are also less likely than other groups to believe in the value of regulating their diet, less likely to say that they watch their diet (29%), less likely to avoid foods that are bad for their condition, and have less confidence in their ability to eat a low-fat diet for at least 1 month. In addition, they are the most likely to smoke cigarettes and they consume alcohol more frequently than group A and C members.

Table 10. Selected Demographic and Psychographic Variables by Patient Subgroup*

	Group†				Total
	A	B	C	D	
Criterion variables					
Mean systolic BP when last checked, mm Hg	137.8	136.7	140.8	141.2↑	139.0
Mean diastolic BP when last checked, mm Hg	79.4↓	83.9	83.2	83.4	81.8
Percentage whose BP was normal ($\leq 130/85$ mm Hg) when last checked	38↑	37↑	25↓	29↓	32
Body mass index, kg/m ²	26.95↓	29.40	31.86↑	29.20	28.93
Demographics					
Percentage of patient population	39	16	22	23	
Sex composition, male/female	42/58	37/63	36/64	59/41	44/56
Percentage of group members older than 65 y	46	38	37	21↓	37
Percentage retired	43	39	36	19↓	35
Percentage graduated from college	32↑	23	21	22	26
Ethnic diversity—percentage of nonwhite	26↑	19	17	10↓	20
Perceived health and value of good health					
Percentage who say their health is excellent or very good	43↑	29	21	26	32
Percentage who say that living life in the best possible health important to them	99↑	86	82	76↓	90
Percentage who say they are afraid of the consequences of not controlling their hypertension	91	92	80	76↓	86
Hypertension history and knowledge					
Percentage who were diagnosed with hypertension ≥ 10 years ago	64	68	57	40↓	57
Percentage who did not know what their BP was when last checked	18	20	19	34↑	22
Mean knowledge score‡	5.12↑	5.06	4.90	4.70↓	4.97
Medication					
Percentage who are currently on medication	88	94	86	74↓	86
Percentage who have ever changed or discontinued their current medication without consulting their doctor	8	8	13	20↑	12
Percentage who have never forgotten to take their current medication	50	56	39↓	50	49
Percentage who strongly believe that not taking their medication as prescribed is a threat to their health	74	87↑	75	63	74
Percentage who say they have difficulty remembering to take their medication as prescribed	10	5↓	12	15	11
Risk factor					
Weight					
Percentage with high-risk body mass index (>30 kg/m ²)	19↓	37	47↑	29	30
Percentage who are confident that they can stay thin or lose weight and keep it off for at least 1 mo	62↑	15↓	17↓	28	38
Lack of exercise					
Percentage who do no regular moderate exercise	4↓	31↑	30↑	10	15
Percentage who strongly believe that regular exercise is important for controlling high BP	83↑	58	61	59	69
Percentage who are confident that they can exercise at least 3 times a week for at least 1 mo	85↑	6↓	22	32	44
Diet					
Percentage who say they are careful about what they eat to keep their weight under control	80↑	64	51	29↓	59
Percentage who strongly believe that a proper diet is important for controlling their hypertension	82↑	72	62	56↓	70
Percentage who say they avoid foods high in fat	92	88↓	86	30↓	48
Percentage who say they avoid foods with a high salt content	92	91	86	54↓	82
Percentage who say it is hard for them to follow the recommended diet for hypertension	36	19↓	95↑	45	48
Percentage who are confident about being able to eat a low-fat diet for 1 mo	76↑	35	32	18↓	46
Consumption of alcoholic beverages					
No. of times drink alcoholic beverages in 1 y	46	104↑	30	98↑	63
Smoking					
Percentage who smoke	12	29	8↓	40↑	21

*BP indicates blood pressure; arrows, values that are significantly higher or lower than average at the .05 level of confidence.

†For explanation of groups, see dagger footnote in Table 2.

‡The knowledge score represents the number of correct responses on 6 items designed to assess knowledge of the risks of high BP. The maximum score is 6.

COMMENT

These findings confirm and refine what every clinician knows to be true—that there is a broad range of patient involvement in, and commitment to, hypertension therapy. Perhaps more importantly, this study shows that patient involvement in the medical and lifestyle aspects of their treatment covaries in clinically relevant ways. Insights afforded by understanding these patterns of covariation may translate into a limited number of tailored patient management strategies with the potential to improve hypertension control rates and to minimize side effects. Tailored approaches to hypertension man-

agement based on the level of patient involvement and other relevant factors have been shown to be effective both from a clinical and a public health perspective.^{1,17,18}

This research indicates that there are 4 distinct subgroups among the population of patients with previously diagnosed hypertension and that these subgroups vary significantly in their involvement in both medical and lifestyle management of their condition. Subgroups were based on patients' knowledge, attitudes, and behaviors that are relevant to the management of hypertension, and were found to predict patients' BP and BMI. Although there are some demographic differences among patient subgroups, they are minor compared with the large

between-group differences in health beliefs, behaviors, and other risk factors.

It is critical to note that hypertension control rates among these 4 patient groups range only from poor to fair; management of hypertension must be improved considerably, even in the most involved patient groups. Given the significant differences in how people manage their hypertension (Table 10) it is likely that different optimal clinical management strategies are indicated for members of each patient subgroup.

Group A, the largest subgroup, is actively involved in the management of their condition both medically and through their health lifestyle. Clinical management strategies should focus on providing these patients with positive reinforcement for their accomplishments to date and should encourage them to adopt incrementally more aggressive health lifestyle goals, as appropriate. Additional gains may be made through adjustments in medication type and dosing. Less frequent office monitoring may be indicated for group A members, but supplementary forms of contact with patients (eg, monthly telephone outreach by nursing staff) may offer considerable benefit.

Group B, the smallest subgroup, is actively involved in the medical management of their condition but is largely uninvolved in managing their BP through a healthy lifestyle. Their outcomes can likely be improved through more aggressive medical management coupled with small steps toward a more active lifestyle. Patients who smoke cigarettes should also be actively encouraged to quit and, given their limited confidence in their ability to quit, should be referred to an intensive (vs self-help) smoking cessation program.

Group C members are fully engaged neither in medical therapy nor in lifestyle treatment for their hypertension. These data suggest that their poor outcomes stem from a tendency to be obese, lack of confidence in being able to change their lifestyle, and an inability to take medicine consistently as prescribed. While group C members appreciate the gravity of their condition, they appear to be overwhelmed by the changes they need to make. Counseling should thus be empathetic and incremental, and more frequent office visits may be required.

For group C members, clinical counseling should focus on developing a simple medication and lifestyle self-management system. For example, to ensure that patients take medications as directed, medication schedules should be simplified and special care taken to minimize side effects. Group C members are also likely to benefit from an increased level of physical activity, but they lack confidence in their ability to stay with an exercise program. Counseling should focus on encouraging greater frequency of easily-enacted moderate physical activities (eg, taking the stairs, a 10-minute walk during lunch, or family walks on the weekend) rather than strenuous exercise, and on modest reductions in total energy intake. Positive feedback for all behavioral change efforts, and routine contact through supplementary methods (eg, telephone contact or meetings with paraprofessionals) will enhance the likelihood of behavior change.

Group D members represent the greatest challenge to clinicians; they are least involved in managing their

hypertension and show little interest in becoming more active partners in the process. It is unclear which strategies are likely to be most productive with this group: empathic education, fear arousal, or simply focusing on keeping them in care until their priorities change. Medical management should focus on making it easier for them to take their medication, eg, by minimizing side effects from the medication. Increased frequency of patient contact through a case manager may also create a more stable patient–primary care physician relationship through which to suggest lifestyle changes over time, especially changes in their diet.

The goal of the current research—to identify and profile distinct, clinically meaningful groups of patients with hypertension based on their health lifestyle—was achieved in large measure. Further research should now be conducted to replicate and validate these findings. Our sample of patients with previously diagnosed hypertension was derived using a quota rather than a probability sampling approach. Although this method is commonly used in marketing research and is known to generate population prevalence estimates similar to random digit dialing methods,¹⁵ it is largely unknown in the fields of epidemiology and medical research. Consequently, validation of these findings should be conducted through a probability-based sampling method. Nonresponse bias represents another possible threat to the validity of the current findings, however, the analysis of respondents to nonrespondents indicated few systematic differences.

VIRTUALLY ALL of the measures employed in this research were based on self-report. Although patient self-reports during clinical assessments vary widely for validity and reliability, behavioral and survey researchers have developed numerous strategies to enhance the validity and reliability of self-reported data.¹⁹⁻²² Methods employed in the current research to enhance validity and reliability of the data included assessment of behavior in clearly specified time frames, questions that can be answered with simple (noncompound) and direct cognitive processes, prompted checking (of medication labels), use of standard psychometric response scales, and extensive pretesting of the survey instruments. Nevertheless, future replication research should include at least some verification of self-reported data with other forms of measurement.

Beyond replication and validation, additional research is required to bring an improved hypertensive patient management system to fruition. Specifically, a valid, reliable, and easily administered hypertension lifestyle assessment instrument must be developed to identify which subgroup an individual falls into. Clinical management protocols tailored for members of each subgroup must then be developed and tested in various clinical settings. In some settings this is likely to include extensive use of allied health professionals and various traditional and new communication technologies, while in other settings this is likely to be limited to physician counseling and referral to outside programs. This kind of tailored treatment permits optimal allocation and use

of health care resources and is likely to become increasingly important in the future.

Perhaps the most important contribution of the current research is simply that it serves as a reminder of the challenges inherent in making further gains in hypertension control. Clinicians must aggressively assess the medication regimens of all patients with hypertension not currently in control, and work with their patients in creative ways to ensure full adherence to the prescribed therapy. Moreover, physicians and other members of the health care team must assist patients with hypertension to understand better the relationship between health lifestyle and their medical condition, and enable patients to manage their condition through an appropriate combination of medication and lifestyle modification.

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