Interrelationships Among Preventive Health Behaviors: A Test of Competing Hypotheses

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THE DETERMINANTS OF THOSE BEHAVIORS that people can control to lessen the probability of chronic disease or a major accident have received increasing emphasis in recent years. An expanding volume of research seeks to explain observed differences in people's preventive health behavior in terms of differing social-psychological attributes of individuals (*1,2*), properties of varying social milieus of persons and groups (*3–5*), or in terms of both these differentials (*3,6*). Although each of these approaches has been used successfully in some studies to account for variation in specific preventive behaviors, other studies using these approaches have not been able to account satisfactorily for variations in behavior.

In spite of the proliferation of studies on preventive health behavior, little attention has been paid to the dependent variable itself. Yet, the failure of studies to account consistently for differences in preventive health behavior may result as much from poor conceptualization and measurement of the dependent variable as from inadequacies in the theoretical frameworks constructed to explain such behavior. Before we can explain variations in preventive health behaviors, we need a better understanding of the interrelationships among these behaviors.

Whether preventive health behavior is best conceptualized as a unidimensional phenomenon, as a collection of disparate behaviors, or possibly as multidimensional is not clear. If it is unidimensional, then any preventive behavior will work equally well as the dependent variable, and failures to account for observed differences in preventive health behaviors must be explained on the basis of measurement errors or insufficient development of the explanatory model. If, however, preventive health behavior is either multidimensional or a collection of unrelated behaviors, then inductive model-building based on the assumption that any behavior is representative of the universe of preventive behaviors is likely to be inadequate. To clear the way for a more comprehensive theory of preventive health behavior, the relationships between 11 kinds of preventive behaviors were explored in the current study.

Review of the Literature

Kasl and Cobb (*7*), in a classic article on health behavior, define preventive health behavior as "any activity undertaken by a person believing himself to be healthy, for the purpose of preventing disease or detecting disease in an asymptomatic stage." However, they then go on to discuss only two kinds of behaviors—those that serve to detect disease (health examinations) and those that reduce the probability of future illness (immunization, prenatal care, and so forth). Explicitly left out of consideration are health maintenance behaviors (exercising or dieting), and implicitly ignored are behaviors that would prevent physical trauma or disability. Subsequent researchers, also, while generally confining themselves to taking the use of various preventive services as their dependent variable(s), have then implied that their results are generalizable to preventive health behavior in general (*3–6,8–27*). While in some studies, seat belt use (*28–30*) or smoking behavior (*31–34*) has been used as the dependent variable, only two have included a wide variety of personal health maintenance and safety practices along with the more usual indicators of preventive health behavior (*35,36*).

Adequate conceptualization and measurement of preventive health behavior would seem to be a necessary prior step to attempts to explain it, but direct infor-

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mation on its nature is scarce in the literature. In most of the studies (especially those published before 1970) that include indicators for two or more kinds of preventive health behavior, the correlations between the dependent measures (*5,11,21–24,35*) are not reported. Those studies in which the interrelationships (or lack thereof) are reported generally indicate that preventive behaviors are weakly but positively related. For example, Haefner and Kirscht (*16*) reported that about three times as many people in both their experimental and control groups got routine physical examinations as got chest X-rays, an observation that implies a low intercorrelation. Bullough (*8*) found *r*'s clustering around 0.20 or less among prenatal care, postnatal visit, and preventive dental care in a sample of 806 poor Los Angeles women. Steele and McBroom (*25*) reported gammas ranging from 0.12 to 0.21 among routine physical examinations, preventive dental examinations, and eye checkups for 1,730 rural Montanans. Williams and Wechsler (*36*) measured 13 different preventive behaviors in three suburban Boston samples and found that less than 30 percent of the available 126 correlation coefficients were both positive and significant at the 0.05 level. Coburn and Pope (*9*) reported that the associations among routine physical examinations, dental examinations, and inoculation with poliomyelitis vaccines were weak for their large sample of Canadian working men.

Faced with the same empirical evidence, some researchers implicitly or explicitly view preventive health behavior as a unidimensional phenomenon (*2,15*), while others argue that it is either composed of essentially independent behaviors (*13,25*) or is multidimensional (*36*). The hypothesis of unidimensionality implies that people are consistent across behaviors, and conversely, the assumption of independence implies that people are inconsistent. Either assumption forces one to explain the weak or moderate behavioral intercorrelations reported in the literature as being due either to response biases that attenuate relationships among preventive behaviors or to measurement errors that inflate them. However, one would expect to find weak to moderate relationships for the population as a whole if one segment of it behaved consistently while another behaved inconsistently. Specifically, if two or more distinct behavioral patterns exist, each of the following patterns of association between preventive health behaviors is congruent with low correlations for the population as a whole: (*a*) among consistents, preventive health behavior is unidimensional, but among inconsistents, preventive health behaviors are independent of one another; (*b*) among consistents, preventive health behavior is multidimensional, but among inconsistents, preventive health behaviors are independent of one another; and (*c*) preventive health behavior is multidimensional for both consistents and inconsistents, but the relationship between the dimensions is different for the two groups, so that the overall relationships among preventive behaviors appear weak or nonexistent.

The primary purpose of the current study was to test the alternative hypotheses that preventive health behavior is (*a*) unidimensional, (*b*) composed of unrelated behaviors, or (*c*) multidimensional. Although these hypotheses appear to be mutually exclusive, it is possible that different segments of the population have different patterns of behavior (consistent or inconsistent), so that more than one of the three hypotheses may be valid simultaneously. This possibility was also explored.

Methodology

In the spring of 1973, a sample of 617 residents of Rockford, Ill., was systematically drawn at random from listings of the city's adult population in the 1970 Rockford City Directory. (In this directory, a housewife is listed under her husband's name. Therefore in the current study, the husband was designated as the re-

spondent in the first half of the sample, and the wife, in the second half. Married working women stood a greater chance of being included in the sample than other women because the directory includes names garnered both from employment lists and from a residential census. Also, employed persons had a greater probability of inclusion than the unemployed, since the employed are listed twice in the directory instead of once. This bias in the sampling list, plus the higher nonresponse rate among the unemployed in the sample, makes the generalizability of the results of the study somewhat problematical. Inclusion in future studies of more representatives of the unemployed category would be useful.)

The 617 people in the sample received a preliminary letter inviting them to participate in research on preventive health behavior being sponsored by the new Rockford School of Medicine. Telephone and personal followups were made until a response rate to this instrument of 62 percent ($N = 383$) was reached approximately 4½ months later.

Compared with the total adult population of the Rockford urban area (*37*), the respondents in this study were more likely to be female (59.4 percent versus 53.6 percent), to have had some college education (27.9 percent versus 19.4 percent of those age 25 and older), and to be under age 65 (86.6 percent versus 83.9 percent). Differences in employment status (66.3 percent of the respondents employed versus 60 percent of the adult Rockford urban area population), in type

Specific behavior scales with scoring and mean results[1]

Medical checkups

1. About how often do you go to the doctor? (mean = 2)
   3 = annual checkup
   2 = biannual checkup
   1 = Papanicolaou test, other checks
   0 = never go to doctor or only when something is wrong
2. What is the main reason you get checkups? (mean = 0)
   3 = go of own accord)
   2 = family pressure
   1 = nonvoluntary
   0 = do not get checkups
3. When was the last time you went to a doctor for a physical checkup? (mean = 2)
   3 = within past year
   2 = 1 to 2 years ago
   1 = 2 to 5 years ago
   0 = more than 5 years ago or never

Scale score: sum ÷ 9 × 100

Dental care

1. About how often do you go to the dentist? (mean = 1)
   3 = checkup every 6 months
   2 = annual checkup
   1 = biannual checkup
   0 = only when something is wrong or never
2. How many times did you brush your teeth in the past 24 hours? (mean = 2)
   3 = 3 or more
   2 = 2
   1 = 1
   0 = none
3. When was the last time you went to a dentist for a routine dental checkup? (mean = 2)
   3 = within past year
   2 = 1 to 2 years ago
   1 = 2 to 5 years ago
   0 = more than 5 years ago or never

Scale score: sum ÷ 9 × 100

Seat belt use

1. Yesterday did you use your seat belt (or the last day you went any place in a car)? (male mean = 1, female mean = 2)
   2 = every time
   1 = at least once
   0 = not even once or no seat belts
2. How often do you use seat belts when traveling in a car on a highway? (mean = 1)
   2 = always or usually
   1 = often or sometimes
   0 = never
3. How often do you use seat belts when driving or riding in town? (mean = 1; code is same as for preceding question)

Scale score: sum ÷ 6 × 100

Exercise

1. During the past 24 hours, how many blocks did you walk out of doors? (mean = 1)
   3 = 12 or more
   2 = 6–11
   1 = less than 6
   0 = none
2. Is there anything else you did for exercise during the past 24 hours? (mean = 0)
   3 = 3 or more kinds
   2 = 2 kinds
   1 = 1 kind
   0 = no other
3. How often do you walk to the third floor of a building when you have the choice, rather than take the elevator? (mean = 1)
   3 = always or usually
   2 = often
   1 = sometimes
   0 = never

Scale score: sum ÷ 9 × 100

Nutrition[2]

1. Milk and dairy products consumption in past 24 hours (mean = 1)
   2 = 2 or more glasses
   1 = 1 glass
   0 = none
2. Quantity of fruits and vegetables combined (mean = 2)
   2 = 4 or more servings
   1 = some
   0 = none
3. Servings of meat (mean = 2)
   2 = 2 or more servings
   1 = 1 serving
   0 = none
4. Vitamin C intake (male mean = 1, female mean = 2)
   2 = adequate
   1 = less than adequate
   0 = none
5. Vitamin A intake (mean = 1; code is same as for preceding question)

Scale score: sum ÷ 10 × 100

Miscellaneous examinations

1. When was the last time you had your eyes (vision) checked? (mean = 2)
2. When was the last time you had your ears (hearing) checked? (mean = 1)
3. When was the last time you had a TB skin test or a chest X-ray? (mean = 2)

Code for all 3 questions:
   3 = within past year
   2 = 1 to 2 years ago
   1 = 2 to 5 years ago
   0 = more than 5 years ago or never

Scale score: sum ÷ 9 × 100

Immunization behavior

1. When was the last time you had a smallpox vaccination? (mean = 0)
2. When was the last time you were immunized or had a booster shot against polio? (mean = 0)
3. When was the last time you were im-

of occupation (55.3 percent nonmanual versus 48.3 percent), and in median family income ($11,298 versus $10,934) are more apparent than real. The U.S. Census figures on employment and occupation in the Rockford urban area include 16 to 18 year olds, a group least likely to be employed or to hold nonmanual jobs and one not included in the study sample. Inflation between 1970 (the year of the U.S. Census data) and 1973 (the year of the current study data) more than accounts for the difference in median family income.

Nonrespondents in the study sample were similar to respondents in terms of sex, but they were more likely to be over age 65 (17 percent versus 13 percent), more likely to be out of the labor force (39 percent versus 34 percent), and if employed, less likely to be in professional or managerial occupations (23 percent versus 27 percent).

The potential universe of preventive health behaviors is extremely large, even when a restricted definition is used, such as any behavior that according to (current) professional medical and scientific standards, prevents disease or disability and/or detects disease in an asymptomatic stage and which is voluntarily undertaken by a person who believes himself to be healthy. The preventive behaviors measured in this study were chosen on the basis of three criteria: (*a*) they had been used as dependent variables in other studies (the same wording being retained in this study insofar as possible); (*b*) they were subject to the respondent's control and referred only to him or her (behaviors performed on

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munized or had a booster against tetanus (lockjaw)? (male mean = 1, female mean = 0)
4. When was the last time you were immunized against influenza? (mean = 0)

Code for all 4 questions:
3 = less than 2 years ago
2 = 2 to 5 years ago
1 = more than 5 years ago
0 = never

Scale score: sum ÷ 12 × 100

Driving behavior

1. Have you been ticketed for a moving traffic violation (for example, speeding, for going through a red light, for bumping into another car, etc.) within the last 12 months? (mean = 3)
   3 = none
   2 = 1
   1 = 2
   0 = 3 or more or did not specify how many
2. How often do you drink one or more alcoholic beverages (beer, wine, cocktails) within an hour of driving a car some place? (male mean = 2, female mean = 3)
   3 = never
   2 = a few times a year
   1 = every week or so or more often
3. How often do you drive a few miles over the speed limit on the highway where the posted limit is 65 miles per hour? (mean = 2)
   3 = never
   2 = sometimes
   1 = often
   0 = usually or always
4. How often do you signal when changing lanes in traffic? (male mean = 2, female mean = 3)
   3 = always
   2 = usually
   1 = often
   0 = sometimes or never

Scale score: sum ÷ 12 × 100

Pedestrian behavior

1. How often do you cross the street against the stop lights? (mean = 3)
2. How often do you cross a relatively busy street in the middle of the block? (mean = 3)

Code for both questions:
4 = never
3 = a few times a year
2 = couple times a month
1 = every week or so
0 = several times a week

Scale score: sum ÷ 8 × 100

Smoking: Do you smoke? (mean = 3)
3 = do not smoke
2 = less than 1 pack of cigarettes per day
1 = 1 to 2 packs per day
0 = more than 2 packs per day

Scale score: sum ÷ 3 × 100

Personal hygiene

1. During the last 12 months, have you attempted to remove or open pimples or blackheads with a sharp object or by squeezing with your fingers? (mean = 1)
   3 = never
   2 = once
   1 = 2 to 3 times
   0 = more than 3 times
2. During the last 12 months, have you lent or borrowed a hairbrush or a comb? (mean = 1)
   3 = never
   2 = once
   1 = 2 to 3 times
   0 = more than 3 times
3. How often do you consciously avoid people who are coughing or sneezing? (mean = 1)
   3 = always
   2 = often
   1 = sometimes
   0 = never
4. How often do you wash your hands with soap before eating or preparing food? (male mean = 2, female mean = 3)
   3 = always or usually
   2 = often
   1 = sometimes
   0 = never
5. How often do you drink from a cup or glass that has not been washed since it was used by a friend? (mean = 1)
   3 = never
   2 = sometimes
   1 = often
   0 = always or usually
6. How often do you wash your hands with soap after going to the toilet? (mean = 3)
   3 = always or usually
   2 = often
   1 = sometimes
   0 = never
7. How often do you share towels or washcloths with other members of your household? (mean = 1)
   3 = never
   2 = sometimes
   1 = often
   0 = always or usually

Scale score: sum ÷ 21 × 100

[1] Respondents with missing information on an item in a scale were assigned the mean value for their sex for that item. If more than 1 scale item was missing, the whole scale was coded as "missing data."

[2] Scores for vitamin C and vitamin A intake are constructed. Respondents were asked to list fruits and vegetables (or juices) they had consumed in preceding 24 hours. U.S. Department of Agriculture Leaflet No. 424 (U.S. Government Printing Office, Washington, D.C., 1967) was used to develop the following codes:
2 = adequate (at least 1 item from vitamin C or vitamin A list)
1 = less than adequate (some fruits or vegetables, but none from vitamin C or A list)
0 = ate no fruits or vegetables.

behalf of someone else, for example, children, being excluded); or (*c*) they were suggested by the literature, personal reflection, or communications from colleagues —particularly those behaviors related to health maintenance and accident prevention.

The behavior measures consisted of 69 closed-response items and 9 open-ended questions. Three kinds of behaviors that were measured were not used in the analyses reported here. Behaviors that were "peripheral" to health were excluded (for example, reading about health matters, having a fever thermometer in the home). Behaviors that might well be extremely significant in terms of their impact on health but which virtually all the respondents claimed they never engaged in were also excluded (for example, taking medicine prescribed for someone else, self-removal of moles, heavy drinking). Finally, 28 items in a third group were considered invalid either because of faulty measurement or because there appeared to be no reasonable way to define appropriate preventive health behavior (for example, amount of sleep).

Thirty-nine items were used to construct 11 additive behavior scales. (See "Specific behavior scales with scoring," page 218.) These scales represent driving behavior, pedestrian behavior, smoking, personal hygiene, seat belt use, medical checkups, dental care, immunizations, screening examinations, exercise, and nutrition. The criterion for inclusion of any given item in a scale was primarily substantive rather than statistical. For most preventive health behaviors, there is an external criterion (for example, medical consensus) for deciding what constitutes good or bad behavior, so that items were included regardless of how weak their association was with other items in the set; (in most instances the correlations among items in a scale were moderate). For example, there is a fairly wide consensus among nutritionists that adults require the equivalent of two glasses of milk daily for adequate nutrition, and therefore this item was included in the nutrition scale even though it did not have a high item-to-total-score correlation.

The respondent in most cases was asked to report on his or her behavior over a limited period. This format made it unlikely that the responses would be biased by either an "acquiescence set" or by a tendency to check only the extreme, only the moderate, or only the neutral response categories. No mechanism to directly assess tendencies to give "socially desirable" answers was built into this study. However, it is clear from a comparison of the frequency of several reported behaviors from this study and others (table 1) that the respondents in this study did not consistently report higher frequencies of good preventive health behavior. Thus, a bias toward socially desirable responses is unlikely to prejudice the results to a greater extent than in previous studies.

The internal reliabilities (Chronbach's alpha) and the discriminate validity of the 11 behavior scales were calculated by Bohrenstedt's method (*39*). The large number of non-zero correlations between the scales in table 2 indicates that the discriminate validity is not high; many of these scales do not represent entirely different concepts (*40*). The internal reliabilities of several scales are very low; however, the small number of component items makes it difficult to attain large coefficients.

Each person's pattern of behavior was also scored. Inspection of the data revealed that most respondents were somewhat inconsistent. For example, only 4 scored above the group mean on all 11 of the behavior scales, and only 5 scored below it on all 11. Nevertheless, it was equally clear that some respondents were more inconsistent than others. Therefore, an arbitrary decision was made to classify a person as behaviorally consistent (226 respondents) if at least 8 of the person's behavior scale scores were all either (*a*) below the scale means for his or her sex, that is, consistently low preventive health behavior; (*b*) above the means, that is, consistently high preventive health behavior; or (*c*) within one standard deviation of the mean, that is, consistently intermediate preventive health behavior. The remaining respondents (154) were classified as behaviorally inconsistent. This classification, in and of itself, tends to create strong positive correlations among preventive behaviors within the behaviorally consistent category and zero correlations within the inconsistent. Nevertheless, the bi-dimensional structure of preventive health behavior among both consistents and inconsistents (discussed in the next section) is not an artifact of this classification system.

The hypotheses were treated by means of correlation analysis (Pearson's product-moment coefficients). These parametric statistics were used even though most of the data were measured on an ordinal scale, and therefore the behavior scales based on these data are technically ordinal also. Parametric statistics provide a more "powerful" tool than do nonparametric statistics, and apparently little error is associated with violating the assumption of interval-level measurement (*41*). Since in correlation analysis the assumption is that the relationship between variables is linear in form, each pair of variables was cross-tabulated and examined for curvilinearity. The nonsignificant relationships reported in the next section were not due to curvilinearity. The 0.05 level of probability was chosen as the criterion for rejecting a hypothesis.

Table 1. Frequency of selected behaviors among current study subjects as compared with that reported in other studies

Preventive behaviors	Percent of current study subjects	Other studies: Percent of subjects	Other studies: Author(s) and reference No.
Dental checkup:			
Every 6 months:			
Men	28.0	34.9	Williams and Wechsler (*36*)
Women	24.2	41.0	
Within last 12 months:			
Men	52.3	24.0	Ellenbogen, Lowe, and Danley (*11*)
Women	49.8	39.0	Freeman and Lambert (*13*)
Both sexes	50.4	41.3	Steele and McBroom (*25*)
Within last 2 or 3 years:			
Both sexes	62.5	56.0	Kegeles (*17*)
General physical examination within last 12 months:			
Men	52.6	35.0	Williams and Wechsler (*36*)
Women	64.7	51.3	
Both sexes	59.5	53.0	Haefner and Kirscht (*16*)
		34.8	Steele and McBroom (*25*)
Papanicolaou test within last 12 months	59.3	48.5	Williams and Wechsler (*36*)
Chest X-ray within last 12 months, both sexes	38.0	19.0	Haefner and Kirscht (*16*)
Seat belt use:			
Never	43.4	25.0	Morgan (*28*)
Always	13.0	33.0	
In town—always or usually:			
Men	23.0	[1] 23.0	Williams and Wechsler (*36*)
Women	17.0	[1] 17.8	
Smoking—do not smoke:			
Men	53.2	56.8	Statistical Abstract of the United States (*38*)
		66.3	Williams and Wechsler (*36*)
Women	69.3	69.1	Statistical Abstract of the United States (*38*)
		75.8	Williams and Wechsler (*36*)

[1] Authors did not provide clear referrent for this percentage.

Table 2. Intercorrelations among 11 behavior scales, with internal reliabilities in diagonal

Behaviors	Driving behavior	Pedestrian behavior	Personal hygiene	Smoking behavior	Seat belt use	Medical checkups	Dental care	Immunization behavior	Miscellaneous examinations	Exercise	Nutrition
Driving behavior	(0.27)	**0.44**	**0.33**	**0.12**	**0.11**	**0.15**	−0.09	−0.19	**0.12**	−0.02	0.00
Pedestrian behavior		(0.80)	**0.35**	**0.09**	**0.10**	0.04	−0.11	−0.20	0.03	−0.22	0.05
Personal hygiene			(0.60)	**0.19**	**0.19**	**0.24**	**0.13**	−0.13	**0.19**	−0.08	**0.12**
Smoking behavior				NA	**0.15**	**0.11**	**0.19**	−0.01	−0.02	−0.03	**0.16**
Seat belt use					(0.87)	**0.13**	**0.24**	**0.17**	**0.15**	**0.10**	**0.22**
Medical checkups						(0.80)	**0.40**	**0.10**	**0.35**	0.08	0.05
Dental care							(0.66)	**0.24**	**0.26**	**0.20**	**0.23**
Immunization behavior								(0.61)	**0.25**	**0.13**	**0.13**
Miscellaneous examinations									(0.47)	**0.14**	0.08
Exercise										(0.35)	**0.10**
Nutrition											(0.59)

NOTE: Boldface type indicates positive and significant at 0.05 level. Figures in parentheses are internal reliabilities. NA = not applicable.

Results

The hypothesis that preventive health behaviors are independent of one another was rejected because fully 63.5 percent (37 of 55) of the intercorrelation coefficients were both positive and significant. If we assume the true proportion of significant positive correlations is 5 percent when the variables are independent, these results are highly significant (Z-score 21.48).

To choose between the remaining hypotheses—unidimensionality and multidimensionality—the pattern of intercorrelations was examined (table 2). The data showed that the scales for driving behavior, pedestrian behavior, and personal hygiene were intercorrelated; (the component items of these scales also consistently showed intercorrelations ranging from 0.33 to 0.44). These behaviors, along with smoking behavior, have in common the fact that noncompliance with medically recommended actions presents a direct risk; driving or walking recklessly or putting oneself in contact with smoke or germs is potentially capable of producing injury or disease. In contrast, inappropriate behavior with regard to seat belt use, medical checkups, dental care, screening examinations, immunization, nutrition, or exercise is not hazardous in and of itself; here noncompliance at most represents an indirect risk to physical well-being. Placing the behaviors into direct and indirect risk clusters maximizes the proportion of nonsignificant and inverse coefficients in the upper right-hand quadrant of the matrix in table 2. However, several of the coefficients within the cluster remain near zero, and the magnitude of association is generally small.

As suggested earlier, the low magnitude of association between the preventive behaviors measured in this and other studies may be due to different patterns of behavior (consistent or inconsistent) within the population. The intercorrelations among the 11 behavior variables, with consistency controlled, are presented in table 3. The majority (76.3 percent) of the coefficients were as expected, positive and significant for respondents classified as behaviorally consistent. As was the case for the sample as a whole, however, most of the nonsignificant and inverse relationships were between direct and indirect risk behaviors. Within clusters, 100 percent of the intercorrelations among the four direct risk behaviors and 90.5 percent of those among the seven indirect risk behaviors were both positive and significant. Furthermore, as was expected, the magnitude of association within clusters was much larger than for the sample as a whole: of the 27 coefficients within a cluster, only 26 percent were 0.25 or larger for the sample as a whole, compared with 59 percent for the consistents alone (table 3).

The clustering of behaviors within the consistent group was rechecked by means of factor analysis (principal components with Varimax rotations—data not shown). With the exception of exercise, all of the indirect risk behaviors loaded above + 0.45 on factor 1; none of the direct risk behaviors did. With the exception of smoking, all of the direct risk behaviors loaded above + 0.60 on factor 2; none of the indirect risk behaviors did. The clearly bi-dimensional structure of preventive health behaviors among the behaviorally consistent was not expected; nor can it be explained as an artifact of dividing the sample into consistents and inconsistents.

Although not as clearly so as among consistents, preventive health behavior appears to be bi-dimensional among inconsistents also. Within the inconsistent group, only 40 percent of the 55 correlation coefficients among the 11 behaviors were significant at the 0.05 level. However, the hypothesis of independence can be rejected, since considerably more correlations were found than the 5 percent that would be expected on the basis of chance (5 percent). Instead of a random distribution of good and bad behavior, the behaviorally inconsistent were inconsistent in the sense that if they engaged in appropriate direct risk preventive health behavior, they tended to have poor indirect risk preventive health behavior, and vice versa. Specifically, people who drive and walk carefully and have good personal hygiene habits are likely to have poor immunization, dental, and exercise behavior. Smoking, seat belt use, and nutrition behavior are generally unrelated to each other or to any other behavior within the inconsistent group; medical checkup behavior and miscellaneous examination behavior are related to each other and to the other utilization behaviors but not to direct-risk preventive health behavior (table 3).

Two composite additive scales were constructed to represent direct risk preventive health behavior (driving behavior + pedestrian behavior + personal hygiene + smoking) and indirect risk preventive health behavior (seat belt use + medical checkups + dental care + immunizations + miscellaneous screening examinations + exercise). For the sample population as a whole, the correlation between these two scales was a weak 0.13. In contrast, the correlation between the composite direct and indirect risk preventive health behavior scales was + 0.38 among consistents and − 0.39 among inconsistents. There were no significant differences in the mean levels of either kind of preventive health behavior between consistents and inconsistents. Thus, the way in which people behave (consistently or inconsistently) appears to be both a suppressor and a specifier with regard to the relation-

ship between the two substantive dimensions of preventive health behavior. Among people with a consistent behavior pattern, it was hypothesized that the relationship between direct and indirect preventive health behavior would increase (and it did, from 0.13 to 0.38), and it was also hypothesized that the relationship among persons with an inconsistent behavior pattern would be reduced to zero. However, far from being zero, the relationship between direct and indirect preventive health behavior was a moderately strong inverse one.

Discussion

The primary intent in this study was to explore the interrelationships among a variety of behaviors that serve to detect or prevent disease or disability with a view to determining whether preventive health behavior is best conceptualized as a unidimensional behavioral predisposition, as a collection of unrelated behaviors, or as multidimensional. The hypothesis of independence of behaviors was rejected. The analyses conducted indicated that a bi-dimensional conceptualization of preventive health behavior gave the best fit for this set of data, especially for people who were consistent in their behavior. Most (83 percent) of the nonsignificant and inverse relationships among the 11 behaviors in this study were between the direct and the indirect risk behaviors; only one relationship between the components of these two dimensions had a magnitude in excess of + 0.20 (medical checkups and personal hygiene).

Some support for this conceptualization of preventive health behavior is indicated in the study by Williams and Wechsler (*36*). In their study, speeding, taking chances, and driving after drinking (direct risk behaviors in our terms) had small inverse loadings on a factor composed primarily of the indirect risk types of behaviors. Confirmation of the bi-dimensionality of preventive health behavior awaits further research in which more rigorous measures will be applied both to the behaviors included in the current study and to additional behaviors.

The hypothesis of bi-dimensionality is intriguing since it implies that explanations put forth to account for differences in utilization behavior (the core of indirect risk preventive health behavior) may not be adequate for explaining variations in direct risk preventive health behaviors. The study suggests that the antecedents of utilization behavior may be generalizable to seat belt behavior (and possibly to exercise and nutrition be-

Table 3. Intercorrelations among 11 specific behavior scales, by consistency

Behaviors	Direct risk scale: Driving behavior	Pedestrian behavior	Personal hygiene	Smoking behavior	Indirect risk scale: Seat belt use	Medical checkups	Dental care	Immunization behavior	Miscellaneous examinations	Exercise	Nutrition
Consistents											
Driving behavior	**0.43**	**0.34**	**0.22**		**0.19**	**0.24**	**0.20**	−0.03	**0.19**	0.09	0.10
Pedestrian behavior		**0.37**	**0.15**		**0.18**	**0.18**	0.09	−0.09	**0.12**	−0.01	0.10
Personal hygiene			**0.33**		**0.34**	**0.34**	**0.28**	0.07	**0.30**	0.04	**0.25**
Smoking behavior					**0.24**	**0.18**	**0.30**	0.07	**0.11**	0.08	**0.23**
Seat belt use						**0.28**	**0.43**	**0.34**	**0.33**	**0.19**	**0.32**
Medical checkups							**0.43**	**0.17**	**0.42**	0.09	**0.21**
Dental care								**0.28**	**0.27**	**0.21**	**0.39**
Immunization behavior									**0.27**	0.09	**0.18**
Miscellaneous examinations										**0.19**	**0.25**
Exercise											**0.20**
Nutrition											
Inconsistents											
Driving behavior	**0.44**	**0.32**	−0.01		0.01	0.06	−0.27	−0.34	−0.00	−0.13	−0.13
Pedestrian behavior		**0.31**	−0.02		0.01	−0.13	−0.41	−0.32	−0.09	−0.44	−0.03
Personal hygiene			−0.08		−0.02	0.09	−0.13	−0.38	0.05	−0.23	−0.08
Smoking behavior					0.02	−0.01	0.01	−0.08	−0.19	−0.03	0.05
Seait belt use						− .08	−0.04	−0.05	−0.11	−0.02	0.08
Medical checkups							**0.36**	0.03	**0.27**	0.07	−0.18
Dental care								**0.19**	**0.24**	**0.20**	−0.02
Immunization behavior									**0.19**	**0.18**	0.07
Miscellaneous examinations										0.08	−0.16
Exercise											−0.02
Nutrition											

NOTE: Boldface type indicates positive and significant at 0.05 level.

havior, although these two behaviors are not well measured in the current study). However, different causal processes may underlie smoking and accident prevention behaviors. Programs that seek to alter smoking and accident prevention behaviors by modifying the social-psychological or social group characteristics found to be related to utilization behavior may be making inefficient use of public health resources.

In this study an additional complexity was uncovered that appears not to have been considered in previous research: differential patterns of behavior (consistent and inconsistent) that alter the relationships between direct and indirect risk preventive health behavior. Preliminary analyses indicate that specific social and demographic characteristics are associated with each behavior pattern (table 4). These divergent characteristics may pose problems for health professionals who, for example, attempt to improve utilization of services. Since the two groups most likely to engage in inappropriate indirect risk behavior (young manual workers and poor elderly women) are very different from each other, very different strategies and programs may be needed to reach them.

Uncovering the dimensions of preventive health behavior and the differential behavior patterns of the population is merely a first step. More intriguing are the related questions, such as: Is preventive health behavior (or a person's behavior pattern) stable over time? What causes some people to engage in appropriate preventive health behavior? Why do some people behave more consistently than others? Is the tendency to act consistently or inconsistently in the area of preventive health behavior characteristic of a person's behavior in other areas of life? This study was not addressed to these questions, but it is hoped that the observations reported here will alert future researchers to the need for including a variety of dependent measures in their studies and for controlling for differential behavior patterns when testing the relationships between independent variables and preventive health behavior.

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Table 4. Social and demographic characteristics associated with four behavior patterns

Social and demographic characteristics	Indirect risk scale			
	Appropriate behavior		Inappropriate behavior	
	Appropriate direct risk (pattern A)	Inappropriate direct risk (pattern B)	Appropriate direct risk (pattern C)	Inappropriate direct risk (pattern D)
	(N=88)	(N=43)	(N=56)	(N=69)
Median age (years)	47.0	29.0	52.5	34.3
Percent female	65.9	51.2	71.4	55.1
Percent with 1 or more years of college	45.4	48.9	14.2	18.8
Percent in manual occupations	36.0	31.3	40.0	64.7
Percent with above-average per capita household income	51.8	56.4	35.3	28.1

NOTE: "Appropriate" indicates scores at or above the mean for the whole sample; "inappropriate" indicates scores below the sample mean; the intermediate groups have been deleted for clarity. Pattern A = consistently good preventive health behavior, pattern B = inconsistent behavior, pattern C = inconsistent behavior, and pattern D = consistently poor preventive health behavior.

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SYNOPSIS

LANGLIE, JEAN K. (Syracuse University): Interrelationships among preventive health behaviors: *A test of competing hypotheses. Public Health Reports, Vol. 94, May–June 1979, pp. 216–225.*

To explore the nature of preventive health behavior, a questionnaire was mailed to a probability sample of 383 adults in a midwestern urban area. Correlation analyses were used to test the hypotheses that preventive health behavior is (*a*) a unidimensional phenomenon, (*b*) composed of unrelated behaviors, or (*c*) multidimensional. On the basis of these analyses, the hypotheses of unidimensionality and of independence were rejected. The 11 behaviors that were then measured formed two clusters. One behavioral constellation, which included driving and pedestrian behavior, personal hygiene, and smoking behavior, was labeled "direct risk preventive health behavior," since inappropriate preventive health behavior in respect to these behaviors constitutes a direct health hazard. The second behavioral constellation, which was labeled "indirect risk preventive health behavior," included use of various preventive services as well as seat belt use, exercise, and nutrition. Failure to follow medical recommendations in these areas is generally not hazardous in and of itself.

An additional complexity in determining preventive health behavior is the propensity of some segments of the population to behave relatively consistently with respect to prevention, while others segments behave rather inconsistently. Among people with a consistent behavioral pattern, the direct risk and indirect risk dimensions of preventive health behavior were found to be positively related, but distinct from one another. The inverse correlation observed between direct and indirect risk preventive health behavior among the behaviorally inconsistent suggests that even within this group, preventive behaviors are not independent of one another.