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RACIAL ATTITUDES AS CORRELATES OF BLOOD PRESSURE:

THREE MULTIVARIATE TECHNIQUES

by
Beverly Johanna Beers

A dissertation submitted in partial fulfillment
of the requirements for the degree of
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ABSTRACT

RACIAL ATTITUDES AS CORRELATES OF BLOOD PRESSURE: THREE MULTIVARIATE TECHNIQUES

by

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The objectives of this research are both substantive and methodological: to examine associations between racial attitudes and blood pressure; and to compare associations indicated by three different methods of multivariate analysis.

Emotional stress caused by situations such as job or marital problems are included among the many variables suspected of being contributory factors in the etiology of hypertension. Racial attitudes are used in this thesis as one set of measures of socio-psychological stress which may be associated with either systolic or diastolic blood pressure, considered as indices of hypertension.

The three multivariate techniques included are step-wise regression analysis, factor analysis, and the new Dwyer-Kowalski or square root method which gives a step-wise selection of predictor variables. Regression and the square root method are compared for similarity of variables selected. These two methods are compared with factor analysis to see whether factors constructed by variable assignment by highest

loading are representative of dimensions indicated by single variable selection in the step-wise methods.

The racial attitude questions were taken from a survey of stress and heredity in black-white differences in blood pressure. Included are such measures as the respondent's experienced contact with members of the other race, desired contact, tenseness, fear or hate in interracial situations, perception of inequalities for blacks in rent and pay, opinions about civil disobedience and law enforcement in racial issues, and opinions about the future of race relations. An average of three blood pressure measurements obtained during the interview is used as the casual blood pressure reading.

The data are divided into sixteen analytic subgroups according to race, sex, age, and education. Within these subgroups step-wise regression analysis is done, with systolic and diastolic blood pressure regressed on the attitude measures. The same analysis is repeated with the square root method, and then with regressions on factor scores. For the latter analysis, the independent variables are factor scores obtained by factor analysis of the attitude variables.

The racial attitudes used in this study do not account for a major proportion of the variation in blood pressure. Yet as much as 34 per cent of the variance is explained using all of the variables. The blood pressure of whites is significantly predicted more often than that of blacks by the attitude variables, as is that of high education groups compared to those with low education. This is true for both systolic and

diastolic blood pressure. There is some indication that personal variables (contact, tenseness, etc.) are more often selected for women and social variables (perceived inequalities, future of race relations, etc.) are more often selected for men. More positive association between degree of prejudice and blood pressure level is found for blacks than for whites and for low education groups than for high education groups.

The variables selected by step-wise regression and the square root method are similar, and actually identical in all cases where significant prediction is obtained. The factor analyses result in factor scores which give significant prediction less often than step-wise regression on the original variables. One type of correspondence between factor analysis and the step-wise selection methods is found. Factor scores provide significant prediction in population subgroups where single variables provide significant prediction. Furthermore, among variables with highest loadings on factors yielding significant factor scores are those variables that are selected by the step-wise regressions. No correspondence is found between step-wise regression and factor analysis when all of the subgroups are considered rather than just those in which significant prediction is obtained.

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CHAPTER I

INTRODUCTION

Statement of the Problem.

One topic of considerable current interest is the investigation of relationships between hypertension and various predisposing factors. In many studies, attempts have been made to link incidence of coronary heart disease, hypertension, and other cardiovascular problems with different kinds of variables suspected of being contributory factors. The types of indices considered in these studies include, among others, general health-related indicators such as weight, smoking history, diet and exercise; family history of heart disease; socioeconomic and demographic variates such as race, sex, age, and social status; and personality and emotional stress indicators.

The intent of this thesis is to examine one aspect of this problem, the relationship of socio-psychological stress to hypertension. There are, of course, many different variables which could conceptually be used as indicators of stress; and there are different possible indices of hypertension that could be derived from the blood pressure measurements. For purposes of this research, we consider measures of attitude

relating to race relations as stress indicators and systolic and diastolic blood pressure as hypertension indicators.

The attitude variables examined include questionnaire items relating to an individual's experienced contact and willingness for contact with members of the other race, feelings of tenseness, fear, and hate in interracial situations. Also included are less personal items dealing with perception of inequalities in rent and pay for blacks, optimism about future race relations, opinions about civil rights and law enforcement.

It is assumed that individuals who express concern about these aspects of race relations are expressing their actual or potential responses to stressful situations based on interracial contact or fear of contact or personal experience with prejudice. Interracial contact or tenseness in interracial situations or the prejudicial responses one receives may cause psychological stress, as we are using the phrase, in terms of resultant fear or anger. We propose to investigate the relationships of psychological responses such as these to blood pressure levels.

The data used for this thesis are from a sample survey, to be described in the next chapter. For this survey, casual blood pressure readings were obtained as a simply measured, objective index of hypertension.

Relationships between these attitudinal questions and blood pressure level are examined and compared for demographic subgroups defined by race, sex, age, and education.

The general procedure utilizes a method of multivariate analysis which relates attitude variables to blood pressure level, within population subgroups.

For this investigation, twenty-four questionnaire items constructed as measures of attitude, and later combined into fourteen analysis variables, are considered. These items were not intended to measure twenty-four (or fourteen) distinct dimensions of attitude, but rather to get at several aspects of race relations attitudes in different ways. Based on the set of fourteen analysis variables, we would like to find a relatively small subset of items representing conceptually distinct aspects of attitude that can be related to blood pressure level. We will also seek statistical justification for any such conceptually defined dimensions in terms of clusters of highly intercorrelated variables. The analysis strategy is therefore based on the usual research plan when a large number of variables are involved, i.e. the reduction, by a technique based on correlations among the variables, of the total set of variables to a smaller subset.

The subset should be selected so that those items included can be nearly as effective in describing the relationship between stress (as measured here) and blood pressure level as the entire set of attitude variables. A more parsimonious description of the entire set of variables can be achieved through construction of a few new variables which represent combinations of the original set of variates, as well as by merely selecting a subset. In terms of prediction, as

opposed to selection of variables, reduction of the number of variables will result in reduction of the total variation in blood pressure that can be explained on the basis of the attitude variables. This will be described more fully in subsequent chapters.

The multivariate statistical techniques to be employed are general linear hypothesis analyses, including analysis of variance and step-wise regression, factor analysis, and a recently devised method for variable selection based on reduction to homogeneous form of the normal equations given by multiple linear regression. A secondary aim of this study is the comparison, for these various techniques, of the results obtained by each method of analysis.

It is hypothesized that relationships between attitudinal variables and blood pressure level will be found in these data, for analyses done within demographically defined subgroups of the sample. Those types of variables that are correlated with blood pressure may vary among these groups, according to various types of socio-psychological pressures that may be relatively important or unimportant for different groups. For example, fear about situations involving social contact with whites might be more threatening for older blacks than for younger blacks. Feelings of shame about the behavior of one's own race may provide more internal conflict for more educated whites than for less educated whites.

For any particular subgroup defined by race, sex, age, and educational level, it is hypothesized that the relevant

variables will be those attitudes that are likely to sustain some kind of psychological stress within the individual, and thus put him in a state of anxiety. The conflict may be, for example, in terms of an attitude about existing conditions that are not as he feels they should be, or may relate to his own attitudes about his relationships with members of the opposite race. Possibly the former will be more relevant for blacks and the latter for whites.

The nature of this investigation is exploratory, however, and the intent is to look for plausible hypotheses about associations between race relations attitudes and blood pressure which might be considered in future studies. Existing research on the subject of psychological stress and blood pressure does not provide well documented relationships which need only to be further substantiated by these data. The kinds of relationships found here may offer support to earlier studies as well as clues to hypotheses about relationships between other types of attitudinal variables and blood pressure.

Review of Hypertension Studies.

Differences in blood pressure.

The interest in the search for correlates of elevated blood pressure is heightened by the well documented variation in blood pressure levels among population subgroups defined demographically. Blood pressure varies by race, sex, and age, in consistent directions. Geographic and other differences in blood pressure distributions have been systematically reviewed by Epstein

and Eckoff (19).

Racial differences in blood pressures in the United States have been reported by several investigators. Examples of such studies can be found in Berkson, et al. (5), Johnson and Remington (37), Scotch and Geiger (61), Stamler et al. (68). For both sexes and for all age levels, blacks in the United States have higher levels of blood pressure than whites, higher rates of hypertensive heart disease, and higher mortality rates for cardiovascular renal diseases.

There is also evidence of large variation in blood pressure levels for various racial groups throughout the world. According to the review of Scotch and Geiger (61), elevated blood pressure is more common in Negroes in the western hemisphere and South Africa than in white and oriental populations. Lovell (45) finds relatively low rates of hypertension among population groups in Oceania, and also presents a lengthy bibliography of papers on the subject of racial differences in blood pressure.

Blood pressure is positively correlated with age. Winkelstein and Kantor (76) review findings on this, as well as the pattern of association of blood pressure with sex. Most of their tabulation is based on the Bøe, et al. (9) data for forty-four thousand individuals. These data show the usual pattern by sex and age: women have lower systolic blood pressures than men through middle age, and finally exceed them at older age levels, and average systolic blood pressure increases with age for both sexes. The same pattern

of sex and age effects occurs for diastolic blood pressure. The differences for diastolic pressure are very small, and increases with age, though substantiated, are less dramatic than for systolic blood pressure.

These race-sex-age differences bear on the consideration of attitudinal variables because of the interrelationships among these demographic variables and psycho-social types of variates. Race, sex, and age are social phenomena as well as biological variables. Due to race, sex, and age, an individual occupies a social position relative to others which, we assume, makes him subject to more or fewer psychological stresses than people in other categories, as well as to stresses which differ from those for people in other categories. By examining variation in blood pressure with attitude within these categories, we may be able to observe differences that would be obscured by looking at combined race, sex, and age groups.

The hypothesis that stress factors affect the relationship of blood pressure to these demographic variables is not implausible. For example, the relationship of blood pressure to age could be affected by some intervening socio-psychological factors that have not yet been uncovered, instead of being purely biological. Age itself is, in fact, a measure of length of exposure to the environment and, presumably, to stress. Ostfeld and Shekelle (53) suggest controlled field trials in which the experimental subjects are given jobs suited to their personal needs, treated for

emotional problems, and assisted in reducing stress factors in their lives, in an attempt to evaluate any resultant reduction in blood pressure. Comments relative to prospective studies such as those suggested by these two researchers will be made in Chapter V.

Epidemiology of hypertension. Reports of numerous investigations regarding possible factors associated with differences in hypertension have been published, suggesting both environmental and genetic relationships. Two fairly recent publications giving quite comprehensive reviews and documentation of current opinions on this subject are those by Stamler et al. (67) and Scotch and Geiger (61).

Heredity studies by Acheson and Fowler (1), Johnson et al. (36), Miall and Oldham (47), Chazan and Winkelstein (14), and Platt (57) have indicated positive correlations between blood pressures of relatives. As a measure of exposure to the same environment, Johnson and Remington (37) examined blood pressures of husband-wife pairs, controlling for age and length of marriage, and found no correlation. Borhani et al. (10) also found no husband-wife blood pressure relationship, controlling for duration of marriage.

These investigations provide possible hypotheses about factors related to hypertension, rather than conclusions. The serious problems of separating genetic and environmental factors, due to the tendency for genetically related people to share similar environments, are discussed both by Stamler

and Scotch and Geiger. The need for better controlled studies, looking at various possible causal or associated factors within and across genetically related groups, and similarly for unrelated groups, is obvious.

One factor which is related to one's environmental situation has been frequently looked at, with varied results. Studies relating coronary heart disease to socioeconomic status have quite contradictory results (Lehman, 44). Stamler et al. (68) find an inverse relationship between the occurrence of coronary heart disease and socioeconomic status; Scotch and Geiger (61) report evidence of positive correlation; and Berkson et al. (5) and Stamler (57) find no relationship.

Psychological factors which may relate to hypertension can be theoretically connected with genetic or environmental predisposition, or both. Attempts to establish social stress and psychological factors in the etiology of hypertension will be discussed in the next section. Just as the variation in blood pressure by race, sex, and age is relevant for the investigation of psychological variates of hypertension, so is the study phrased in terms of genetic and environmental hypotheses. Hypothetically, psychological variables such as those dealing with attitudes may be intervening variables between genetic and environmental factors and blood pressure. Another possibility is that psychological variates may interact with genetic or environmental variates to accentuate or mitigate effects on blood pressure.

Psychological factors in blood pressure. Recent comprehensive reports of research in the area of relationship of psychological variables to hypertension have been made by Scotch and Geiger (61) and McGinn, et al. (46). Extensive lists of references to earlier work are given in both of these publications, as well as in an article by Kasl and Cobb (39). Ostfeld and Shekelle (53) also briefly summarize the current state of knowledge, and conclude with the statement:

1) It is established beyond a reasonable doubt that acute psychological stress may initiate sudden and transient elevations of blood pressure in some persons.

2) It is not established that repetitive or continuous psychological stress leads to sustained elevation of blood pressure in anyone.

The first statement is also discussed and documented by McGinn, et al. (46) in terms of immediate response of blood pressure to stimuli provoking emotion, such as dreams, various kinds of music and sounds, and to stress provoked in situations like psychoanalysis. Studies reported in this same paper, which will be referred to in the analytical part of this thesis, report differential response in diastolic and systolic blood pressure. More response seems to be observed in diastolic than in systolic blood pressure readings. This is particularly true for anger and pain producing stimuli as opposed to situations intended to evoke fear. One of the studies mentioned in the same paper reported increases in systolic pressure evoked by fear.

Scotch and Geiger (61) and Mordkoff and Parsons (49; 54 references included) discuss theories and cite investigations relating to the idea that a "coronary personality type" exists. The supposed attributes are usually related to repressed aggression, hostility and anxiety, along with competitive success drives. Both articles point out the shortcomings of these studies. Most of the studies are made retrospectively on coronary patients, and it is not clear that these patients are representative of any known population or that the attitudes studied were not developed in response to the coronary episode. Scotch and Geiger (61) discuss the ambiguities in measurement of the supposed personality traits which make it difficult to provide for objective testing by independent investigators.

Three studies which may have some bearing on the relationships between stress and blood pressure, in terms of the present investigation, will be examined briefly. All of these studies use sampling and control methods that provide confidence in representativeness, which is in doubt in other work in this area. The first is a study by Scotch (62) of blood pressure among Zulus.

Just as we plan to examine variables within sociologically relevant race-sex-age-education groups, Scotch looked for correlates of blood pressure within two groups, rural and urban Zulus. Within each of these two groups, age, sex, obesity, and marital status (Currently married respondents had lower average blood pressure than others,

adjusted for age.) were clearly related to blood pressure level.

But, for example, for urban dwellers, individuals living in extended families were more likely to be hypertensive than those in nuclear families,[1] and blood pressure was positively correlated with number of children for urban (but not rural) Zulus. These types of relationships can conceivably be related to stress resulting from lack of adjustment to urban life, since the large, extended family that was so desirable for rural life could be a social and economic burden in the city. In any case, the differences in relevant variables in this study suggest that the investigation of possible stress factors should take into account various social and economic subgroups within a population.

The second piece of information comes from the Ostfeld and Shekelle article (53) mentioned earlier. The data are from the Western Electric Study (described by Paul, et al. (55)), which includes 2000 men aged 40 to 55, who are randomly selected employees in a large manufacturing plant.

Two groups were used, consisting of all men more than one standard deviation above or below the mean systolic and diastolic blood pressure. Matched pairs were made, controlling for age and arm girth. Minnesota Multiphasic Personality Inventory (MMPI) and Rorschach tests and the Cattell 16 Personality Factor Questionnaire were administered. These

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[1]The term "nuclear family" refers to a household consisting of father, mother, and children, in contrast to an "extended family," in which relatives such as grandparents, cousins, etc., are present.

tests include scales for measuring such concepts as Depression, Hysteria, etc. No significant differences in patterns of response to these tests were found between the two groups. The same type of testing was done to compare hypertensive ($\geqslant$ 160 systolic or 95 diastolic) and normotensive ($\leqslant$ 140 systolic and 90 diastolic) men among those with positive family histories of hypertension, and again no differences were apparent.

The third study is a recent investigation by Kasl and Cobb (39). Men who lose their jobs due to a permanent plant shutdown are followed through the phases of unemployment, temporary re-employment, and finally stability on a new job. Continuously employed men in comparable jobs constitute a control group. Several rounds of interviews, which included blood pressure measurements, were taken at 1, 4, 8, 12, and 24 months after loss of the job.

For the controls, no significant long term trends in blood pressure levels or pulse rates were observed. Although the relative order of blood pressure measures for men in the test group remained highly stable, 80% showed some decrease in blood pressure from the earlier to later periods. The decreases for both systolic and diastolic blood pressure were highly significant. The earliest period corresponded to job loss, and the last period to stabilization on new jobs.

The most interesting part of the data as far as this thesis is concerned has to do with the relationship of blood pressure level to an individual's perception of the problems

he had in getting through the unemployment period. Association between psychological stress caused by job loss and blood pressure level in the Kasl and Cobb data would support findings of association between stress (in terms of attitude variables) and blood pressure in the data under consideration in this thesis. Asked retrospectively how long it took for things to get back to normal, those reporting a quick return to normal showed large decreases in diastolic blood pressure. Systolic blood pressure was not related to this question.

Related questions and measures gave similar results. Men scoring high on psychological tests of ego strength showed decreases in diastolic blood pressure. The same was true for those who reported less irritation with the situation as the months progressed, and for those who reported increased self esteem. Men who reported at the end of two years that they had been relatively happy during the period of job loss did not show increases in diastolic pressure during the early anticipation period, as did the others. In all of these measures, systolic blood pressure changes were in the same direction as diastolic changes, but did not achieve statistical significance. This is interesting in view of the fact that the downward trend in blood pressure for all men in the test group was highly significant for both diastolic and systolic measures, and these two measurements are highly correlated. The authors offered no explanation for this. Perhaps the possibility of different contributing factors for systolic and diastolic blood pressure should be considered.

The total number of weeks unemployed was used as an objective measure of possible stress. This variable showed some association with blood pressure, nonsignificant for diastolic blood pressure and just significant for systolic pressure. There was no blood pressure variation associated with the respondent's financial situation.

Kasl and Cobb also report early findings on a similar study that was begun on a second company. Preliminary results agree with those from the first study. Again, the significant changes in blood pressure over time are in diastolic blood pressure, with systolic changes in a consistent direction but nonsignificant. The data presented by these authors are supported by the concurrent use of Goodman-Kruskal gamma tests of association and Kendall's Tau. The Goodman-Kruskal statistic measures, for two ordered characteristics, the extent to which one characteristic can be predicted from knowledge of the other. Kendall's Tau is also designed to measure the association between two traits, with a correction for ties.

Kasl and Cobb consistently find statistical significance more often for diastolic than for systolic blood pressure in their attempts to associate blood pressure with stress caused by job loss. The relative success in prediction of these two blood pressure measures in the data for this thesis will be examined and compared with the findings just discussed.

The only controlled experimental studies where attempts have been made to link stress with blood pressure are laboratory

experiments using monkeys and mice. Recent examples of this type of inquiry will be found in Forsyth (21, 22) and Henry (33). Several references to earlier work of this type are also included in the bibliography of the paper by McGinn, et al. (46). These experiments involved such methods as restraining monkeys physically and putting mice into crowded boxes. Although the sample sizes are small, significant increases in both diastolic and systolic pressure compared with the controls were observed.

The studies on animals are exploratory rather than conclusive, but some interesting tendencies were noted. Henry (33) found less severe blood pressure changes for animals who were subjected to the treatment situations from birth. Forsyth (22) found increases to occur only after several months of observation, and suggested this as a possible reason that earlier investigations (e.g. Forsyth, 21) had demonstrated no relationships. These types of observations, however tentative, may provide ideas for kinds of effects of stress to look for in humans.

Problems with hypertension studies. In many of the articles discussed and cited above, the need for prospective studies of factors related to hypertension is repeatedly emphasized. Lebovits et al. (43) point out two major drawbacks of retrospective studies important for the study of psychological factors:

1) Survivors of the illness may differ on variables being investigated, such as personality,

from those who die and thus are not included in the retrospective study.

2) The occurrence of illness may itself be associated with systematic changes in these variables among the survivors.

Although the study on which this thesis is based is not a long-term prospective study, it is a cross sectional study that is based on a random sample of individuals. The measure obtained as one predictor of coronary heart disease is a simple average of several blood pressure measurements obtained during an interview in the respondent's home. We are not comparing individuals with history of coronary heart disease or hypertension with other individuals.

Thus we do not systematically introduce comparisons that are likely to result in the two problems mentioned above. The first problem is relevant to the degree that those individuals who have died from heart disease (before age 54) are obviously excluded from the sample. The second problem may arise to the extent that living individuals with heart disease have blood pressure levels different from others.

Statistical Techniques.

Descriptions. As mentioned above, this investigation of the relationship of attitude variables to blood pressure level necessitates the use of multivariate methods of analysis. We seek a method which can provide for the simultaneous analysis of all the race relations attitude variables included in the questionnaire. This can be done either by selection

of a few variables which do nearly as good a job of explanation as the whole set, or by construction of indices which represent combinations of the original questions into important facets of attitude.

Some introductory remarks about each of these techniques to be used follow. An outline of the theoretical development of each type of analysis will be given in Chapter II, along with some more specific remarks about advantages and problems in using the various methods.

One major analytical technique used will be factor analysis. A basic comprehensive text is Harman (31). Theoretical developments and discussion are also given in Anderson (2), Lawley and Maxwell (42), and Morrison (50). Factor analysis is basically a method for analyzing a set of variables by constructing linear combinations of the original variables. These linear combinations of variables can then be viewed as indices which combine the information present in each of the individual variables into more comprehensive measures. Ideally the number of linear combinations necessary to describe the system will be somewhat smaller than the original number of variables.

As an alternative to use of the factor scores (the linear combinations) as indices, we can associate each variable with the factor on which its coefficient (loading) is highest. In this second procedure, factor analyzed data can provide clustering of individual variables into groups used as representatives of dimensions of the subject under study.

Examples of uses of factor analysis are numerous. The reader may wish to refer to some recently published ones by Bernstein and Allen (6) and Braun and Reynolds (13). In each of these studies, a factor analysis is done on a large number of items intended to measure fear. Through grouping of the items on the basis of factor loadings, the authors attempt to construct factors representing dimensions of feeling associated with fear.

Another interesting example is given by Berry and Rees (7). These authors describe the use of variables such as age distribution, urbanization, and family status. A factor analysis is used to investigate the pattern of ecological development for the area studied. Other examples, all related to the survey of attitudes, have been published recently by Gordon (26), Jenkins and Zyzanski (35), and Oskamp and Hartry (52).

The second major multivariate technique used is regression. Most elementary theoretical statistics books, e.g. Mood and Graybill (48), Dixon and Massey (17), contain an outline of regression theory. Comprehensive theoretical development is presented in Kendall and Stuart (40) and Graybill (27). The intent of regression analysis is to express a dependent variable, in this case systolic or diastolic blood pressure, as a linear combination of several independent variables, here the attitudinal measures. The main goal may be either prediction of the dependent variable using all of the independent variables or the selection of a few

of the independent variables as the most useful indicators, based on their relative importance in the regression equation. The goal of a form of regression known as step-wise regression is the selection of a subset of the original variables which explain as much of the significant variation in the dependent variable as could be explained using any set of the original variates.

Many examples of analysis with multiple regression are available. Wegner and Sewell (72) used this method to investigate factors such as intelligence, socioeconomic status, and type of college attended as predictors of the probability of college graduation. O'Lessker (51), by means of step-wise regression, used the changes in voter turnout and changes in vote totals for major political parties to try to determine the origin of support for Hitler. Two other examples using socioeconomic variables such as occupational and educational level as predictors are the studies by Hodge and Treman (34) and Gockel (24).

A third technique, related to regression, is a method for selection of variables devised by Dwyer and Kowalski (18). This method is used to reduce the normal equations given by multiple regression to homogeneous form. As in regression analysis, the objective is to express a dependent variable as a linear combination of several predictor variables. Dwyer and Kowalski stress the goal of parsimony or reduction of the number of variables considered more than the goal of prediction using all the available variates.

All of these methods rely on analysis of the input variables in terms of their correlation matrix. Factor analysis can be used to provide sets of variables which are more highly correlated within sets (factors) than across sets. Regression analysis and the technique due to Dwyer and Kowalski, subsequently referred to as the square root method, will select variables that are correlated with the dependent variable but not highly related to each other.

Comparisons. In order to compare the results obtained by these alternative statistical techniques, we will look particularly at cases where significant prediction is obtained. Comparing step-wise regression with the square root method, we can simply see whether the same variables are selected for prediction and whether they are selected in the same order.

For comparing step-wise regression or the square root method with factor analysis, we will consider the variables selected by the first two methods in relation to the factor scores giving significant blood pressure prediction. The optimal situation, as far as similarity between these methods, occurs when a significant factor score includes as one of its components, with a relatively high loading, a variable which is selected in the step-wise regression as a significant predictor. By evaluating the extent to which this criterion is met, therefore, we have a means of measuring the agreement of results obtained by the three methods.

The basis for the comparison described above is the idea of using multivariate methods to reduce a large number

of variables to a more parsimonious number while at the same time retaining most of the information contained in the entire set. If step-wise regression or the square root method using single variables (as opposed to factor scores) is to obtain this objective, the selected variables must be considered as representing groups or sets of variables. That is, variables not formally included in the prediction equation may be effectively included by their correlations with the variables that are included. The criterion we have established here will help determine whether the variable sets selected as predictors of blood pressure are similar for step-wise regression on the single variables and regressions on factor scores.

In the following chapters, the step-wise regressions for systolic and diastolic blood pressure on the original analysis variables will be referred to as the "single variable" (or "single variate") regressions. The regressions in which we predict blood pressure using the factor scores as independent variables will be denoted as the "factor score" regressions. The demographic categories established by divisions on the basis of race, sex, age, and education will be called "groups" or "subgroups." The clusters of variables utilized will be referred to as "sets."

CHAPTER II

DESCRIPTION OF DATA AND METHODS

The Stress-Heredity Study.

Objectives. The data used in this thesis are part of a large study which attempts to consider genetic factors in blood pressure as well as several measures of environmental influences.[1] This study of stress and heredity differences in blood pressure was undertaken for several reasons. Most studies on the subject have considered only one type of factor at a time, e.g. sociological or demographic position, personality, or heredity. There has been little attempt to assess the relative importance of these kinds of variables in terms of differences in blood pressure. Need for a study which would permit a comprehensive examination of all of these variables simultaneously is evident.

The authors of many of the articles reviewed in Chapter I also make clear the need for a study based on survey sampling techniques, using comparable criteria and methods to measure heart disease and related variables. Several studies have utilized reported death rates from heart disease, where certification may vary by such factors as race

[1]Stress and Heredity in Negro-White Blood Pressure Differences. CD-00209-01-04. U.S. Public Health Service and Michigan Heart Association.

or residence, and over time. Others have used hospital populations, which cannot be assumed to be representative of the general population. Comparisons made among individuals living with heart disease at a given point in time are problematic due to differences in medical care and hence in survival rates for different economic and racial subgroups.

The stress-heredity study investigators, in order to avoid some of these problems, used survey sampling methods. Blood pressure was taken as one precursor of possible future heart disease. The survey and interview methods will be discussed in the immediately following sections.

One of the first objectives of the stress-heredity study was to devise a single study design that would permit the simultaneous investigation of several types of variables, both genetic and environmental. Although this particular study was concerned with blood pressure, a design was sought that would be useful as a prototype in studies of other populations and other diseases or conditions. The second major objective was to examine the relationships of social and psychological stress and genetic factors to blood pressure levels and variability.

Survey design. A sample survey which would give statistical justification for generalization to larger groups of people and provide an adequate number of subjects for analysis was used. From city records measuring the general socioeconomic level, crime rate, rates of residential crowding

and family breakdown, all census tracts in Detroit were ranked by degree of "ecological stress." This was done separately for predominantly black and predominantly white tracts. Ecological stress was defined by factor scores obtained from a factor analysis of the rates (crime, etc.) for all of the census areas in the city. The four tracts included in the survey were selected from the upper and lower quartiles of the ranked factor scores for each racial set. Two predominantly black tracts and two predominantly white were selected, a "low" stress tract and a "high" stress tract for each racially defined group. All sampling was then done within these four tracts.

In each of the four tracts, a census of all households was taken to obtain a complete listing of all persons who were married, aged 30 to 54, and who had, potentially, a "family set," defined as follows. A "family set" consists of an index case, his spouse, a sibling and a cousin both within 5 years of age of the index case and living in Detroit, and an unrelated person (control). Within each of the tracts, a random sample was taken from the list of all such potential index cases to obtain family sets to be interviewed. Individuals who turned out to have incomplete family sets were returned to the pool of potential cases and could be used only as controls. In all about 2500 individuals were actually interviewed. Over 2300 of these belonged to complete family sets (with all 5 members interviewed). The respondents comprised about 460 complete family sets, with

roughly equal numbers obtained from each of the four census tracts.

A pilot survey was done both to test the interview questions and to investigate the feasibility of the study design, in terms of probable success in obtaining enough family sets for analysis. Reports of this survey are given by Harburg et al. (29) and Schull, et al. (60).

Interview. During July, August, and September of 1968, a team of about 20 nurses was recruited and trained. Interviewing was done from October, 1968, through June, 1969, for about 2500 individuals. The interviewing was carried out by the nurses at the homes of the respondents. Respondents and interviewers were matched by race. Each member of a family set was given an interview approximately an hour and a half in length, except for spouses, who were given an interview which consisted roughly of the first half hour of the full interview.

Personal stress of the respondent was measured by questions related to job satisfaction, marital and family relations, early family life, neighborhood living conditions, race relations, emotional responses to interpersonal and social relations, and self-esteem. A brief medical history provided information on health risk factors whose relationship to blood pressure level had been suggested by earlier studies. These included age, smoking history, level of physical activity, family cardiovascular disease history,

cardiac awareness, height, present and highest weight, and use of medical resources.

The scope of this thesis did not permit the simultaneous examination of all of the stress measures. Only the questions related to race relations were used for this research. Since racial conflict has recently been a widespread issue of concern and discussion, these questions were thought to be ones that would reflect a large amount of variation in attitudes that are assumed to be stress producing for many individuals. These are the independent variables used as measures of stress.

Three blood pressure readings were obtained by the nurse-interviewers during the first half hour and two more during the last ten minutes. These readings included pulse rate as well as systolic and diastolic measurements. During the interval in which the first three measurements were taken, the medical history was obtained. The last two blood pressure measurements were not taken until the end of the interview when questions related to many areas of personal stress had been asked.

The first three measurements were assumed on this basis to be those most free of disturbing effects of the interview experience itself and, therefore, most representative of casual blood pressure readings. The averages of the first three readings for diastolic blood pressure and for systolic blood pressure provided the measures of blood pressure level used as dependent variables in this research.

Organization and Manipulation of Data.

Selection of sample. For this thesis, only a portion of the total interview respondents were included. Each complete family set from the original study consisted of an index case, spouse, sibling, cousin, and control, described and selected as in the preceding discussion. For several reasons, a subpopulation consisting only of index cases and controls was used for this research.

The original purpose for the design of the stress-heredity study in terms of family sets was to provide data for the investigation of the relationship between blood pressure variability and various measures of genetic relationship. However, this thesis includes no consideration of genetic variables. The focus is on racial attitudinal variables as indicators of personal stress which may be related to blood pressure. An individual's position in his family set is not a factor under consideration, and thus it is not useful, in terms of the objectives of this thesis, to maintain the family set as a unit of analysis. Spouses could not be included in any case, since they did not complete that part of the interview dealing with the race relations questions.

Index cases and controls were both part of the original random sample of the study. Individuals selected at random were assigned to the position of index case or control on the basis of availability of other members to complete the family set. Thus the group of all index cases and controls provides a random sample from the eligible respondents, i.e., a

set whose members can be treated as individuals in terms of statistical analysis of their attributes. All the available subjects from the study, including spouses, siblings, and cousins, however, decidedly do not form a random sample, for purposes of investigations using the individual rather than the family set, as the basic unit of analysis. Statistically, therefore, the observation of index cases and controls only is more useful in providing substantive implications for the population from which the subjects were selected.

Selection of variables. The second decision to be made regarding limitation of the investigation was the choice of variables to be used for this research, from several hundred questionnaire items on the interviews. Preliminary tabulations indicated that those questions dealing with one's attitudes toward race relations and toward individuals of the other race, and experienced contact with members of the other race, were relatively complete. There appeared to be no major problems in terms of coding errors or large numbers of nonascertained responses.

This particular set of questions coincided with the present author's interest in possible effects of psychologically and sociologically related attitudes on manifestations of an individual's physical health, such as blood pressure level. The possibility that psychological variables may be causally related to other factors influencing blood pressure, such as age, makes the study of such factors important in the whole context of the epidemiology of hypertension. Some

recent studies dealing with attempts to link psychological variables with blood pressure, and some problems of such studies, are discussed in Chapter I.

The interest in the comparison of several analytical techniques was also one of the determinants in choice of a data subset. The major statistical techniques of interest here are factor analysis and regression analysis. Both techniques are commonly used on attitudinal type data. Therefore, this set of questionnaire items constitutes a useful and appropriate type of data in which to assess comparability of various analysis methods.

For the above reasons, a set of twenty-four interview items dealing with attitudes about race relations was chosen. A complete list of the actual interview questions and response alternatives can be found in Appendix I, part A.

Nonascertained responses. For any study, questions which respondents have refused to answer, or which for any reason have not been recorded, can be serious problems, if many observations are missing, or if there is any suspicion that the omissions are not random. Fortunately, this investigation does not present any serious nonresponse problems. The highest percentage of missing observations for any single question is 2%; the average for all questions is .4%. Details of the distribution of missing observations are given in Appendix I, part B.

On this basis, the choice of a method for handling individuals who failed to answer some questions is relatively

unimportant. Five individuals who did not answer any of the questions, or failed to answer several questions, were not included. In the remaining cases, each missing value was replaced with the response most common for all other individuals within the relevant subgroup. (Subgroups will be discussed shortly.)

The averages of the first three systolic and diastolic blood pressure measures were used as the two dependent variables for the analyses. Of the 1004 subjects, recordings for the first diastolic blood pressure reading were not ascertained for two respondents. For these two individuals, the two recorded measures were averaged. All other necessary blood pressure data were complete.

Construction of analysis variables. The list of original questions and responses as presented to the respondents during the interviews is found in Appendix I, part A. The same questions were asked of both black and white respondents, with wording changes as indicated. For several reasons, it was decided to combine several of the original variables to create a smaller set of variables to use for the actual analysis. The list of combined variables, their sources, and the final list of 14 variables used for analysis, are also given in Appendix I, part C.

Combining variables into a scale representing feelings within a particular area of race relations concern has the effect of providing an analysis variable which may be a more accurate indication of an individual's strength of

feelings about a particular subject than a simple agreement-disagreement answer to one item. Discussions of scaling can be found in Selltiz, et al. (63), Peak (56), and Francis (23).

One example of this scaling procedure is as follows. Items thirteen and seventeen from the original interview are as follows:

13) "Many times Negroes (whites) are so unreasonable I really wonder if I want more integration with them."

0) Disagree 1) Agree

17) "Sometimes I hate Negro (white) people."

0) Disagree 1) Agree

These two items were combined into one analysis variable intended to measure the strength of an individual's feelings of antagonism toward members of the other race. The new variable (variable number 9 of the analysis variables) is coded as follows:

0) Disagree with both items 13 and 17.
1) Agree with either item 13 or item 17.
2) Agree with both items 13 and 17.

A second purpose for combining variables in this way is to normalize the distribution of the analysis variables. Authors such as Box and Watson (11) have investigated the robustness of regression techniques to non-normality, and present some evidence that the sensitivity to non-normality in the dependent variable is determined by the extent of non-normality of the independent variables.

The effects of serious departures from normality are reflected in the distribution of R, the sample multiple correlation coefficient, which determines the value of the F-statistic for testing for significance of the regression coefficients. These same authors state that independent variates whose values are much different in magnitude than others may also cause greater sensitivity to non-normality. Thus we wanted to combine variables into scales in such a way as to create a set of analysis variables with similar magnitudes of values and with distributions approximating the normal shape.

The general procedure, then, was to consider sets of two or three variables, mostly dichotomous items, which were assumed by the author to be conceptually related. Response distributions for proposed analysis variables constructed from these sets were examined for approximate normality. The proposed analysis variables were coded in such a way as to keep all variables of similar magnitude.

Because of the extreme difference in distribution of responses for blacks and whites on most items, and because most of the analyses were to be done within these groups, the distribution of proposed analysis variables was observed for blacks and whites separately. In fact, the distributions within race were usually similar in shape, with the distribution for whites shifted toward higher codes (indicating greater prejudice). The item combinations were then made identically for both races on the basis of the observed distributions.

Combination of the 24 original variables resulted in 14 variables used for analysis. Using the same variables described on page 32, for example, we have the following spread of responses for the original and combined variables:

		Blacks		Whites	
		N	%	N	%
Item 13					
Negroes (whites) unreasonable	No	244	48.3	174	35.9
	Yes	261	51.7	311	64.1
Item 17					
Hate Negroes (whites)	No	375	74.3	348	71.8
	Yes	130	25.7	137	28.2
Item 9					
(combined)	No; No	194	38.4	133	27.4
	Mixed	231	45.7	256	52.8
	Yes; Yes	80	15.8	96	19.8

Most variable combinations were made similarly to the one described in the preceding paragraph. There was one set of questions, original items 2-5, which was designed as a Guttman scale type of measure. A description of Guttman scaling can be found in Appendix I, part D. Theoretically, i.e., conceptually, these questions are ordered in terms of increased willingness for interracial contact and therefore increased probability of refusal. To be consistent, an individual must answer "yes" to all questions until he first replies "no," after which all remaining responses must be negative. These four questions were combined into one, representing the point at which response became negative. This was done after tabulation of all combinations of possible

responses indicated a very high degree of consistency. The reader should refer to Appendix I, part D, for this tabulation and its interpretation, noting the difference in order of responses for blacks and whites.

Specific discussion of the Guttman scale technique, often used as a measure of social distance with respect to some ethnic or racial group of people, will be found in Selltiz et al. (63, p. 366 ff.). Construction of this type of scale, also called a cumulated scale, is contrasted with Likert, or summated scales, which are similar to the variable scaling mentioned in the first part of this section.

An alternative to scale construction on the basis of conceptual relationships among variables is the combination of variables that are related statistically, i.e. highly correlated. This could be done by examining the correlation matrices or by a procedure such as factor analysis. Factor analysis would give linear combinations (factor scores) of the variables which could then be used as analysis variables.

Some of the problems of interpretation of factors as conceptual dimensions on the basis of one factor analysis are mentioned in Chapter IV. In addition, factors are constructed to be independent. We wanted to establish variables to be used singly in regression analysis and in regressions on factor scores computed from the same variables, in order to compare these two methods of analysis. By creating analysis variates on the basis of factor scores, we would be creating a set of already independent variables to use in

regression analysis. This would preclude the consideration of variables selected in regression as representatives of highly correlated sets of variables, and would thus interfere with regression-factor analysis comparisons.

Another reason for combining variables in this study is to obtain a balance of number of subjects with number of variables for analysis purposes. In the next section, the splitting of the total sample, 1004 subjects, into 16 subgroups, is explained. The resulting sample size is about 60 for each group, and much of the analyses are done within these groups. Using all 24 of the original variables with the chosen breakdown of subjects into demographic subgroups would have resulted in a very high ratio of variables to subjects. The expected value of R^2, the squared multiple correlation coefficient, which represents the percent of variance explained by the regression, is closely related to the ratio of variables to subjects. It has been shown (77) that R^2 approaches 1 as the number of variables approaches the number of subjects, even when $\overline{R}$, the population correlation coefficient, equals zero. Thus considering a much smaller number of variables will help reduce the inflation of the R^2 due to its dependence on the subject-variable ratio.

Construction of subgroups. The total sample was divided into sixteen subgroups, defined demographically, and most of the analyses are done within these groups. Each of the four variables race, sex, age, and education is used to define an individual's group membership. There were two major research

objectives in the plan for this thesis that suggested the division of subjects into several groups. The first concerns the substantive aspect of the investigation, and the second is methodological.

A major factor which led to the division of the subjects into groups was the interest in the demographic variables race, age, and sex. As discussed in the introduction, several studies (9, 61, 68, 76) have indicated that these variables have significant effects on blood pressure level. Examination of these variables will help us establish consistency of these data with earlier studies and thus increase our confidence in the reliability of the measurement of blood pressure.

Because of the relationships between attitudes indicative of prejudice and different measures of social status (75, p. 55 ff.; 8, p. 35 ff.) and because of suspected relationships between status and blood pressure level (see Chapter I), education, considered a measure of social status, was also used for subgroup definition. Originally the Duncan socio-economic scale, which takes both income and education into account, was used, but this was later dropped in favor of a direct measure of education, the number of grades completed.

The Duncan scale is based on a nationwide sample from the 1950 census, and its currentness and applicability to this particular sample are unclear. Bradburn (12, p. 191) presents some data which show that, although the Duncan scale provides a clear distinction between professionals and skilled laborers, the status of occupations in the middle is not so well defined. The Duncan score for many blue-collar

craftsmen is the same as for many white-collar clerical workers, though their life styles are likely to be quite different. Furthermore, tabulations done on the present data before the Duncan scale was omitted did not indicate any pattern of differences in regressions done within status groups compared to randomly selected (i.e., ignoring the Duncan scale score) groups of comparable size, either in terms of total variation explained or in terms of variable selection. In view of these limitations, we selected level of education as the fourth descriptor. This variable correlates highly with social status by any of the usual measures and has also been correlated with attitudes toward race relations by Williams, (75, p. 55 ff).

Studies such as those by Scotch (62) indicate that for individuals in different social groups, the variables significantly related to blood pressure level can be quite different for different social groups. Since race, sex, age, and education are considered important determinants of social position in the population studied here, we would like to know whether membership in a particular one of these groups determines which attitudinal variables are the most important predictors of blood pressure level for an individual. To do this we can consider an analysis such as regression of blood pressure on attitudinal variables within groups defined by the above demographic variables.

An alternative way to measure the effect of race, sex, age, and education on blood pressure level would be to include

these variables as regressors along with the attitudinal variables in the regression equations. But, as discussed in Chapter I and also in this section (see above), it is firmly established that race, sex, and age are related to blood pressure level. The studies on psychological relationships show no such clear indications. Thus it is anticipated that the predictive capability of race, sex, and age is likely to be greater than that of any of the attitude variables. In regression equations of this type, these three demographic variables would undoubtedly account for most of the significant explained variation in blood pressure, giving little information regarding the attitude variables. For purposes of substantive interpretation of results, therefore, we will utilize separate demographic subgroups for analysis.

The second major objective of this research, along with the substantive content issue of relating race relations attitudes to blood pressure, is a methodological one: specifically, the examination and comparison of three statistical techniques. The main question of interest is the extent of similarity of factor analysis, regression analysis, and the square root method in terms of selection of variables, or combinations of variables, as predictors of blood pressure level. We would like to know whether these methods lead to similar conclusions about which, if any, of the race relations questions are correlates of blood pressure. Evaluation of the similarity between methods will be made as described in Chapter I.

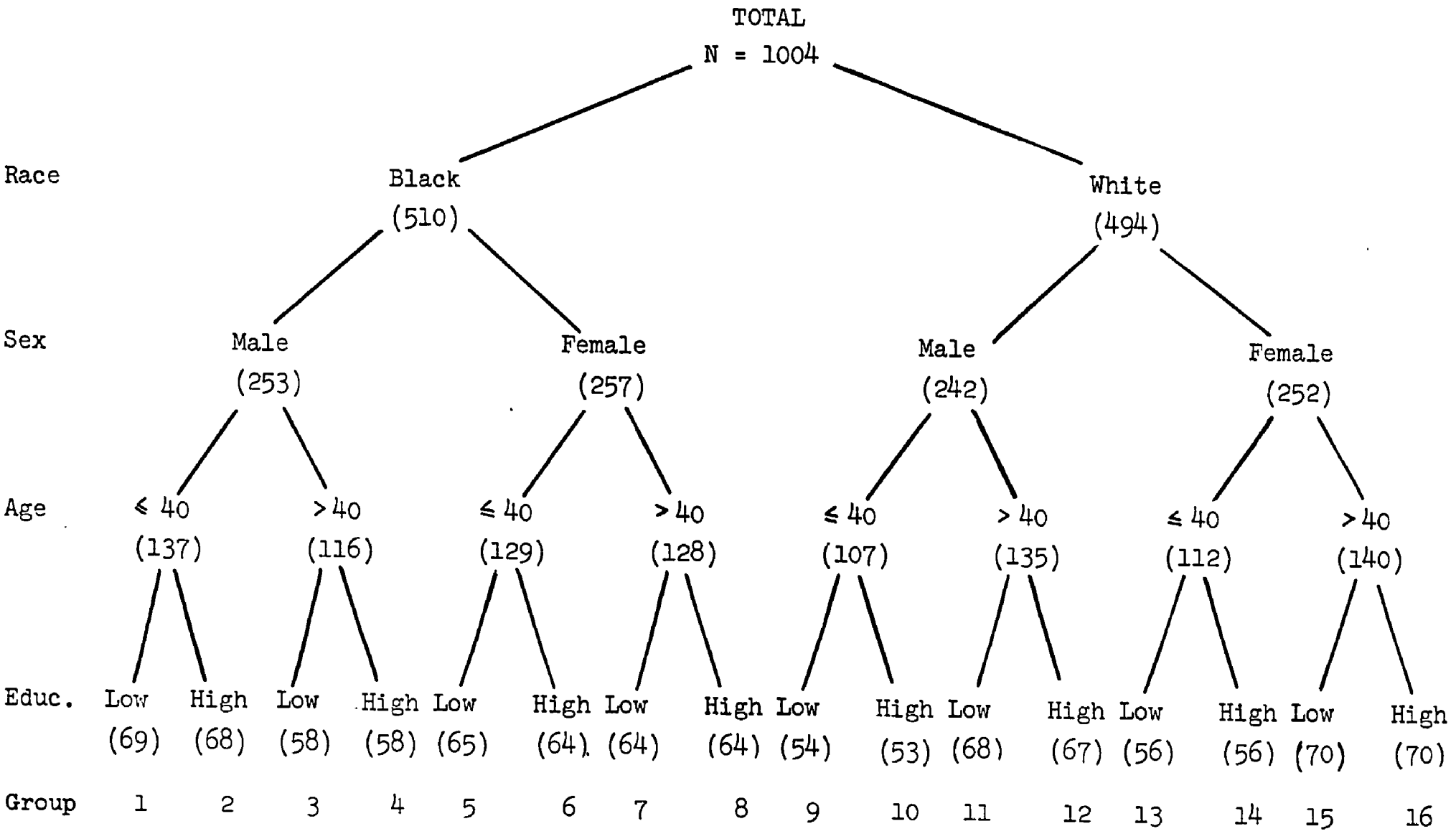
These three analytical methods, therefore, are to be repeated on the same set of data and results then compared. Division of the total sample into subgroups gives us a set of replicates, so that this comparison can be repeated several times. Thus we can examine not only the similarity of the statistical methods considered, but the consistency of the results of this comparison among several sets of data.

Figure 1 on page 41 illustrates the subgroup composition. The mean age and education for each of the resulting sixteen subgroups is given in Appendix I, part E. Actual grouping of the 1004 subjects was made as follows. First, subjects were divided into four groups, defined by race and sex. The age distribution in each of these four groups was tabulated. One objective was to subdivide each of the four race-sex groups into two age groups, in such a way as to maintain fairly equal numbers in the resulting eight groups. Simultaneously we wished to make an age split that we could assume represents some conceptual division between "young" and "middle-aged" in modern American society. The split into 40 years old or younger and over 40 seemed to meet both of these criteria fairly well. Except for a few individuals, the range of age for all subjects is from 30 to 54, so that this age categorization results in an age span of 10-15 years for each group.

Each of the resulting eight race-sex-age groups was then ordered by years of school completed and divided in half into an upper and lower educational group. The split here

FIGURE 1

CONSTRUCTION OF DEMOGRAPHIC SUBGROUPS ACCORDING TO RACE, SEX, AGE, AND EDUCATION VARIABLES



could not be made easily at a uniform level without seriously imbalancing the sample sizes for each group. In six cases the halfway point fell in the middle of those respondents completing twelfth grade, and in two cases it was in the group completing eleven grades. Members at the educational level including the median for each race-sex-age group were randomly assigned to upper and lower groups in the correct proportion required to get equal sample sizes in the two groups.

Theoretical Statistical Models.

Regression model. The general outline of the following discussion comes from Mood and Graybill (48, Chapter 13). A simple regression model is defined by the following equation:

$$y_i = \alpha + \beta x_i + e_i, \; i = 1, \ldots, n.$$

Here, $y_1, y_2, \ldots, y_n$ are n uncorrelated observable random variables (the so-called dependent variables), α and β are unknown parameters, $x_1, x_2, \ldots, x_n$ are mathematical (i.e., nonrandom) observable variables (independent), and the e_i are uncorrelated, unobservable random variables with mean 0 and variance σ^2, such that σ^2 is independent of α, β, and x_i.

As is usual for any statistical model, since we are concerned with sample data, it is necessary to estimate the parameters α and β. Using the least squares criteria, we will take as $\hat{\alpha}$ and $\hat{\beta}$, the estimators of α and β, the functions of y_i and x_i that minimize the sum of squares of the errors, $\sum_{i=1}^{n} e_i^2$. Minimization of this quantity gives

the estimates

$$\hat{\alpha} = \bar{y} - \hat{\beta}\,\bar{x} \quad \text{and} \quad \hat{\beta} = \frac{\sum_{i=1}^{n}(y_i - \bar{y})(x_i - \bar{x})}{\sum_{i=1}^{n}(x - \bar{x})^2},$$

where $\bar{y} = \sum_{i=1}^{n} y_i/n$ and $\bar{x} = \sum_{i=1}^{n} x_i/n$, i.e., the sample means.

It can be shown (73, p. 283 ff.) that among the class of linear unbiased estimators, the least squares estimators of α and β are the best linear unbiased estimators, i.e., their variances are smaller than those of any other linear unbiased estimators of α and β . In addition, in case the random variable y is normally distributed for a given x value, the method of maximum likelihood estimation gives estimates of α and β coinciding with the above estimates.

The above mentioned normality is one of the assumptions required in the theory established for the derivation of statistical tests of the appropriateness of the regression model. The most common hypothesis to be tested is that the y_i are actually linear functions of the x_i. The hypothesis is accepted on the basis of statistical rejection of the hypothesis that $\beta = 0$, which is based on an F-test, which is appropriate under certain assumed conditions. Robustness of this test, mentioned on page 32, is investigated by Box and Watson (11). As discussed in Hays (32, p. 509 ff.), this model can be used as a descriptive tool to ascertain whether certain kinds of variables tend to go together, whether or not

the assumptions necessary for an actual statistical hypothesis test are met. Having estimated α and β, we can use the regression equation to predict or approximate the expected value of y for a given x value.

In general, the applications of regression to much data of interest, for example sociological data, are based on the simultaneous measurement of several x-type or independent variables, on the basis of which prediction of the y or dependent variable is to be made. This leads to the generalized version of the above regression model, the general linear hypothesis model.

Under this model, y is hypothesized to be a linear function of several x variables at once; the model is written as follows:

$$y_i = \sum_{j=1}^{p} \beta_j x_{ij} + e_i, \quad i = 1, \ldots, n, \quad j = 1, \ldots, p.$$

Here, again, the y_i are independently observed random variables, the β_j are unknown constants, the x_{ij} are known variables (not random), and the e_i are uncorrelated, unobservable variables with mean 0 and variance σ^2.

The number of subjects here is n and the number of independent (sometimes called predictor) variables is p. Therefore x_{ij} represents the value of the jth independent variable observed on subject i. The above model represents the y observation for the ith subject; the entire set can be represented in matrix notation as

$$Y = X\beta + e.$$

The values in the β vector are referred to as the regression coefficients.

As in the simple regression case, the method of least squares is used to obtain estimates of β . The least squares estimate, in matrix notation, which again corresponds to the maximum likelihood estimate, given normality, is

$$\hat{\beta} = (X'X)^{-1} X'Y,$$

where

$$Y = \begin{bmatrix} y_1 \\ y_2 \\ \vdots \\ y_n \end{bmatrix}, \quad X = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1p} \\ x_{21} & x_{22} & \cdots & x_{2p} \\ \vdots & & & \vdots \\ x_{n1} & x_{n2} & & x_{np} \end{bmatrix}, \quad \text{and} \quad \hat{\beta} = \begin{bmatrix} \beta_1 \\ \beta_2 \\ \vdots \\ \beta_p \end{bmatrix}.$$

Again, under the above assumptions included in the model, this estimate is the best linear unbiased estimate of β . And, as in the simple case, under these assumptions, statistical tests can be derived for hypotheses about the β's.

When the $\hat{\beta}_j$, the estimated values of the β_j, are put into the original model equation, to replace the unknown parameters β_j, we have

$$\hat{y}_i = \sum_{j=1}^{p} \hat{\beta}_j x_{ij} + e_i, \; i = 1,\ldots, n, \; j = 1,\ldots,p.$$

The $\hat{y}_i$ are the predicted values of the y_i's, and the correlation of the $\hat{y}_i$ with the observed y values is referred to as the multiple (sample) correlation coefficient, R, which estimates $\bar{R}$, the corresponding unknown population value.

The population variance among the dependent variables is denoted σ_y^2, and the variance given X, $\sigma_{y.x}^2$. The difference between these represents the decrease in the variance σ_y^2 due to the use of the x variates as predictors. An important result (41, p. 91) is:

$$\sigma_{y.x}^2 = (1 - \bar{R}^2) \cdot \sigma_y^2 ,$$

which reduces to

$$\bar{R}^2 = \frac{\sigma_y^2 - \sigma_{y.x}^2}{\sigma_y^2} .$$

Thus $\bar{R}^2$ represents the proportion of the variance of Y which is attributable to the regression relation with X. The estimation of $\bar{R}$, denoted R, and R^2, will be considered in the following chapters.

For data such as that involved in this thesis, we are not merely concerned with the R^2, or the proportion of variance in blood pressure which can be explained by using all of the attitudinal variables. We are interested in seeing whether a few of the variables are quite a bit more important than the others in terms of explaining the variation in blood pressure.

The technique known as step-wise regression is designed to order variables in these terms. Based on the above multiple regression model, this technique attempts to select variables from the set of independent variables in order of magnitude of their contribution to R^2, the explained variance. First, a regression equation is estimated using the single

independent variable which gives the highest R^2. For the first step, this corresponds to the independent variable most highly correlated with the dependent variable. Next, a second regression is estimated using the first variable chosen plus a second one. In the particular computer program used for this research, the second variable is the one, of those remaining, whose addition will increase R^2 more than the addition of any other variable. This process is continued until the addition of any more variables has an arbitrarily small effect on R^2.

Step-wise regression thus gives an ordering of the independent variables which is to some extent a measure of their importance for prediction of the dependent variable. Because of the inter-correlations among independent variables, the addition of a new independent variable can reshuffle priorities among those variables already included, and it is possible for a variable to be removed from the equation. The increase in R^2, though tending to decrease as more variables are added, can increase in some cases, due to this same inter-correlation problem. The computational method designed by Dwyer and Kowalski (18), which will be mentioned shortly, is designed to handle some of these problems raised by step-wise regression for variable selection.

Theoretically, the best way to proceed might be to search for the best set of predictor variables of a given size, by comparing regressions on all possible subsets of variables of that size, from a larger set of variables. Some attempts

have been made to devise algorithms for this kind of problem (4, 59), but simple and feasible programs are not available now.

Step-wise regression is one of the main analytical techniques used in this thesis (see Chapters III and IV for the complete discussion of analysis). In general, the increase in R^2 due to adding a variable, as well as its order of selection, is used as a measure of its importance, relative to the other independent variables.

The form of the above model equations makes the dependent variable a linear function of the independent variables. When significant linear prediction is not obtained using this model, or when experience suggests that a linear model is inappropriate, other functions of the independent variables are sometimes used. For example, instead of

$$y_i = \alpha + \beta x_i + e_i \quad ,$$

we might consider the model

$$y_i = \alpha + \beta x_i^2 + e_i \quad .$$

Such alternatives to the linear model are not used in this thesis.

Factor analysis model. Factor analysis, the second basic analytic technique used in this thesis, is a method of analysis that was designed to handle multivariate observations, i.e., it is not a generalization of a simple bivariate model. The following discussion comes mostly from Morrison (50,

Chapter 8). The basic factor analysis model can be written as follows:

$$\begin{aligned} X_1 &= \lambda_{11} Y_1 + \cdots + \lambda_{1m} Y_m + e_1 \\ &\vdots \\ X_n &= \lambda_{n1} Y_1 + \cdots + \lambda_{nm} Y_m + e_n \ . \end{aligned}$$

This is, in matrix notation,

$$x = \Lambda y + \varepsilon \quad ,$$

where

$$x' = [X_1, \ldots, X_n]; \quad y' = [Y_1, \ldots, Y_m]; \quad \varepsilon' = [e_1, \ldots, e_n];$$

and

$$\Lambda = \begin{bmatrix} \lambda_{11} & \cdots & \lambda_{1m} \\ \vdots & & \\ \lambda_{n1} & \cdots & \lambda_{nm} \end{bmatrix}$$

In the above equations, $x_1, \ldots, x_n$ represent the n observed random variables. Because it is the covariance structure that is of interest, the means of the x_i are unimportant and are assumed to be 0. The model assumes that all n variables can be expressed as linear combinations of the same m variables, the Y's, which are referred to as factors. The λ_{ij} are referred to as factor loadings, their size representing the importance of any particular factor Y_j in the determination of any X_i. The e_i represent that part of the x_i which are not linear combinations of the Y_j.

The Y_j's are assumed to be independently distributed N(0,1), as are the e_i's, and the y and e variables are assumed to be independently distributed. Thus

$$\text{var}(X_i) = \sum_{j=1}^{m} \text{var}(Y_j) + \text{var}(e_i)$$

$$= \lambda_{i1}^2 + \ldots + \lambda_{im}^2 + \Psi_i$$

is the variance of the ith response. Here Ψ_i is referred to as the specific variance or specificity of the ith response, and λ_{ij}^2 are the common variances or communalities. In matrix notation, the entire variance matrix of the X_i can be expressed as

$$\Sigma = \Lambda\Lambda' + \Psi .$$

It is easily shown (50, p. 262) that λ_{ij} is the covariance (or correlation, if standardized) of the ith response with the jth common factor. Thus, the factor loadings reflect the relative importance of each variable for a given factor.

The general procedure used in factor analysis is to estimate the factor loadings based on sample data. A set of equations derived by the method of maximum likelihood must be solved to get at these estimates. Various iterative procedures are derived and discussed by Harman (31). Test statistics for determining the adequacy of the model, i.e., the adequacy of m factors to describe the data, are described by Morrison (50, p. 269).

Procedures called factor rotations are used on the original factor matrix to change the loading values, for example to make them approach 0 or 1. These are manipulations involving orthogonal transformations of the originally estimated factor loading matrix. This is legitimized as follows. Recall that the population correlation matrix is

$$\Sigma = \Lambda\Lambda' + \Psi .$$

Suppose we transform Λ by an orthogonal matrix T so that $H = \Lambda T$. Then

$$\Sigma^* = HH' + \Psi = (\Lambda T)(\Lambda T)' + \Psi = \Lambda TT'\Lambda' + \Psi$$
$$= \Lambda\Lambda' + \Psi = \Sigma .$$

Thus the model is satisfied not only by Λ, but by any ΛT, where T is orthogonal, and the factor loadings ΛT can be used just as well as those of Λ to describe the data. Harman (31) also discusses various methods of factor rotation.

Characteristically, factor analysis is used as an attempt to describe data involving a large number of variates in a simplified manner. Hopefully, the original variables can be described adequately by a number of factors which is much smaller than the original number of variables. One desirable goal is to make the factor loadings close to 0 or 1 by means of some rotation procedure. Ideally the loading for any particular variable will be particularly high on one factor and low on all other factors. This makes it possible to identify

each variable with the factor on which it loads most highly, i.e., the factor most responsible for determining the value of the variable. Substantive interpretations of the data can be greatly simplified by this kind of variable-factor identification.

Factor analysis is used in this research for comparison with regression analysis. Variables are identified with factors on the basis of factor loadings obtained from a rotated factor matrix, using one of the common rotation methods, known as varimax rotation. The pattern of this variable-factor identification is to be compared, for a given factor analysis, with the pattern of variable selection which occurs in a step-wise regression performed on the same data. The relative success in predicting blood pressure using factor score regressions compared to the single variate regressions is also investigated. Detailed discussion of the comparative methods and results follows in Chapter IV.

Square root method. This new method for variable selection is described fully in an unpublished paper by Dwyer and Kowalski (18). Their purpose is to provide an efficient computational procedure for solving a set of simultaneous linear equations, $Cb = f$, with concentration on application to the situation where these equations are the normal equations given by multiple regression theory.

Considering the rank of the matrix C as the minimum size for a subset of variables required for the regression equation, these authors use a square root technique to

reduce the equations to approximate homogeneous form. Variables are selected successively so that, at each stage, the variable chosen is the one whose correlation with the dependent variable is largest in absolute value, with the effect of previously selected variables removed. A modification can be introduced to insure that maximal contribution to the multiple correlation coefficient is made at each step. Results using this new method are included in Chapter IV for comparison with regression and factor analysis.

CHAPTER III

DEMOGRAPHIC DIFFERENCES IN BLOOD PRESSURE AND RACE RELATIONS ATTITUDES

Introduction.

The four demographic variables considered in this research are race, sex, age, and education. These are the variables used to construct the sixteen analytic subgroups described in Chapter II, page 36. Analyses done within these groups will be reported in Chapter IV. Many earlier researchers have noted correlations of some of these demographic variables with blood pressure level and with race relations attitudes. Relationships consistent with those found in earlier studies appear in the data under consideration here. The intent of this chapter is to present the analyses of the four demographic variables in terms of differences in blood pressure level and attitude variates and to compare the results with findings of previous studies.

For the following discussion, and for the results presented in Chapter IV, a number and letter system is used to identify the subgroups being considered. The notation is as follows:

Group	Race	Sex	Age	Education
1	B	M	Y	L
2	B	M	Y	H
3	B	M	O	L
4	B	M	O	H
5	B	F	Y	L
6	B	F	Y	H
7	B	F	O	L
8	B	F	O	H
9	W	M	Y	L
10	W	M	Y	H
11	W	M	O	L
12	W	M	O	H
13	W	F	Y	L
14	W	F	Y	H
15	W	F	O	L
16	W	F	O	H

Race	Sex	Age
B = Black	M = Male	Y = $\leq$ 40 years
W = White	F = Female	O = $>$ 40 years

Education

L = Lower half for race-sex-age group

H = Upper half for race-sex-age group

Thus, for example, "1-BMYL," "1," or "BMYL" always designates those individuals from the sample who are black males under age 40 with low education.[1]

Blood Pressure.

Differences. Some differences in blood pressure by race, sex, and age have been repeatedly demonstrated in various research settings. These are described in Chapter I.

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[1]The average age for all "Y" subjects is 34.0 and that for the "O" subjects is 47.9. The average education for all "L" subjects is 9.5 years of school and that for all "H" subjects is 13.0 years of school. Mean age and education for each of the sixteen subgroups is given in Appendix I, part E.

Blacks in the Unites States have been found by numerous investigators (e.g., 5, 37, 61, 68) to have higher levels of blood pressure than whites, for both sexes and for all age levels.

Differences in systolic and diastolic blood pressure by sex and age are also well substantiated (76). Blood pressure level increases with age, for both men and women. Women have lower systolic blood pressures than men to about age 50, after which they gradually exceed men in average blood pressure level. The same pattern appears in diastolic blood pressure levels, although the sex differences are much less marked than those for systolic blood pressure. No consistent relationship of blood pressure level with education or with other measures of socioeconomic status has been established.

The differences described above are found in these data, as expected. In Table 1, the average systolic and diastolic blood pressures are given for race-sex-age-education subgroups. As noted in Chapter II, the measure for systolic and diastolic blood pressure used in all the analyses is the average of three measures (the first three of five) taken during the course of the interview.

One observation from these data that is consistent with the findings discussed by Winkelstein and Kantor (76) is an increase in both systolic and diastolic blood pressure variability with age. For all race-sex-education groups denoted in Table 1, standard deviations are larger for those over 40 than for those in the under 40 age group. One can compare

groups by age, holding the other three variables constant, by looking at groups 1-3, 2-4, 5-7, 6-8, etc.

TABLE 1

AVERAGE SYSTOLIC AND DIASTOLIC BLOOD PRESSURE FOR RACE, SEX, AGE, AND EDUCATION SUBGROUPS

Group	N	Systolic Pressure		Diastolic Pressure	
		Mean	Std. dev.	Mean	Std. dev.
1 BMYL	69	124.4	14.0	82.4	9.6
2 BMYH	68	123.7	12.3	81.2	8.7
3 BMOL	58	135.0	17.8	88.0	13.4
4 BMOH	58	133.1	24.2	85.1	11.5
5 BFYL	65	117.0	15.0	76.9	10.7
6 BFYH	64	120.8	17.0	78.4	11.9
7 BFOL	64	138.2	27.8	87.5	15.0
8 BFOH	64	129.8	21.4	84.4	12.9
9 WMYL	54	122.6	15.7	78.7	10.4
10 WMYH	53	122.0	11.4	78.9	9.4
11 WMOL	68	129.1	17.8	83.6	11.4
12 WMOH	67	131.1	14.9	83.9	11.0
13 WFYL	56	113.5	13.5	74.0	9.3
14 WFYH	56	113.9	13.6	74.2	9.6
15 WFOL	70	126.4	17.9	80.0	10.7
16 WFOH	70	129.3	22.7	81.0	13.3

The mean blood pressures from Table 1 are arranged in Tables 2-5 to illustrate the relationships of blood pressure with race, sex, age, and education. For each of these demographic characteristics, the groups corresponding on the other three characteristics are matched and their average blood pressures compared. Group numbers are given in the two lefthand columns.

TABLE 2

AVERAGE SYSTOLIC AND DIASTOLIC BLOOD PRESSURE BY RACE

Groups		Systolic pressure			Diastolic pressure		
B	W	Black	White	Difference	Black	White	Difference
1	9	124.4	122.6	1.8	82.4	78.7	3.7
2	10	123.7	122.0	1.7	81.2	78.9	2.3
3	11	135.0	129.1	5.9	88.0	83.6	4.4
4	12	133.1	131.1	2.0	85.1	83.9	1.2
5	13	117.0	113.5	3.5	76.9	74.0	2.9
6	14	120.8	113.9	6.9	78.4	74.2	4.2
7	15	138.2	126.4	11.8	87.5	80.0	7.5
8	16	129.8	129.3	0.5	84.4	81.0	3.4
Total		127.5	124.0	3.5	82.9	79.6	3.3

TABLE 3

AVERAGE SYSTOLIC AND DIASTOLIC BLOOD PRESSURE BY SEX

Groups		Systolic pressure			Diastolic pressure		
M	F	Male	Female	Difference	Male	Female	Difference
1	5	124.4	117.0	7.4	82.4	76.9	5.5
2	6	123.7	120.8	2.9	81.2	78.4	2.8
3	7	135.0	138.2	-3.2	88.0	87.5	0.5
4	8	133.1	129.8	3.3	85.1	84.4	0.7
9	13	122.6	113.5	9.1	78.7	74.0	4.7
10	14	122.0	113.9	8.1	78.9	74.2	4.7
11	15	129.1	126.4	2.7	83.6	80.0	3.6
12	16	131.1	129.3	1.8	83.9	81.0	2.9
Total		127.7	124.0	3.7	82.8	79.7	3.1

TABLE 4

AVERAGE SYSTOLIC AND DIASTOLIC BLOOD PRESSURE BY AGE

Group		Systolic pressure			Diastolic pressure		
≤40	>40	≤40	>40	Differences	≤40	>40	Differences
1	3	124.4	135.0	-10.6	82.4	88.0	-5.6
2	4	123.7	133.1	-9.4	81.2	85.1	-3.9
5	7	117.0	138.2	-21.2	76.9	87.5	-10.6
6	8	120.8	129.8	-9.0	78.4	84.4	-6.0
9	11	122.6	129.1	-6.5	78.7	83.6	-4.9
10	12	122.0	131.1	-9.1	78.9	83.9	-5.0
13	15	113.5	126.4	-12.9	74.0	80.0	-6.0
14	16	113.9	129.3	-5.4	74.2	81.0	-6.8
Total		119.9	131.3	-11.4	78.3	84.0	-5.7

TABLE 5

AVERAGE SYSTOLIC AND DIASTOLIC BLOOD PRESSURE BY EDUCATION

Group		Systolic pressure			Diastolic pressure		
L	H	Low	High	Differences	Low	High	Differences
1	2	124.4	123.7	0.7	82.4	81.2	1.2
3	4	135.0	133.1	1.9	88.0	85.1	2.9
5	6	117.0	120.8	-3.8	76.9	78.4	-1.5
7	8	138.2	129.8	8.4	87.5	84.4	3.1
9	10	122.6	122.0	0.6	78.7	78.9	-0.2
11	12	129.1	131.1	-2.0	83.6	83.9	-0.3
13	14	113.5	113.9	-0.4	74.0	74.2	-0.2
15	16	126.4	129.3	-2.9	80.0	81.0	-1.0
Total		125.9	125.7	0.2	81.5	81.0	0.5

The relationships found in the data in Tables 2-5 are in the same direction as those differences found in the above mentioned studies. For the four pairs of categories higher levels of both systolic and diastolic blood pressure are found for blacks, males, and for older age groups. The age categorization gives the largest differences for both systolic and diastolic blood pressure. Negligible differences in blood pressure levels by education group are discernible. An analysis of variance was done to test for significant differences in blood pressure level for these demographic variates. The resulting ANOVA for systolic and diastolic blood pressure are presented in Tables 6 and 7 below.

TABLE 6

ANALYSIS OF VARIANCE FOR SYSTOLIC BLOOD PRESSURE

Source	Sum of squares	DF	Mean square	F-value
Race	4520.39	1	4520.39	13.96**
Sex	3957.07	1	3957.07	12.22**
Age	34404.32	1	34404.32	106.27**
Education	8.93	1	8.93	0.03
Race x sex	485.40	1	485.40	1.50
Race x age	147.41	1	147.41	0.46
Race x education	672.60	1	672.60	2.08
Sex x age	2072.59	1	2072.59	6.40*
Sex x education	0.05	1	0.05	0.00
Age x education	315.67	1	315.67	0.98
Error	321489.72	993	323.76	

** $p \leq .01$ * $p \leq .05$

TABLE 7

ANALYSIS OF VARIANCE FOR DIASTOLIC BLOOD PRESSURE

Source	Sum of squares	DF	Mean square	F-value
Race	3454.61	1	3454.61	26.94**
Sex	2620.52	1	2620.52	20.44**
Age	9197.29	1	9197.29	71.73**
Education	45.02	1	45.02	0.35
Race x sex	164.62	1	164.62	1.28
Race x age	49.30	1	49.30	0.38
Race x education	243.90	1	243.90	1.90
Sex x age	403.40	1	403.40	3.15
Sex x education	42.38	1	42.38	0.33
Age x education	117.11	1	117.11	0.91
Error	127322.36	993	128.22	

** $p \leq .01$

For both systolic and diastolic pressure, there are highly significant differences by age, race, and sex, in descending order of magnitude. The significance of the sex x age interaction for systolic blood pressure (the diastolic figure does not achieve significance) may be related to the change in pattern of blood pressure differences by sex with aging. The majority of the individuals considered in this study are within the ages 30-54, thus including the over 50 age group where women begin to overtake men in average blood pressure levels. Winkelstein and Kantor (76) noted this change to be more significant for systolic than for diastolic blood pressure, as is noted in these data.

Systolic-diastolic correlations. One further aspect of these data that is of interest here is the correlations between systolic and diastolic blood pressure readings. These are given in Table 8, according to race, sex, age, and education classification.

TABLE 8

CORRELATIONS BETWEEN SYSTOLIC AND DIASTOLIC BLOOD PRESSURE, BY RACE, SEX, AGE, AND EDUCATION

Control	Mean systolic blood pressure	Mean diastolic blood pressure	Product moment correlation
Race:			
Black	127.5	82.9	.79
White	124.0	79.6	.79
Sex:			
Male	127.7	82.8	.77
Female	124.0	79.7	.80
Age:			
≤ 40	119.9	78.3	.78
> 40	131.3	84.0	.78
Education:			
Low	125.9	81.5	.79
High	125.7	81.0	.79

There is no variation in the correlation by any of the demographic classifications employed here. Although the correlation is high, as is the case in most investigations, some authors (e.g., 46, 39) suggest dissimilar effects of different kinds of stress producing situations on diastolic and systolic

blood pressure. Analyses discussed in Chapter IV are thus carried out for both systolic and diastolic pressures, and the results are compared.

The data presented here indicate that, in terms of systolic and diastolic blood pressure levels, the respondents (index cases and controls) interviewed in the stress-heredity study are similar to other populations whose blood pressure has been investigated. Earlier studies are based on both clinical and interview blood pressure measurements. There is no evidence in these data to suggest that the interview experience itself had any kind of systematic (race-sex-age-education related) effect on blood pressure which would result in differences from previous studies.

Race Relations Attitudes.

Measure of association. In looking at the effects of race, sex, age, and education on the attitudes used in the stress heredity study as measures of attitudes toward race relations, we are concerned with four major questions: How does demographic status affect willingness or desire to associate with members of the other race? How does status affect the extent of concern about race relations as a social problem? How does status affect the extent of contact with members of the other race? And how do these attitude variables relate to each other?

The original interview questions are listed in part A of Appendix I. Part C contains the analysis variables

constructed from the original questions, and the item numbers 1-14 used in the following discussion refer to these recoded analysis variables. All of the variables form ordered non-metric scales.

All codes were constructed so that, as much as possible, an increasing value represents increased prejudice. A lower code represents more contact with the other race, more willingness to integrate, greater perception of inequality for blacks in this country, greater belief in civil rights effectiveness and the necessity to change conditions for blacks as opposed to stress on law enforcement. Respondents with higher codes on these questions prefer segregation, have less contact with members of the other race, stress law enforcement rather than changing social conditions as a means for handling civil unrest, and are less willing to admit the existence of inequalities for blacks. Two questions (6 and 8) which reflect optimism or pessimism about future race relations and beliefs about how white attitudes will be changed are not scaled so that responses can be associated with the degree of prejudice or the extent of concern about racial problems.

For calculation of the two measures of correlation discussed below, codes assigned to the demographic variables are:

Race:	1) Black 2) White	Sex:	1) Male 2) Female	Age:	1) ≤ 40 2) > 40

Education:
1) Low
2) High

Thus in general, positive correlations indicate greater prejudice for whites, females, people over 40, or highly educated individuals. Negative correlations show greater prejudice for blacks, males, younger individuals, or less educated respondents.

All of the fourteen analysis variables were cross tabulated with race, sex, age, and education. Interactions among the demographic variables are not considered in this thesis. These tabulations, showing response distributions, are given in Appendix I, part F. The tables were tested for significant associations by three measures: Spearman's rank-order correlation, Pearson's product moment correlation, and chi-square. These statistics will be briefly discussed and compared. A detailed discussion of the methods can be found in Siegel (64).

Spearman's rank correlation coefficient, sometimes called rho, is a measure of association for two characteristics that requires ordinal scale measurement of both variables. All individuals are ordered on both scales, and the value of rho measures the extent of agreement of the ranks on both measures. A correction factor is used for tied ranks. The ordinary (Pearson, or product moment) correlation coefficient also measures the association between two variables, but uses the actual values instead of ranks. Significance testing for the product moment correlation is based on statistics assuming normal, interval scaled variables. The chi-square test compares observed categorical frequencies

with those expected under the hypothesis of no association, and can be used for any kind of categorical data.

The two correlation measures are used to indicate direction, as well as strength, of the association between two traits. For these data, a correlation coefficient will be computed in order to ascertain, for example, whether blacks are more or less willing to integrate than whites, whether higher educated individuals are more or less prejudiced than those with low education, etc. Chi-square is sensitive to differences in distribution of responses for two groups and will indicate whether we can distinguish between blacks and whites, males and females, etc., on the basis of their answers to the race relations questions.

One purpose for using the product moment correlation, even though, strictly speaking, the data does not meet the normal, interval scale requirements of the test statistic, is to provide a third measure of association whose results can be used for comparison with the trends suggested by the Spearman rho and chi-square tests. A more important intention is to compare this coefficient with the nonparametric Spearman rank order correlation coefficient in terms of consistency of statistical significance or nonsignificance of the computed statistics. The test for the product moment correlation comes from the normal distribution and that for the Spearman rho from the distribution of differences of the ranks on the two variables being considered. Substantial correspondence between these two measures as far as

significance or nonsignificance of the statistics would increase our confidence that regression techniques could reasonably be used for the variables under consideration, though the data are discrete and only approximately normally distributed.

Good agreement between these two correlation indices is found in all of the Tables 9-12. Discrepancies in these two statistics result from the correction for ties made in calculation of the Spearman rho. Of the fifty-six correlations computed, there is only one instance (Table 11, variable 2) in which the product moment correlation is significant and the Spearman rho is not, and the actual difference in the p value in that instance is .01. These two methods give virtually the same results, therefore, in terms of statistical significance of their respective test statistics. When we find significant correlations in the regression analyses, we will assume that the results are comparable to what we might find if we had available a nonparametric regression technique.

The values for the three measurements discussed above, and p values (significance level at which the hypothesis of no association can be rejected) are given in Tables 9-12, by race, sex, age, and education, with significant items noted. Appendix I, part C, gives a more complete description of each attitude variable. All tests are two-tailed; i.e., the direction of the hypothesized difference is not specified in advance. The study of demographic correlates of race relations attitudes, although related to this thesis, is not the major subject under consideration. Interactions between race,

sex, age, and education in terms of racial attitudes are not discussed in depth. The general tendency reported by Williams (75) and Bettelheim (8) is for differences by race, for example, to hold up when controlled by age, sex, and education, etc., and for similar results to persist when any of these variates are held constant and the others examined.

For purposes of this paper, only those cases in which all three of the tests for statistical significance allow us to reject the null hypothesis at the $\alpha = .01$ level of significance are considered significant results. This conservative criterion helps us to some extent to adjust for the repeated use of significance tests and for the tendency for small differences to be significant due to large numbers of cases in each group. The reader will note that the majority of significant correlations have very low p values. At the .01 level, we would expect to find $56 \times .01 = .56$ or less than one correlation significant by chance.

Differences by race. Statistical measures of differences in response to the analysis variables by race are given in Table 9. Nearly all of the differences in race relations attitudes are highly significant, as well as in agreement with other studies of prejudice. Blacks are more willing to integrate than whites (variables 1, 2, 9, 14), have more social contact with whites than whites do with them (5), more personal contact (12), and are less tense or fearful in interracial situations (10, 13). Blacks are also more likely to report perceived inequalities in rent and pay

TABLE 9

SPEARMAN RANK CORRELATION COEFFICIENT, PRODUCT MOMENT CORRELATION COEFFICIENT, AND CHI-SQUARE VALUES, FOR ASSOCIATION BETWEEN FOURTEEN RACE RELATIONS ATTITUDE QUESTIONS AND RESPONDENT'S CLASSIFICATION BY RACE

Item	Statistic			p value**		
	Spearman rank	Product moment	Chi-square	Spearman rank	Product moment	Chi-square
* 1. Housing integration preference	.745	.717	608.86	.0001	.0001	.0001
* 2. Social distance	.638	.592	436.89	.0001	.0001	.0001
* 3. Rent inequality perceived	.582	.565	365.44	.0001	.0001	.0001
* 4. Pay inequality perceived	.513	.487	271.87	.0001	.0001	.0001
* 5. Social contact	.417	.428	188.24	.0001	.0001	.0001
6. Future equality	.008	.007	0.26	.80	.83	.88
* 7. Civil disturbance	.527	.527	278.76	.0001	.0001	.0001
* 8. White attitudes	.179	.161	43.07	.0001	.0001	.0001
* 9. Hate black/white	.112	.108	14.59	.0004	.0006	.0007
*10. Fear black/white	.335	.334	113.53	.0001	.0001	.0001
11. Shame, own race	.027	.052	35.16	.40	.10	.0001
*12. Personal contact	.495	.494	247.68	.0001	.0001	.0001
*13. Tense with black/white	.152	.144	59.66	.0001	.0001	.0001
*14. Desired contact	.147	.169	80.31	.0001	.0001	.0001

*$p \leq .01$ for all three measures of association.

**Exact p values were computed for each statistic. Values of .0001 indicate p-values equal to .0001 or smaller.

(3, 4), to have positive reactions to civil rights demonstrations (7, as opposed to the whites' stress on more law enforcement), and to see more likelihood of change in white attitude by force than by persuasion (8).

Both Bettelheim (8) and Williams (75) report studies in agreement with the general indications of these data. Williams (p. 246) uses a Guttman scale similar to the one used here to show the greater social distance preference of whites compared to blacks. He also (p. 152) describes the greater contact of blacks with whites than whites with blacks in terms of the sheer relative sizes of these groups in most populations, which makes contact much more likely and necessary for blacks than for whites. Blacks in this study express greater desire for contact with whites as well as greater actual contact.

Differences by sex. Table 10 gives the statistical values for differences in attitudes by sex. Males have more interracial contact than females, both social (5) and personal (12) contact, and they express more interest in becoming friends with members of the other race (14) than do females. Conversely, they are more willing to agree with statements expressing hate for the other race and reservation about integration (9).

Williams (75, p. 145) reports greater contact for males, and again explains the greater contact more in terms of greater opportunity for contact than in terms of more desired contact due to less prejudice. He does cite several studies

TABLE 10

SPEARMAN RANK CORRELATION COEFFICIENT, PRODUCT MOMENT CORRELATION COEFFICIENT, AND CHI-SQUARE VALUES, FOR ASSOCIATION BETWEEN FOURTEEN RACE RELATIONS ATTITUDE QUESTIONS AND RESPONDENT'S CLASSIFICATION BY SEX

Item	Statistic			p value**		
	Spearman rank	Product moment	Chi-square	Spearman rank	Product moment	Chi-square
1. Housing integration preference	.017	.007	13.24	.60	.82	.0042
2. Social distance	.046	.020	14.89	.14	.53	.0049
3. Rent equality perceived	-.026	-.026	1.98	.41	.41	.58
4. Pay inequality perceived	-.027	-.026	1.45	.39	.41	.69
* 5. Social contact	.163	.154	29.67	.0001	.0001	.0001
6. Future equality	-.067	-.070	6.14	.03	.03	.05
7. Civil disturbance	.001	.003	7.81	.98	.91	.02
8. White attitudes	.033	.042	5.08	.30	.18	.08
* 9. Hate black/white	-.121	-.123	15.81	.0001	.0001	.0004
10. Fear black/white	-.042	-.042	1.87	.19	.19	.39
11. Shame, own race	-.021	-.011	5.18	.52	.74	.08
*12. Personal contact	.162	.164	39.90	.0001	.0001	.0001
13. Tense with black/white	.001	-.013	6.47	.98	.67	.17
*14. Desired contact	.162	.154	28.33	.0001	.0001	.0001

*$p \leq .01$ for all three measures of association.

**Exact p values were computed for each statistic. Values of .0001 indicate p-values equal to .0001 or smaller.

(p. 266) which indicate greater general levels of prejudice among women than among men. The significant correlations here are in general agreement with Williams' generalization, but these data do not indicate an absolutely clear association of sex with the extent of prejudice. For nonpersonal items such as those relating to the extent of inequality, effect of civil rights, need for law enforcement, etc., no differences are found.

Differences by age. Age differences appear in Table 11. Only one of the race relations questions was significantly associated with age. Younger people in this study more often perceive inequalities in pay for blacks compared to whites. No significant differences are found relating to interracial contact, desire for integration, or any of the other indices used here.

Bettelheim (8, p. 15) states that younger people tend to be less prejudiced than their elders. In our data, ten of the fourteen correlations are positive (associating more prejudice with the older age group), and three of the positive correlations (variables 2, 3, and 8) are significant at the .05 level for all three measures. Although the trends in these data are consistent with the hypothesis of increased prejudice with age, they are not statistically significant by our earlier established definition. Williams (75, p. 264) reports the same kind of nonsignificant trend toward less prejudice in younger age groups. A possible explanation for the difference between the results of the data in this thesis

TABLE 11

SPEARMAN RANK CORRELATION COEFFICIENT, PRODUCT MOMENT CORRELATION COEFFICIENT, AND CHI-SQUARE VALUES, FOR ASSOCIATION BETWEEN FOURTEEN RACE RELATIONS ATTITUDE QUESTIONS AND RESPONDENT'S CLASSIFICATION BY AGE

	Statistic			p value**		
	Spearman rank	Product moment	Chi-square	Spearman rank	Product moment	Chi-square
1. Housing integration preference	.061	.061	4.82	.05	.06	.19
2. Social distance	.075	.083	16.96	.02	.01	.0020
3. Rent inequality perceived	.074	.067	11.36	.02	.03	.0099
* 4. Pay inequality perceived	.101	.096	15.04	.0013	.0023	.0018
5. Social contact	.019	.021	0.55	.54	.51	.76
6. Future equality	-.038	-.043	5.29	.23	.18	.07
7. Civil disturbance	.033	.034	2.90	.30	.28	.23
8. White attitudes	.086	.084	7.58	.01	.01	.02
9. Hate black/white	-.048	-.050	2.97	.13	.11	.23
10. Fear black/white	-.006	-.006	0.42	.86	.85	.81
11. Shame, own race	.006	.007	0.11	.86	.83	.94
12. Personal contact	.060	.060	3.75	.06	.06	.29
13. Tense with black/white	.019	.025	3.96	.56	.43	.41
14. Desired contact	-.011	-.013	10.02	.72	.69	.04

*$p \leq .01$ for all three measures of asociation.

**Exact p values were computed for each statistic.

compared with Bettelheim's observations is the difference in the age groups studied. Bettelheim's "young" and "old" age groups are under 28 and 28 to 36. Those used here are under 40 and over 40, with nearly all respondents at least 30 years old. Thus our respondents really comprise the "old" age group studied by Bettelheim. For our data as they are, there is not a strong relationship between age and the attitude variables considered here.

Differences by education. For individuals in the low and high education groups (low and high relative to one's race-sex-age category), Table 12 shows differences in interracial contact (5, 12), discomfort in interracial situations (13), in opinions regarding civil rights (7) and future race relations (6). More highly educated individuals have more contact and are less tense about it, are more favorably disposed toward civil rights efforts and changing social conditions as opposed to strong law enforcement, and are less optimistic about future racial equality. No differences are found for educational level in regard to desire for increased personal contact or willingness for close association with members of the other race.

Bettelheim (8, p. 17) reports less prejudice among the better educated subjects in his study. Williams (75) finds more highly educated respondents to be less prejudiced on the Guttman social distance scale (p. 50) and to have more interracial contacts (p. 145). Our subjects thus are generally similar in attitude by education to those in these

TABLE 12

SPEARMAN RANK CORRELATION COEFFICIENT, PRODUCT MOMENT CORRELATION COEFFICIENT, AND CHI-SQUARE VALUES, FOR ASSOCIATION BETWEEN FOURTEEN RACE RELATIONS ATTITUDE QUESTIONS AND RESPONDENT'S CLASSIFICATION BY EDUCATION

Item	Statistic			p value**		
	Spearman rank	Product moment	Chi-square	Spearman rank	Product moment	Chi-square
1. Housing integration preference	.019	.020	1.29	.55	.52	.73
2. Social distance	-.011	-.028	7.78	.73	.38	.10
3. Rent inequality perceived	-.063	-.065	4.98	.05	.04	.17
4. Pay inequality perceived	-.055	-.056	3.27	.08	.08	.35
* 5. Social contact	-.102	-.105	11.14	.0012	.0009	.0038
* 6. Future equality	.120	.112	24.24	.0001	.0004	.0001
* 7. Civil disturbance	-.099	-.096	20.45	.0017	.0025	.0001
8. White attitudes	-.046	-.045	2.17	.14	.16	.34
9. Hate black/white	.008	.011	1.65	.81	.74	.44
10. Fear black/white	-.075	-.076	5.72	.02	.02	.06
11. Shame, own race	-.049	-.051	2.78	.12	.11	.25
*12. Personal contact	-.160	-.159	27.15	.0001	.0001	.0001
*13. Tense with black/white	-.131	-.145	22.14	.0001	.0001	.0002
14. Desired contact	.021	.006	9.23	.51	.84	.06

*$p \leq .01$ for all three measures of association.

**Exact p values were computed for each statistic. Values of .0001 indicate p-values equal to .0001 or smaller.

earlier studies. It is interesting that education is the only one of the four demographic variables employed in the present study that is significantly related to extent of optimism about the future of racial equality.

Ten of the fourteen correlations are negative (indicating less prejudice with increased education), though only five are statistically significant. The significant differences here refer both to concern about social equality and to personal experiences of contact with members of the other race. The association between increased education and decreased prejudice with reference both to personal and social factors has obvious practical implications from the point of view of improving race relations. In terms of attempts to change the system in order to better these relations, this is the only one of the four demographic variables considered here that is subject to manipulation.

Summary. In general, the data present fewer indications of prejudice, as measured by the variables included here, among blacks, males, the young, and the more highly educated. The most striking and consistent differences, for actual interracial contact, desired contact, perceived existing social prejudice, and law enforcement vs. changing social conditions, are found when blacks and whites are compared. Of the four demographic status categories considered in this study, age is the least significant indicator of differences in race relations attitudes. The overall differences support the conclusions of Bettelheim (8) and Williams (75).

Attitude Intercorrelations.

A brief consideration will be made here of the correlations among these attitude variables within race, sex, age, and education groups. Correlation matrices for the fourteen attitude questions are given separately for all of these groups in Tables 13-16.

Several general impressions can be made from these data. In general, a similar pattern is found in Tables 14, 15, and 16. These are correlations by sex, age, and education. The correlations among variates in Table 13, which are calculated for blacks and whites separately, are generally lower than in the other tables.

The highest correlations are in most cases for variables dealing with personal aspects of race relations. Preference for integrated housing (1) correlates positively with willingness to reduce social distance (2, 14) and with experiences of interracial contact and friendship on both an impersonal (5) and personal level (12). The general tendency of reduced prejudice to accompany increased interracial contact is supported by Williams (75, p. 157). For the present data, the relationships of this kind, though found in both racial groups, are much less strong among black respondents than among white respondents.

Reduced feelings of tension in interracial situations (10, 13) also accompany contact experience and willingness to associate with the other race, as well as disagreement with statements expressing distrust and hate of the other race (9).

TABLE 13

CORRELATION MATRIX FOR FOURTEEN RACE RELATIONS ATTITUDE VARIABLES BY RACE

BLACKS
(N = 510)

Item	2	3	4	5	6	7	8	9	10	11	12	13	14
1	.19	.00	-.08	-.03	.05	-.04	-.05	.17	.23	.04	.15	-.05	.26
2		-.07	-.13	.12	.06	-.06	-.04	.22	.24	.01	.24	.13	.31
3			.36	-.06	-.08	-.03	.12	-.06	-.11	.07	-.00	-.01	-.03
4				-.09	-.11	.07	.19	-.19	-.21	.08	-.08	-.09	-.11
5					-.02	.05	.01	-.02	.08	-.09	.25	.08	.08
6						-.10	-.14	.10	.03	.02	-.05	-.05	.27
7							.15	-.11	-.09	-.12	-.01	.00	-.15
8								-.14	-.14	.01	-.01	.02	-.13
9									.30	-.12	.02	.18	.21
10										-.26	.25	.30	.10
11											-.03	-.16	.08
12												.09	.24
13													-.01

TABLE 13--Continued

WHITES
(N = 494)

Item	2	3	4	5	6	7	8	9	10	11	12	13	14
1	.46	.13	.08	.27	.05	.16	-.11	.19	.20	.14	.26	.22	.39
2		.15	.11	.37	.00	.21	-.11	.18	.35	.11	.35	.27	.45
3			.31	.05	.00	.08	-.06	.11	.07	.13	.05	-.00	.06
4				.06	-.07	.13	.03	.06	.08	.09	.11	.05	.07
5					.07	.06	-.08	.14	.26	.09	.33	.22	.35
6						-.06	.04	.04	.03	-.07	.01	.04	.02
7							-.08	.16	.17	.00	.07	.15	.14
8								-.06	-.08	-.02	-.04	-.03	-.05
9									.25	.03	-.01	.07	.11
10										.02	.34	.28	.35
11											.14	-.06	.13
12												.19	.49
13													.25

TABLE 14

CORRELATION MATRIX FOR FOURTEEN RACE RELATIONS ATTITUDE VARIABLES BY SEX

MALES
(N = 495)

Item	2	3	4	5	6	7	8	9	10	11	12	13	14
1	.64	.45	.25	.44	.06	.46	.02	.20	.34	.10	.45	.15	.29
2		.43	.26	.48	.07	.44	.06	.25	.40	.06	.49	.25	.35
3			.51	.29	-.04	.34	.12	.08	.15	.11	.31	.08	.07
4				.21	-.13	.32	.22	-.09	-.00	.11	.23	.01	.00
5					.09	.33	.02	.14	.28	.02	.38	.21	.22
6						-.04	-.09	.07	.05	-.06	.02	-.01	.17
7							.15	.06	.19	-.04	.35	.14	.03
8								-.07	-.04	.00	.06	.01	-.10
9									.28	-.02	.06	.10	.20
10										-.17	.35	.30	.22
11											.05	-.09	.11
12												.20	.34
13													.12

TABLE 14--Continued

FEMALES
(N = 509)

Item	2	3	4	5	6	7	8	9	10	11	12	13	14
1	.58	.44	.41	.35	.02	.35	.10	.21	.43	.10	.52	.21	.42
2		.29	.27	.43	-.02	.29	.01	.20	.45	.09	.53	.27	.48
3			.51	.20	-.02	.28	.13	.07	.19	.11	.30	.07	.15
4				.17	-.03	.32	.18	-.00	.13	.08	.23	.07	.08
5					-.01	.21	.04	.12	.33	.03	.47	.23	.32
6						-.09	-.01	.05	.00	.04	-.03	.02	.13
7							.08	.09	.23	-.02	.22	.16	.15
8								-.09	-.06	.01	.05	.03	-.03
9									.30	-.08	.10	.16	.18
10										-.05	.48	.32	.34
11											.09	-.10	.12
12												.21	.42
13													.23

TABLE 15

CORRELATION MATRIX FOR FOURTEEN RACE RELATIONS ATTITUDE VARIABLES BY AGE

UNDER 40
(N = 485)

Item	2	3	4	5	6	7	8	9	10	11	12	13	14
1	.60	.44	.35	.39	-.01	.43	.03	.22	.34	.12	.45	.23	.32
2		.38	.28	.43	-.01	.38	.06	.20	.36	.11	.46	.30	.42
3			.48	.27	-.07	.29	.18	.07	.12	.11	.24	.14	.07
4				.20	-.15	.34	.22	-.05	.01	.09	.19	.07	-.02
5					.02	.29	.04	.10	.25	.01	.42	.21	.27
6						-.08	-.12	.10	.05	.01	-.07	.02	.14
7							.15	.02	.15	-.06	.27	.16	.07
8								-.08	-.05	-.03	.07	.07	-.12
9									.29	.01	.01	.10	.19
10										-.07	.34	.30	.25
11											.08	-.08	.15
12												.16	.36
13													.18

TABLE 15--Continued

OVER 40
(N = 519)

Item	2	3	4	5	6	7	8	9	10	11	12	13	14
1	.63	.44	.31	.39	.09	.40	.07	.19	.42	.07	.50	.13	.38
2		.34	.24	.48	.07	.37	.00	.25	.48	.05	.56	.23	.42
3			.54	.21	.02	.33	.06	.09	.21	.11	.34	.02	.14
4				.16	.03	.30	.17	-.02	.13	.11	.26	.01	.11
5					.03	.24	.02	.12	.34	.04	.46	.21	.30
6						-.05	.03	.04	.01	-.05	.04	-.01	.13
7							.08	.12	.26	-.00	.29	.14	.11
8								-.08	-.06	.04	.04	-.04	.00
9									.29	-.11	.11	.16	.15
10										-.15	.47	.32	.29
11											.06	-.11	.07
12												.23	.44
13													.16

TABLE 16

CORRELATION MATRIX FOR FOURTEEN RACE RELATIONS
ATTITUDE VARIABLES BY EDUCATION

BELOW MEDIAN
(N = 504)

Item	2	3	4	5	6	7	8	9	10	11	12	13	14
1	.62	.46	.30	.41	.11	.43	.08	.24	.35	.11	.45	.21	.36
2		.38	.24	.49	.10	.38	.06	.25	.41	.10	.48	.32	.42
3			.52	.23	.06	.33	.10	.11	.14	.13	.22	.09	.11
4				.14	.01	.33	.18	-.00	.00	.10	.12	.05	.03
5					.11	.31	.02	.13	.29	.02	.41	.28	.34
6						-.02	-.03	.07	.08	.03	.07	.02	.17
7							.13	.09	.20	-.02	.26	.17	.11
8								-.07	-.03	.05	.06	-.01	-.04
9									.30	.02	.05	.14	.19
10										-.12	.37	.35	.27
11											.06	-.10	.10
12												.19	.43
13													.24

TABLE 16--Continued

ABOVE MEDIAN
(N = 500)

Item	2	3	4	5	6	7	8	9	10	11	12	13	14
1	.61	.43	.36	.38	-.05	.39	.04	.17	.42	.08	.52	.14	.33
2		.35	.29	.42	-.06	.37	.01	.19	.44	.06	.53	.17	.40
3			.50	.24	-.12	.29	.14	.05	.19	.09	.36	.04	.10
4				.22	-.15	.31	.22	-.07	.12	.09	.31	.02	.05
5					-.05	.21	.03	.09	.29	.02	.45	.10	.22
6						-.10	-.07	.07	-.00	-.06	-.07	.03	.10
7							.10	.05	.21	-.05	.28	.09	.07
8								-.09	-.08	-.04	.05	.03	-.07
9									.29	-.11	.07	.14	.15
10										-.11	.43	.25	.27
11											.06	-.11	.12
12												.16	.38
13													.08

These correlations are consistent, although not as strong as those connecting experienced contact and willingness for contact.

Those variables which deal more with social issues such as perceptions of inequality (3, 4), attitude toward civil disturbances and law enforcement (7), and optimism about future race relations (6) are not highly intercorrelated, but there are some interesting relationships among them and with the more personal variables discussed above. Among these social type variables, only the two questions concerning perception of inequalities in rent (3) and pay (4) are highly correlated with each other (positively).

Optimism about the attainment of future racial equality (6) correlates positively with desire for more interracial contact (14) for both sexes, both age groups, both education groups, and for blacks. For blacks, males, young, and highly educated, the groups tending to be least prejudiced, optimism also correlates negatively with the assertion of inequality in pay for blacks (4).

The pattern of relationship of one's attitude toward civil unrest with other attitudes is similar for all groups except blacks. In general, a positive attitude toward the helpfulness of civil disturbances and changing social conditions as opposed to better law enforcement as a means of solving race problems (7) is held by those who have more desire for integration (1, 2, 14), are less tense about interracial situations (10, 13), have experienced more interracial

contact (5, 12), and see existing inequality (3, 4). For blacks, supporters of civil disturbance are more likely to be pessimistic about the future of race relations (6), to believe whites will be forced rather than persuaded to change their attitudes (8), to hate whites and feel negative about contact (9, 14).

For whites, females, older people, and those in the low educated group, the belief that whites will change by force or persuasion (8) is uncorrelated with any of the other variables discussed here. Again, there is a similarity of pattern for the less prejudiced--blacks, males, young, and more highly educated. In the latter groups, those who think whites will be forced to change are those who affirm existing inequality (4) and who support the civil rights movement as helpful in solving race relations problems (7).

A remaining variable which again has a similar pattern for all of the eight correlation matrices except the one for blacks is the extent of shame one feels for one's own race (11). In general, increased shame accompanies greater contact (12), desire and willingness for interracial activity (1, 2, 14) and acknowledgment of social inequality (3). For blacks, increased shame is associated with tenseness in the presence of whites (10, 13).

In the next chapter, we will use the attitude variables discussed here as blood pressure predictors within groups defined by race, sex, age, and education simultaneously. The patterns of intercorrelations of the attitude variables as

well as the zero-order correlations determine, in step-wise regression, for example, which variables are selected in the attempts to predict systolic and diastolic blood pressure. These intercorrelations also determine the factors constructed by the factor analyses. Thus we will refer back to the patterns discussed here to help interpret the analytic results of Chapter IV.

CHAPTER IV

ATTITUDINAL CORRELATES OF BLOOD PRESSURE

Introduction.

Substantive objectives. Relationships between demographic status in terms of race, sex, age, and education and blood pressure level have been discussed in Chapter III. The correlations found for these data replicate those of earlier studies. Variations in race relations attitudes by these status factors have also been discussed, and the results have been compared and found consistent with other investigations. Thus in terms of characteristically observed relationships between status (as defined above) and blood pressure and between status and race relations attitudes, this sample resembles other groups studied previously.

The differences in systolic and diastolic blood pressure by race, sex, age, and education lead to the examination of groups defined by these characteristics for differences which might be intervening factors in the etiology of hypertension. One difference we have found, and which we now proceed to examine, is a difference in attitudes regarding race relations. Because the subgroups were constructed in such a way as to be relatively equal in size on each successive division (as discussed in Chapter II), demographic controls are built into the race, sex, age, and education

categories. That is, for example, blacks do not have higher blood pressure than whites because they are older; the young are not less prejudiced because they are more likely to be black. The intent of this chapter is to examine relationships between the attitude variables and level of systolic and diastolic blood pressure, within the sample subgroups defined demographically.

Studies of psychological factors in blood pressure, reviewed in Chapter I, have suggested that stress-provoking situations can be associated with increases in blood pressure. It has been fairly well documented that stress situations can cause immediate, temporary increases in blood pressure. Whether stress can cause sustained blood pressure elevation over an extended period of time is not at all clear. By our use of questions regarding race relations as measures of stress, we are dealing with factors that may vary in their "stress value" or ability to cause anxiety according to the social position of an individual. The social position considered here is that defined by the characteristics mentioned above--race, sex, age, and education. By attempting to find attitudinal variables that are statistically (significantly) correlated with blood pressure level within these demographic subgroups, we hope to be able to see relationships that might be masked by failure to take one's position in society into account, that is, by trying to predict blood pressure by attitude for the entire sample at once.

The studies mentioned earlier do not suggest any consistent and clear cut relationship of particular kinds of psychological factors to blood pressure level. The nature of this study is thus of necessity exploratory. We do hypothesize that there will be relationships between some of the race relations questions and blood pressure level.

The only specific hypothesis that is made here is one which has to do with a difference between personal feelings about one's own experience and attitude in interracial situations and more impersonal feelings about the status of equality or inequality for blacks and how social changes should be made. The former, more personal types of variates are hypothesized to be more stress producing (and thus more closely related to blood pressure level) for whites than for blacks. Blacks, simply because of the relative size and status of the two racial groups in this country, are bound to have experienced interracial contact much more frequently than whites. Hypothetically, the stress factors for blacks will not be those variables related to personal contact with whites ("personal variables"), to which they must be very accustomed, but to questions dealing with racial inequalities, the future of race relations, the handling of civil disturbances, and the possibility of changes in white attitudes toward blacks ("social variables").

Whites are in the position of having to make choices about how much interaction they will have with blacks, and their previous contact experiences have been to a large extent

based on choice. For blacks, interracial contact is much more a matter of unavoidable circumstances than of choice, particularly in job experiences and other impersonal situations. It is one of the tenets of this thesis that questions relating to change in society to eliminate problems of race relations will be more important to blacks than to whites, since the future for blacks is likely to be much more strongly affected by these changes than that for whites.

The major kinds of effects for which we will look, therefore, are differences in blood pressure prediction by attitude variables according to race, sex, age, and education. We will be looking not only at the kinds of variables selected, but at the relative success of prediction within different subgroups, in terms of the percent of blood pressure variation that can be accounted for by the attitude variables. Comparisons will also be made to ascertain the similarity or dissimilarity of results using systolic vs. diastolic blood pressure level as a dependent variable.

Methodological objectives. The differences discussed in the preceding section will be compared for step-wise regressions done on the fourteen analysis variables, for regressions done using the square root method, and for regressions done on factors constructed from the fourteen original regression variables.

As discussed at the end of Chapter I, we will make comparisons between regression and the square root method on the basis of variables chosen for significant prediction. For comparisons between regression and factor analysis, we will

look at single variables selected as representatives of groups of variables defined by the factor analysis.

Computational methods. The step-wise regressions on the original variables as well as the factor analyses were done using the UCLA Biomedical Computer Programs, as modified by the Statistical Research Laboratory of the University of Michigan. Regression using the square root method was done using a program written in the Statistical Research Laboratory. All computer analyses were done on the University of Michigan Computer Center's IBM 360/67.

The step-wise regression program (BMD2R) was designed to compute a sequence of multiple linear regression equations, with specified priorities for adding and deleting variables. At each step the variable is added which causes the greatest reduction in the unexplained variation. This is, equivalently, the variable having the highest partial correlation with the dependent variable, holding constant the variables already included in the equation.

The computer output includes the equation constructed at each step, with the necessary coefficients, and partial correlations with the dependent variable for all omitted variates. Computation stops when the increase in R^2 due to adding another variable is below an arbitrarily specified level. A final summary table lists the multiple correlation coefficient (R), the squared multiple correlation coefficient (R^2, the percent of variance in the dependent variable explained by the independent variables included in the equation),

the increase in R^2, and the F-value for testing the significance of R, as computed at each step in the sequence.

The summary table is given, for each demographic subgroup, in Appendix II, part A. Asterisks mark the significant F values, i.e., F values corresponding to R^2's significantly different from 0. These denote points in the stepwise procedure where significant prediction is obtained using the variables included to that point. For groups where significant prediction is obtained at all, it is reached on the first or second step. As additional variables are included, significance may be maintained for up to three or four steps, after which the R^2 value is no longer significant. Further explanation appears beginning on page 104 ff.

The factor analysis program (BMD03M) first obtains a principal components solution, i.e., it finds that linear function of the variables that accounts for the greatest proportion of the variance, the one (orthogonal to the first) accounting for the second greatest proportion, etc. An orthogonal rotation of the factor loading matrix is then done, as described in Chapter II. The method of rotation used in this particular program is referred to as varimax rotation. The general idea is to rotate in such a way that the factor loadings tend toward unity and zero, making it possible to identify each factor in terms of those variables loading highly on it ("simple structure"). For this particular program, the number of factors to be rotated is specified by the user.

Output includes the original factor matrix and the cumulative proportion of the total variance explained by each factor, the rotated factor matrix, and factor scores for each individual computed from the rotated factor matrix. The rotated factor matrices for the sixteen groups are given in Appendix III, part B, with two, three, four, and five factors specified. Systolic and diastolic blood pressure were regressed on the factor scores computed by BMD03M, with BMD2R, described above, and these results are also presented in Appendix III, part C.

The program for the square root method for selecting the regression variables is based on a method described in the paper by Dwyer and Kowalski (18). Variables are again selected in steps, but with the criterion of reduction of the normal equations to homogeneous form rather than the criterion of maximization of the multiple correlation coefficient. Output includes the variables in order of selection and the accumulated contributions to the multiple correlation coefficient and multiple determination coefficient. Results of these calculations are given in Appendix II, part B. Variables selected by the square root method appear, in order of selection, on the second line of each pair.

Correlations.

Both the regression analyses and the factor analysis methods, as well as the square root method, are based on manipulations using the matrix of intercorrelations among the variables being considered. These matrices, for all of the

sixteen combinations of race, sex, age, and education categories considered, are given in Appendix I, part G. In Tables 17 and 18, correlation coefficients are given, for systolic and diastolic blood pressure separately. Those attitude variates significantly related to blood pressure level at the .05 level are presented, with those significant at the .02 level starred.

As expected from other studies, none of the correlations are outstanding, though there are significant correlations for either systolic or diastolic blood pressure for all groups except groups 4 (black, male, over 40, high education) and 13 (white, female, under 40, low education). There are in the two tables a total of 448 correlations. At the .05 level, we would expect to find 22 significant correlations (by chance), and at the .02 level, 9. These estimates are conservative, since they are based on the assumption of independence among the variables. There are actually 28 significant correlations at the .05 level for these data and 12 at the .02 level. Thus we do find more instances of correlation than expected by chance, but no indications of very striking relationships between these attitude variables and blood pressure for any of the sixteen groups considered. It will be shown later that, using combinations of variables, we are more successful at establishing some relationships than by just considering correlates of individual variates with blood pressure.

TABLE 17

SIGNIFICANT CORRELATIONS (α = .05) OF ATTITUDE VARIABLES WITH SYSTOLIC BLOOD PRESSURE BY GROUPS

Group	N	Variable													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1 BMYL	69						.25								
2 BMYH	68														
3 BMOL	58													.29*	
4 BMOH	58														
5 BFYL	65														
6 BFYH	64					-.25								-.27	
7 BFOL	64														
8 BFOH	64			.31*									.30*		
9 WMYL	54						-.28	-.32*							
10 WMYH	53				-.29										
11 WMOL	68														
12 WMOH	67											.29*			
13 WFYL	56														
14 WFYH	56						.27								
15 WFOL	70										.24				
16 WFOH	70		-.27*			-.27									

*p $\leq$ .02

TABLE 18

SIGNIFICANT CORRELATIONS (α = .05) OF ATTITUDE VARIABLES WITH DIASTOLIC BLOOD PRESSURE BY GROUPS

Group	N	Variable													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1 BMYL	69														
2 BMYH	68												.24		
3 BMOL	58			-.26											
4 BMOH	58												.24		
5 BFYL	65														
6 BFYH	64														
7 BFOL	64									-.34*					
8 BFOH	64														
9 WMYL	54				-.29			-.31*				.29			
10 WMYH	53														
11 WMOL	68				-.25										
12 WMOH	67														
13 WFYL	56														
14 WFYH	56														
15 WFOL	70										.23			.27	
16 WFOH	70	-.32*	-.28*			-.29*							-.32*		

*p $\leq$ .02

Tables 17 and 18 do not in general reveal a predominance of correlations, or of correlations for particular variables, within groups defined by race, sex, age, and education. For example, these tables give no evidence that significance is obtained more often for groups defined by either sex, or that certain correlations tend to be significant more often for women. There is one exception to this. There are more significant correlations for whites than for blacks for both systolic (8 vs. 6) and diastolic (10 vs. 4) blood pressure. It remains to be seen whether we can explain more variation in the blood pressure of whites than blacks with these attitude variables. No individual variables seem to do particularly well as blood pressure predictors.

It has been suggested above that we consider two types of variables, those relating more to personal aspects of race relations (1, 2, 5, 9, 10, 12, 13, 14) and those dealing with the social system itself (3, 4, 6, 7, 8, 11). Of the 28 correlations significant at the .05 level, 16 are of the first type and 12 the second. For those 12 significant at the .02 level, 8 are personal type variates and 4 social types. Since we have assigned the variables to these two groups in such a way that 8 are of the first type and 6 of the second, the percentages of significant correlations of each type are about what we would expect, assuming that neither type of variable is generally more associated with blood pressure than the other.

An original hypothesis was that personal variables would be more often significant for whites and social variables for blacks. These data do not show any striking difference by race in the type of variables selected. Comparing significant systolic correlations with significant diastolic correlations, again we find no difference in variable types chosen.

Another hypothesis is that blood pressure level is associated with the extent of prejudice or the strength of feelings one way or the other about race relations problems. If this were true, we might expect a preponderance of either positive or negative correlations among the values in Tables 17 and 18, since the variables were coded so that generally higher values indicate more prejudice, less contact, less willingness for integration, etc.

Some difference is apparent, indicating a possible relationship which will be examined later in this chapter. There are 12 positive correlations and 16 negative correlations significant at the .05 level; the corresponding frequencies at the .02 level are 4 and 8. Thus we find a greater than expected occurrence of negative correlations, or an increase in blood pressure with apparent decrease in prejudice. Examination of these correlations does not give us a clear picture of any striking relationships between the attitude variables measured and either systolic or diastolic blood pressure level. We now turn to a consideration of the regression analyses which were done on all of the sixteen race-sex-age education subgroups.

Square Root Method.

As a preliminary to consideration of the regression analysis results, we will briefly examine the results of the square root method in comparison with the step-wise regression technique. The square root method gives a step-wise selection of attitude variables for prediction of systolic and diastolic blood pressure, as does the regression procedure. The results in terms of final R^2 values and order of variable selection are so similar that the square root method will not be discussed separately.

Appendix II, part B gives a comparison of the variables selected by the two methods. For each group, the first set is for systolic blood pressure and the second for diastolic blood pressure. The first line in each instance gives the variables, in order of selection, for the step-wise regression, and the second gives the same information for the square root method. The similarity of the results is quite clear.

In all instances where significant blood pressure prediction was obtained, the variables selected (in order) by these two methods were identical. This is evident from the vertical lines for the data in Appendix II, part B. Each line denotes the point after which significance is no longer obtained with the addition of more variables. Therefore, in the following discussion, all that will be said about the significant variables in the regressions can be equally said about the variables chosen in the square root analysis. Possible implications of this perfect agreement will be discussed in Chapter V.

Regression Analysis.

Explained variance in blood pressure. The most evident observation to be made about the results of the step-wise regression analyses is that the attitude variables used in this study are not outstandingly successful as predictors of blood pressure level, if we use R^2, the per cent of variance in blood pressure due to the linear relationship with the attitudinal predictors, as a measure of success in prediction. Statistical significance is obtained in many instances, but the total percent of variance explained is in no case higher than 34%. There are attitude variables in most groups that are significantly associated with systolic or diastolic blood pressure level, however.

Tables 19 and 20 give the sample multiple correlation coefficient R, R^2, and the F value for all variables selected and for sets of variables giving significant R^2 values (These data are taken from Appendix II, part A.). It is recalled that at each step, the variable is selected which has the highest partial correlation with the dependent variable. The significance test for this partial correlation is based on the ordinary F test for significance of any zero-order correlation coefficient. That is,

$$F = (N - 2)\left(\frac{r^2}{1 - r^2}\right) \quad ,$$

with 1 and N - 2 degrees of freedom, where N is the sample size and r equals the sample correlation coefficient.

Significance of the linear equation is established by rejection of the hypothesis that $\bar{R}$ equals 0, where $\bar{R}$ represents the correlation of the selected linear combination of variables making up the regression equation with the dependent variable. It is the test of this hypothesis, obviously a generalization of the test mentioned above, which tells whether a given set of attitude variables can be used to predict systolic or diastolic blood pressure.

The test for significance of R, the sample multiple correlation coefficient, is based on an F statistic which has both the total number of individuals observed, N, and the number of variables, q (both independent and dependent) as parameters. Both N and q not only appear in the test statistic, but also determine the degrees of freedom used in the test. The statistic used is

$$F = \left(\frac{N - q}{q - 1}\right)\left(\frac{R^2}{1 - R^2}\right)$$

which is, under normality assumptions, distributed as F with q-1 and N-q degrees of freedom. Thus the test for significance of R at any step in the regression procedure takes into account the relative number of variables and subjects as well as the magnitude of the sample R itself.

The expected value of R depends on the relative size of q to the sample size N. It can be shown (77) that as the number of variables, q, approaches N, the expectation of R approaches 1 even when the population multiple correlation coefficient, $\bar{R}$, equals 0. The actual mathematical expectation

of R^2 is, for $\bar{R}$ equal to 0,

$$E(R^2) = \left(\frac{q - 1}{N - 1} \right) .$$

By adding variables in this step-wise procedure, we are increasing q for a fixed N. As we add variables, significance is reached and maintained until the ratio of variables to sample size is high enough that the sample R^2 is not significantly different from what we would expect it to be just by chance.

TABLE 19

TOTAL R AND R^2 VALUES FOR ALL ATTITUDE VARIABLES SELECTED AS BLOOD PRESSURE PREDICTORS, USING INCREASE IN R^2 AS A STOPPING CRITERION, FOR SYSTOLIC AND DIASTOLIC BLOOD PRESSURE

Group	N	Systolic			Diastolic		
		R	R^2	No. steps	R	R^2	No. steps
1 BMYL	69	.436	.19	12	.420	.18	12
2 BMYH	68	.400	.16	11	.455	.21	11
3 BMOL	58	.463	.21	13	.471	.22	12
4 BMOH	58	.521	.27	13	.431	.19	11
5 BFYL	65	.497	.25	13	.471	.22	14
6 BFYH	64	.463	.21	14	.428	.18	13
7 BFOL	64	.406	.16	14	.502	.25	14
8 BFOH	64	.527	.28	13	.454	.21	13
9 WMYL	54	.585	.34	14	.547	.30	13
10 WMYH	53	.568	.32	13	.539	.29	13
11 WMOL	68	.521	.27	14	.499	.25	13
12 WMOH	67	.483	.23	12	.425	.18	14
13 WFYL	56	.199	.04	9	.345	.12	13
14 WFYH	56	.533	.28	13	.522	.27	12
15 WFOL	70	.413	.17	14	.486	.24	13
16 WFOH	70	.462	.21	14	.531	.28	14

Total R^2 values will be considered briefly before we turn in the rest of this section to the consideration of significant regressions only.

It is apparent from Table 19 that we cannot explain a major proportion of the variance in systolic or diastolic blood pressure using the attitude variables included in this study, though there are some significant relationships, as will be shown. The highest R^2 value is only 34%. However, there are some interesting differences in the R^2 values which relate to demographic differences.

Suppose that for both systolic and diastolic regressions, we order the sixteen subsamples according to the R^2 values and split them in half on this basis into "high" and "low" R^2 groups, where R^2 is the percent of variance in blood pressure which is accounted for by the attitude variables included. The resulting groups are as follows:

Systolic

High R^2 ($\geq .23$): 4, 5, 8, 9, 10, 11, 12, 14
Low R^2 ($< .23$): 1, 2, 3, 6, 7, 13, 15, 16

Diastolic

High R^2 ($\geq .222$): 5, 7, 9, 10, 11, 14, 15, 16
Low R^2 ($< .222$): 1, 2, 3, 4, 6, 8, 12, 13

We can now categorize the subgroups by the consistency of R^2 across systolic and diastolic regressions. Some groups fall into high R^2 groups in both cases and some into low R^2

groups, while others are low in one group and high in the other. These groupings are as follows:

A. High R^2 for both systolic and diastolic regressions

5-BFYL, 9-WMYL, 10-WMYH, 11-WMOL, 14-WFYH

B. Low R^2 for both systolic and diastolic regressions

1-BMYL, 2-BMYH, 3-BMOL, 6-BFYH, 13-WFYL

C. Reversed R^2 grouping for systolic and diastolic regressions

4-BMOH, 7-BFOL, 8-BFOH, 12-WMOH, 15-WFOL, 16-WFOH

Note that all of the subgroups in the C category are "old"--those in the over 40 age group. These are the people for whom prediction of blood pressure is least consistent; the success in prediction for these groups tends to change from a relatively high level to low or the reverse as we move from systolic to diastolic predictions, rather than remaining constantly high or low. Those in the A group, where prediction is comparatively high for both systolic and diastolic blood pressure, are white, except for group 5. And those in the B group, in which prediction is consistently low for both blood pressure measures, are black, except for group 13.

These data initially suggest, therefore, that prediction of blood pressure level by these attitude variables is more consistently high or low for people in the sample under 40, high for whites and low for blacks. This race difference is in the same direction as for the original correlations.

Consistency of these relationships when we examine these data using only significant R^2's instead of total R^2's, and when we use factors instead of individual variates as predictors, remains to be examined.

We now consider only those cases where significant reduction in variance is obtained. For each group, we present, in Table 20, the summary data for the greatest number of steps for which significance was obtained.

TABLE 20

SIGNIFICANT R AND R^2 FOR ALL ATTITUDE VARIABLES SELECTED AS BLOOD PRESSURE PREDICTORS FOR SYSTOLIC AND DIASTOLIC BLOOD PRESSURE

Group	N	Systolic				Diastolic			
		R	R^2	F-value	Steps	R	R^2	F-value	Steps
1 BMYL	69	.250	.06	4.47	1	----	---	----	-
2 BMYH	68	.290	.08	5.98	1	----	---	----	-
3 BMOL	58	----	---	----	-	.260	.07	4.03	1
4 BMOH	58	----	---	----	-	----	---	----	-
5 BFYL	65	.454	.21	2.80	4	----	---	----	-
6 BFYH	64	.252	.06	4.20	1	----	---	----	-
7 BFOL	64	----	---	----	-	.336	.11	7.88	1
8 BFOH	64	.411	.17	5.42	2	.308	.09	3.16	2
9 WMYL	54	.485	.23	2.90	3	.476	.23	4.24	3
10 WMYH	53	.415	.17	5.20	2	.476	.23	2.66	4
11 WMOL	68	.460	.21	2.53	5	.236	.06	4.54	1
12 WMOH	67	.287	.08	5.85	1	----	---	----	-
13 WFYL	56	----	---	----	-	----	---	----	-
14 WFYH	56	.274	.08	4.40	1	.477	.23	3.95	4
15 WFOL	70	.239	.06	4.11	1	.271	.07	5.39	1
16 WFOH	70	.274	.08	5.53	1	.457	.21	2.76	3

Just as before in looking at the total R^2, we can now consider significant and non-significant groups based on R^2

for systolic and diastolic regressions. These are as follows:

Systolic

Significant R^2:

1, 2, 5, 6, 8, 9, 10, 11, 12, 14, 15, 16

Nonsignificant R^2:

3, 4, 7, 13

Diastolic

Significant R^2:

3, 7, 8, 9, 10, 11, 14, 15, 16

Nonsignificant R^2

1, 2, 4, 5, 6, 12, 13

Categorizing the groups, as before, we have

A. Significant R^2 for both systolic and diastolic regressions

8-BFOH, 9-WMYL, 10-WMYH, 11-WMOL, 14-WFYH, 15-WFOL, 16-WFOH

B. Nonsignificant R^2 for both systolic and diastolic regressions

4-BMOH, 13-WFYL

C. Reversed R^2 grouping for systolic and diastolic regressions

1-BMYL, 2-BMYH, 3-BMOL, 5-BFYL, 6-BFYH, 7-BFOL, 12-WMOH

Looking at the correlation matrices and at the total R^2 regressions, we found significant association of race relations attitudes with blood pressure more frequently for whites than for blacks. Greater success in blood pressure prediction is again found for whites when only the groups giving statistically significant prediction are considered.

Those who are inconsistent here with respect to systolic vs. diastolic measurement (list "C") are characterized by race rather than by age. For significant rather than total prediction, the "40 or younger" groups are not any more likely to show relationships between attitude and blood pressure than the "over 40" groups. The same kinds of groupings will be considered when the regressions on factors are discussed.

For both total R^2's and significant R^2's, we do not find any difference in R^2 values between systolic and diastolic regressions. The pertinent values are given in Table 21. The average R and R^2 were obtained by averaging the relevant columns from Tables 19 and 20. In both cases, the R values are so similar that the rounded R^2 values are within .01.

TABLE 21

AVERAGE R AND R^2 FOR SYSTOLIC AND DIASTOLIC REGRESSIONS FOR TOTAL R^2 VALUES AND SIGNIFICANT R^2 VALUES

Group	Systolic			Diastolic		
	N	R	R^2	N	R	R^2
Total R^2	16	.467	.22	16	.470	.22
Significant R^2	12	.341	.12	9	.368	.13

Significant predictor variables. We now wish to consider the variables that are responsible for the significant R^2 values in Table 20, in twelve groups for systolic blood pressure, and in nine groups for diastolic blood pressure. Tables 22 and 23 give the significant variables selected in

TABLE 22

INCREASE IN R^2 FOR SIGNIFICANT ATTITUDE VARIABLES, BY GROUP, FOR SYSTOLIC BLOOD PRESSURE REGRESSIONS

Group	Variable														Total Significant R^2
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
1 BMYL						.06*									.06
2 BMYH													.08*		.08
3 BMOL															--
4 BMOH															--
5 BFYL		.06		.03			.04						.07*		.21
6 BFYH					.06*										.06
7 BFOL															--
8 BFOH			.09*									.07			.17
9 WMYL			.04			.09	.10*								.23
10 WMYH				.09*				.09							.17
11 WMOL	.04*			.05	.05							.04		.03	.21
12 WMOH											.08*				.08
13 WFYL															--
14 WFYH						.08*									.08
15 WFOL										.06*					.06
16 WFOH		.08*													.08

*First variable selected in step-wise regression

TABLE 23

INCREASE IN R^2 FOR SIGNIFICANT ATTITUDE VARIABLES, BY GROUP, FOR DIASTOLIC BLOOD PRESSURE REGRESSIONS

Group	Variable														Total Significant R^2
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
1 BMYL															--
2 BMYH															--
3 BMOL			.07*												.07
4 BMOH															--
5 BFYL															--
6 BFYH															--
7 BFOL									.11*						.11
8 BFOH			.05*					.05							.09
9 WMYL				.06			.10*				.07				.23
10 WMYH									.07		.04	.06	.05*		.23
11 WMOL				.06											.06
12 WMOH															--
13 WFYL															--
14 WFYH			.06		.07				.05				.05*		.23
15 WFOL													.07*		.07
16 WFOH	.10*		.03		.07										.21

*First variable selected in step-wise regression

each case, the tabled values giving the increase in R^2 due to adding each variable. All of these increases in explained variation are at least 3%. For each regression, the first variable selected is starred.

To summarize the significant variables, Table 24 presents, for systolic regressions, diastolic regressions, and for both, the number of times each variable is selected as significant, and the number of times selected as the first significant variable in a regression.

TABLE 24

NUMBER OF TIMES SELECTED, AND NUMBER OF TIMES SELECTED FIRST, FOR EACH OF FOURTEEN ATTITUDE VARIABLES, FOR SYSTOLIC AND DIASTOLIC BLOOD PRESSURE REGRESSIONS

Regression type	Variable													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Systolic														
Selected	1	2	2	3	2	3	2	1	0	1	1	2	2	1
Selected 1st	1	1	1	1	1	1	1	0	0	1	1	0	2	0
Diastolic														
Selected	1	0	4	2	2	0	1	1	3	0	2	1	3	0
Selected 1st	1	0	2	1	0	0	1	0	1	0	0	0	3	0
Both														
Selected	2	2	6	5	4	3	3	2	3	1	3	3	5	1
Selected 1st	2	1	3	2	1	1	2	0	1	1	1	0	5	0

No single variable acts as a strong blood pressure predictor. Variables 3 (unequal rent), 4 (unequal pay), and 13 (tenseness in interracial situations) are selected most often. It is of interest to note that variable 13 is selected in five cases as the single most important predictor of blood pressure

and is always chosen first whenever it is chosen at all.

In order to look more closely at these variables, we need a method of grouping the individual variates into clusters. It is the opinion of the author that, in order to evaluate the selection of particular variables in regression as indicative of relationships with the dependent variable, it is more useful to think of a variable as a representative of a group of variables which are related conceptually, than to seek substantive meaning in the significance of an individual variable. In addition, to make comparisons for systolic and diastolic regressions and to make comparisons by race, sex, age, and education, in terms of variables selected here, it may be advantageous to try to categorize the variables into groups, and to make comparisons based on the groupings.

Because of the dependence of the regression technique on the intercorrelations among variables, the omission of a variable from selection by the step-wise regression does not allow us to conclude that that particular variable is unimportant. A high correlation between two available predictor variables is likely to result in the selection of only one of them as significant. The remaining one may not appear in the list of significant variables, since its predictive value has largely been accounted for by its association with the variable already selected.

For these same reasons, there are problems in using the regression coefficients for the variables selected (and the related R^2 values) as indicators of the strength of relationship of individual variates to the dependent variable. Some

of these difficulties are discussed in a very lucid paper by Gordon (25). He points out that as redundant predictor variables (i.e., highly intercorrelated) are successively introduced into a regression problem, their common predictive value gets averaged out over all of the regression coefficients, so that all of the regression coefficients decrease in absolute value. Thus if in our choice of variables we have represented a particular theoretical concept by several variables and a second concept by only one variable, if it happens that several of the first group are included in the regression, the predictive value of the first will be spread out over several regression coefficients, giving the impression that these variables are much less important than the second, where the predictive value is all concentrated in one coefficient. These are some of the problems that lead to the use of factor scores as predictor variables. This will be discussed in a later section.

Our procedure will be to attempt to assign the fourteen attitude variables to conceptually distinct sets. Then, rather than looking at individual variables or comparing the sizes of R^2 values, we will look at the variable sets represented by significant variables. Two questions will be considered: Do variables selected by any particular regression problem tend to come from the same or from different variable sets? Do the variable sets represented by the regressions tend to vary in any systematic way for systolic vs. diastolic blood pressure, or by race, sex, age, and education?

The most obvious and conceptually simple grouping of variables, to the author, is the one briefly discussed earlier in this chapter. This is a division of the attitude questions into two groups, those dealing with personal situations related to interracial contact, willingness or preference for contact, tenseness about contact, etc., and social variables, such as perceptions of the extent of inequality for blacks, optimism about the future of race relations, belief in the effectiveness of civil rights vs. law enforcement, etc. This two-concept model is the one that will be used here.

For purposes of evaluation of the reasonableness of such a model, a factor analysis was done on the fourteen attitude variables for the entire sample. This preliminary factor analysis should not be confused with the later ones which were done on the individual race, sex, age, and education groups, with somewhat different objectives. The factor loadings obtained by this factor analysis, as originally done, are given in Table 25, along with the cumulative proportion of the total variance accounted for by each factor. The highest loading for each variable is underlined.

Most of the variance explained by these factors is explained by the first two factors. The addition of further factors does not greatly increase the explained variance. It will be noted that the highest loadings (correlations of variables with the factors) are on the first two factors. Only variable 11 has its highest loading on a factor other than the first or second. Using the varimax rotation included in the

BMD program for factor analysis described earlier, and specifying two factors as the number to be rotated, we obtain the rotated factor matrix presented in Table 26, which fits the factor analysis model as well as the original first two factors.

TABLE 25

UNROTATED LOADING MATRIX FOR FACTOR ANALYSIS FOR FOURTEEN ATTITUDE VARIABLES

Variable	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
1	.75	-.05	-.05	.12	-.06	.02
2	.77	.09	-.05	.03	-.05	.02
3	.52	-.39	.01	.15	.06	-.03
4	.41	-.50	.03	.04	.06	-.01
5	.56	.07	-.03	-.15	-.00	.03
6	.02	.17	-.11	.13	.07	.10
7	.48	-.21	.18	-.03	-.08	.05
8	.08	-.28	.07	-.11	.03	.05
9	.24	.27	.12	.25	-.00	-.01
10	.53	.32	.20	.02	.03	-.05
11	-.07	-.14	-.33	.05	-.02	-.04
12	.66	.07	-.11	-.21	.02	-.04
13	.32	.20	.20	-.08	.05	.01
14	.46	.28	-.27	-.01	.03	.02
Cumulative % of variance	23.1%	29.5%	32.0%	33.5%	33.7%	33.9%

TABLE 26

ROTATED FACTOR LOADING MATRIX FOR FACTOR ANALYSIS ON FOURTEEN ATTITUDE VARIABLES, TWO FACTORS ROTATED

Variable	Factor 1	Factor 2
1	.65	.36
2	.73	.26
3	.30	.58
4	.15	.63
5	.54	.18
6	.09	-.15
7	.35	.40
8	-.05	.28
9	.33	-.14
10	.62	-.06
11	.00	.16
12	.62	.22
13	.37	-.05
14	.54	-.06

The loading for the factor on which each variable loads most highly is underlined in each case. This gives us a division of the variables into two sets, those correlating best with factor 1 and those correlating best with factor 2. These two sets, which accord well with our notions of personal vs. social types of variables, are:

Personal:

(A) 1) preference for integrated vs. segregated housing
2) social distance, i.e., extent of willingness for contact
5) attitude toward school integration and social contact
9) negative, hateful attitudes toward other race
10) extent of fear of interracial association

12) interpersonal contact with other race
13) tenseness in interracial situation
14) desire for interracial contact

Social:

(B) 3) perceived rent inequalities
4) perceived pay inequalities
6) optimism about future of race relations
7) effectiveness of civil rights vs. law enforcement
8) whether whites will change by force or persuasion
11) feelings of shame for behavior of own race

These are the two sets of variables, referred to as personal (A) and social (B), which will be considered in the following discussion. A further justification for using these two sets instead of some others is the relationship of the results of this factor analysis to those done for the sixteen demographic subgroups. This will be explained in the next section, but only briefly discussed here. When we rotate specifying two factors in the latter cases, we tend to get two sets of variables which can in most cases be identified with the A and B sets listed above. As the number of factors rotated is increased, however, the grouping of variables seems to become more related to each specific sample subgroup than to one overall factor pattern. These groupings and the corresponding factor loadings are given in Appendix III, part B. The two-factor pattern, with personal and social variables as listed above defining the two factors, seems to be the only pattern for this particular set of data that fits all of the sample groups simultaneously and that can be interpreted in terms of conceptual dimensions of prejudice.

Table 27 gives the number of significant variables of each type selected for each subgroup, for systolic and diastolic regressions together and separately.

TABLE 27

NUMBER OF SIGNIFICANT A(PERSONAL) AND B(SOCIAL) VARIABLES SELECTED BY GROUP, FOR SYSTOLIC, DIASTOLIC, AND ALL REGRESSIONS

Group	Systolic		Diastolic		All regressions	
	Personal (A)	Social (B)	Personal (A)	Social (B)	Personal (A)	Social (B)
1 BMYL	0	1	0	0	0	1
2 BMYH	1	0	0	0	1	0
3 BMOL	0	0	0	1	0	1
4 BMOH	0	0	0	0	0	0
5 BFYL	2*	2	0	0	2	2
6 BFYH	1	0	0	0	1	0
7 BFOL	0	0	1	0	1	0
8 BFOH	1	1*	0	2	1	3
9 WMYL	0	3	0	3	0	6
10 WMYH	0	2	3*	1	3	3
11 WMOL	4*	1	0	1	4	2
12 WMOH	0	1	0	0	0	1
13 WFYL	0	0	0	0	0	0
14 WFYH	0	1	3*	1	3	2
15 WFOL	1	0	1	0	2	0
16 WFOH	1	0	2*	1	3	1
Total	11	12	10	10	21	22

*Frequency contains the single best predictor

There are six groups (5, 8, 10, 11, 14, 16) in which variables of both types are selected as significant predictors. These do not make a strong case for equal importance of both A and B type variables, however. In most of these groups there is a strong preference for one type, both in terms of order

of variables selected and R^2 contributions.

We see from Table 27 that there is no tendency for either type A or type B variables to be selected much more often than the other type. There is no association between the frequency of type A and B variables selected and the blood pressure measurement used, i.e., systolic or diastolic. Variables of type B are selected slightly more often than expected. Given 43 significant variables, with 6 of type B and 8 of type A available for selection, we would expect 43 x 6/14 or 18 type B variables and 43 x 8/14 or 25 of type A. The actual corresponding figures are 22 and 21. There is no strong evidence that B variables are more important than A variables. This holds also when we consider only the variable selected first in each case.

To look at whether the demographic variables have any effect on tendency toward selection of A or B variables, we have characterized the fourteen relevant (having significant R^2's) subgroups as A or B types according to the significant variables selected in each case, and have tabulated the results in Table 28. This characterization was based mostly on the data in Table 27.

In those six cases (groups 5, 8, 10, 11, 14, 16) where variables of both types were selected, there was a clear preference in order of selection in each case, and usually in number of variables selected and R^2 values (see Tables 22 and 23), for either the A or B type. Therefore, in each instance, we could assign a group to either the A or B type,

for each of the two regressions done in that group. In three cases (groups 10, 11, 14), the classification by A or B type was different for diastolic blood pressure prediction than it was for systolic. Thus for the "either" tabulation, these three groups are included in the tabulations for both the A and B columns.

TABLE 28

NUMBER OF GROUPS OF TYPE A(PERSONAL) AND TYPE B(SOCIAL) SELECTED FOR SYSTOLIC, DIASTOLIC, AND COMBINED REGRESSIONS, BY RACE, SEX, AGE, AND EDUCATION

Control	Systolic		Diastolic		Either	
	Personal (A)	Social (B)	Personal (A)	Social (B)	Personal (A)	Social (B)
Race:						
Black	3	2	1	2	4	3
White	3	4	4	2	5	5
Sex:						
Male	2	4	1	3	3	6
Female	4	2	4	1	6	2
Age:						
< 40	3	4	2	1	5	4
> 40	3	2	3	3	4	4
Education:						
Low	3	2	2	3	4	4
High	3	4	3	1	5	4

Defining groups:

Systolic	A)	2, 5, 6, 11, 15, 16
	B)	1, 8, 9, 10, 12, 14
Diastolic	A)	7, 10, 14, 15, 16
	B)	3, 8, 9, 11
Either	A)	2, 5, 6, 7, 10, 11, 14, 15, 16
	B)	1, 3, 8, 9, 10, 11, 12, 14

The only overall pattern revealed in this table, which is upheld for both systolic and diastolic regressions separately and combined, is one related to sex. For all three cases considered here, the significant predictors of blood pressure are more likely to be type B or social variables for men, while those for women are more likely to be type A or personal variables. As the factor score regressions are discussed, we will attempt to corroborate this tendency. No consistent race, age, or education differences in type of variable selection are evident.

Factor Analysis.

Factor structure. For the sixteen groups defined by race, sex, age, and education, the unrotated factor analysis matrices are given in Appendix III, part A. By the factors comprising these matrices, we can explain an average of 41% of the variance. Table 29 shows the cumulative variance explained as each factor is added, for each of the sixteen groups.

The number of factors defined ranges from 7 to 9, and the cumulative explained variance due to adding factors is quite similar for all the groups. A noticeable difference is that although the average variance explained is only slightly higher for whites than for blacks (42.5% compared to 40.2%), the increases in variance for blacks are a bit more spread out over several factors than the increases for whites. For one to five factors, the average cumulative values are:

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Blacks	14.7%	23.0%	29.2%	33.8%	36.9%
Whites	19.7%	26.8%	32.1%	36.0%	39.0%

TABLE 29

CUMULATIVE EXPLAINED VARIANCE FOR UNROTATED FACTORS, FOR FACTOR ANALYSES DONE FOR FOURTEEN ATTITUDE VARIABLES FOR EACH OF SIXTEEN SUBGROUPS (PERCENT)

Group	Factors								
	1	2	3	4	5	6	7	8	9
1 BMYL	15.5	23.2	27.9	31.2	33.9	35.7	36.6	37.1	--
2 BMYH	12.4	21.3	27.0	32.7	35.9	36.8	37.0	37.3	--
3 BMOL	12.6	21.9	29.4	34.4	37.0	39.0	40.9	41.2	--
4 BMOH	13.1	20.4	26.8	31.9	34.4	36.5	37.6	--	--
5 BFYL	15.0	22.5	27.5	31.8	35.0	36.8	38.2	38.3	--
6 BFYH	17.0	26.1	32.5	36.9	39.9	42.0	42.9	43.2	--
7 BFOL	19.8	28.8	36.5	41.1	45.3	46.4	47.4	--	--
8 BFOH	12.3	19.8	26.0	30.4	34.1	37.0	38.5	39.1	--
9 WMYL	22.2	29.0	34.5	38.2	41.3	44.2	45.0	45.4	--
10 WMYH	22.7	28.9	33.3	37.2	40.0	42.7	44.6	44.8	--
11 WMOL	17.1	23.9	27.9	30.4	32.8	34.3	35.4	36.0	--
12 WMOH	20.9	28.0	33.3	36.4	39.2	40.6	41.9	42.3	--
13 WFYL	17.7	24.6	30.1	34.7	38.6	40.2	41.6	42.5	42.9
14 WFYH	18.5	27.5	34.2	40.0	43.8	46.2	47.3	47.7	47.9
15 WFOL	18.6	25.5	30.2	33.3	35.9	37.2	37.9	38.0	--
16 WFOH	20.1	27.2	32.9	37.4	40.4	41.6	42.2	42.3	--

Thus by the time we reach the third factor, for example, we are adding 6.2% to the explained variance for blacks and, comparatively, 5.3% for whites. This seems to be due partly to a tendency for the variables dealing with contact situations and desire for contact situations to be less closely correlated for blacks than whites. And, in general, the correlation matrices show lower correlation coefficients for

blacks than for whites (see Appendix I, part G), for most variables.

Varimax rotations were done for all sixteen unrotated factor matrices, with two, three, four, and five factors rotated in each case. The highest loading for each variable, for each rotation, is given in Appendix III, part B. The loading in each case is the highest correlation for the particular variable with any of the rotated factors.

The usual procedure in factor analysis at this step is to assign each variable to the factor on which it loads most highly. We can then speak of factors as generally being represented by groups of variables, and it is these groups we look at as indicators of the main conceptual dimensions invloved in the entire set of variables used originally. For any given factor, the variables with the highest loadings are the ones most representative of that factor, i.e., the ones most important in determining the factor score for the factor, for any particular individual. Most factors in these data have variables with loadings of at least .50, a highly significant correlation for the sample sizes we are dealing with, and these variables could be used in efforts to "define" the factors.

We will use the factor scores as variables to try to predict blood pressure and will compare the variables related to significant factors to significant variables from the single variate regressions. We will also look at the success of selected single regression variates as representatives of factors in each of the subgroups. We do not propose

here to go through all of the factor matrices in an attempt to label all of the factors in some meaningful way.

Some of the problems involved in such a procedure are discussed by Armstrong and Soelberg (3). They report a study in which employees are asked to rate supervisors on twenty traits. These responses are factor analyzed and 71% of the variance accounted for by 9 factors. The authors name the factors and cite literature lending support to their factor solution. They then reveal that the responses actually consist of random normal deviates with arbitrary trait names assigned prior to the factor analysis, i.e., there were no real employees. As measures of factor reliability they suggest repeated factor analyses on data split randomly into two samples, a priori postulation of groupings and variables expected to dominate factors, and simulation methods.

We may think of our sixteen subgroups as representing repetitions in which we are looking for similar factor structures, even though the groups are not constructed by random selection. Considering rotations on two factors, we find a reasonable clustering of variables into the A type (personal) and B type (social) for most of these groups. This will be demonstrated shortly. For rotations on more than two factors, no clearly repeated structure is obtained, either for all of the groups or among those groups defined by some characteristic such as race.

As discussed earlier, the factor matrix for the attitude variables on all subjects was rotated to give two groups of

factors, those listed on page 117 ff. We will briefly consider the extent to which the individual subgroup factor analyses provide data in agreement with this two-factor structure, by looking, within each subgroup, at the rotation on two factors.

The procedure for assigning variables to factors has been discussed previously. Each variable is assigned to the factor with which it correlates most highly (i.e., the factor on which it loads most highly). This gives, for each subgroup, two sets of variables. On the basis of the variables included in each factor, one factor can be designated the personal factor and one the social factor.

There is no subgroup in which the two sets of variables correspond exactly with those defined by factor analysis on the entire sample, but, generally, the "personal" variables dominate one factor and "social" variables the other. There are two groups (3 and 5) in which this is not true. In these cases, factors were called personal and social factors on the basis of relative sizes of the factor loadings of "personal" and "social" variables.

In Appendix III, part B, "P" and "S" mark the factors for each group that were designated "personal" and "social" on the basis described above. Table 30 gives, for each group, the personal variables (1, 2, 5, 9, 10, 12, 13, 14) and social variables (3, 4, 6, 7, 8, 11) assigned respectively to the factors designated as personal and social.

TABLE 30

AGREEMENT OF INDIVIDUAL FACTOR ANALYSES WITH TOTAL FACTOR ANALYSIS, WITH TWO FACTORS ROTATED

Group	Factor A(personal)								Factor B(social)						Total
	1	2	5	9	10	12	13	14	3	4	6	7	8	11	
1 BMYL		*	*	*	*	*	*				*	*	*	*	10
2 BMYH	*	*	*			*		*	*	*	*	*	*	*	11
3 BMOL			*		*	*	*		*	*			*		7
4 BMOH			*			*	*	*			*	*	*	*	8
5 BFYL		*	*		*	*		*			*	*			7
6 BFYH	*	*		*	*	*		*	*	*	*		*		10
7 BFOL	*	*				*		*	*	*	*		*	*	9
8 BFOH				*	*	*	*	*	*	*	*	*	*		10
9 WMYL		*	*		*	*	*	*	*	*		*	*		10
10 WMYH	*	*	*	*	*			*	*	*			*	*	10
11 WMOL	*	*	*	*	*	*	*	*	*	*					10
12 WMOH	*	*	*	*	*	*		*		*	*		*	*	11
13 WFYL	*	*	*	*		*	*	*	*		*		*	*	11
14 WFYH		*	*			*	*	*	*	*	*				8
15 WFOL		*	*		*	*	*	*	*	*		*	*	*	11
16 WFOH	*	*	*	*	*	*		*	*	*	*	*			11
Total	8	13	13	8	11	15	9	14	12	12	11	8	12	8	

The figures in the bottom row give the total number of groups including each personal variable (defined by factor analysis on the entire sample) on the subgroup factor designated the personal factor, and the corresponding totals for social variables. The actual figure for any variable is, thus, the number of times (of 16 possible) that it was "correctly" assigned. For the personal factor, there are four of the eight variables (2, 5, 12, and 14) that load correctly in at least 13 of the 16 subgroups (more than 75%). On the

social factor, three of the six variables (3, 4, 8) load correctly on 75% of the groups.

The right-hand column gives the number of variables, of a possible 14, that load correctly, as defined in the preceding paragraph, for each group. In 11 of the 16 groups, 10 or more variables (70+%) are correctly assigned by maximum loading. The two-factor structure gives an acceptible, though not perfect interpretation for this set of attitude questions, with some indications that variables 2, 3, 4, 5, 8, 12, and 14 are the most consistent representatives of the two factors considered. No such correspondence between factor structures for the whole sample and the individual subgroups could even be approximated with rotations on 3, 4, and 5 factors. We now turn to the consideration of factor scores (linear combinations of the individual variates, with weights equal to the loadings) as blood pressure predictors, using step-wise regression.

Explained variance in blood pressure. Regressions were done for each of the sixteen subgroups using the two, three, four, and five factor rotated matrices to compute factor scores for each individual. Results appear in Appendix III, part C. Cases in which significant R^2's resulted are given in Tables 31 and 32. In all but one instance, the significant R^2 values were due to one factor score only. For diastolic prediction in group 16, two factor scores provided significant prediction.

TABLE 31

SIGNIFICANT R AND R^2 FOR ALL FACTORS (COMPOSED OF ATTITUDE VARIABLES) SELECTED AS SYSTOLIC BLOOD PRESSURE PREDICTORS

Group	N	Two factors			Three factors			Four factors			Five factors		
		R	R^2	F	R	R^2	F	R	R^2	F	R	R^2	F
1 BMYL	69												
2 BMYH	68							.274	.08	5.37	.277	.08	5.51
3 BMOL	58												
4 BMOH	58												
5 BFYL	65												
6 BFYH	64												
7 BFOL	64												
8 BFOH	64	.367	.13	9.65	.338	.11	8.01	.318	.10	6.98	.342	.12	8.21
9 WMYL	54	.344	.12	6.97	.316	.10	5.75				.289	.08	4.75
10 WMYH	53							.270	.07	4.01	.282	.08	4.42
11 WMOL	68												
12 WMOH	67	.244	.06	4.12	.244	.06	4.13						
13 WFYL	56												
14 WFYH	56							.342	.12	7.14	.301	.09	5.36
15 WFOL	70												
16 WFOH	70	.248	.06	4.45	.251	.06	4.58	.262	.07	5.01			

TABLE 32

SIGNIFICANT R AND R^2 FOR ALL FACTORS (COMPOSED OF ATTITUDE VARIABLES) SELECTED AS DIASTOLIC BLOOD PRESSURE PREDICTORS

Group	N	Two factors			Three factors			Four factors			Five factors		
		R	R^2	F	R	R^2	F	R	R^2	F	R	R^2	F
1 BMYL	69												
2 BMYH	68							.273	.07	5.31	.238	.06	3.98
3 BMOL	58												
4 BMOH	58												
5 BFYL	65												
6 BFYH	64												
7 BFOL	64				.255	.06	4.30	.283	.08	5.40	.270	.07	4.88
8 BFOH	64												
9 WMYL	54	.311	.10	5.57	.286	.08	4.64						
10 WMYH	53												
11 WMOL	68												
12 WMOH	67												
13 WFYL	56												
14 WFYH	56												
15 WFOL	70										.236	.06	3.99
16 WFOH	70	.366	.13	10.52	.376	.14	11.20	.355	.13	9.77	.399	.16	6.78

One can see from Appendix III, part B, by comparing the factor composition from two to five factors for any group, that there is a high degree of consistency. As each new factor is added, a few variables split off from the previous factors to form the new factor. The loadings of the remaining variables do not change greatly. Therefore, in each succeeding rotation, there tend to be factors whose computed factor scores are similar to the previous ones. The result is that where there is significant prediction by a factor score from one rotation, there tends to be significance due to a similarly constituted factor score on succeeding rotations.

Prediction here is significant somewhat less often than when individual variates are used. In this discussion the regressions on the individual variables presented in the last section are referred to as the single variate regressions, and the regressions on linear combinations are referred to as the factor score regressions. Just as for the single variate regressions, we find for the factor score regressions a greater success in prediction for whites than for blacks. Those who have consistently high or low R^2 values are more likely to be in the younger age group, as for the single variate regressions, although the relationship here is not as strong. Neither the systolic nor diastolic regressions has consistently higher R^2 values for the significant regressions, as was found also for the single variate regressions. Significant systolic predictors occur more often than diastolic

however, and this is consistent with the regressions previously discussed. More detailed comparison of the predictive success of individual variates vs. factor scores will be made in a later section. The immediate focus is on the regressions on factor scores.

For practical as well as empirically justifiable considerations, we did not attempt to go beyond five factor rotations. As discussed on page 122 ff., most of the explained variation is contained in the first two or three factors. As the number of factors increases, the highest loadings tend to remain on a small number of factors. There is only one instance (group 15, diastolic) in which significance is achieved only on the five factor model and not earlier.

Significant predictor variables. The next aspect of this analysis to be considered is the variable composition of the factors that produce significant regressions. Using the usual procedure of assigning variables to factors on the basis of their highest loadings, we can establish, for each of the significant factors, just which variables are involved in determination of the factor score. Tables 33 and 34 show for systolic and diastolic regressions, by subgroup, the variables for each group which load more highly on significant than nonsignificant factors.

For each variable, we have in Table 35 the number of times the variable is present on a significant factor, for systolic, diastolic, and combined regressions on factors.

TABLE 33

VARIABLES WITH HIGHEST LOADINGS ON FACTORS SIGNIFICANT IN SYSTOLIC BLOOD PRESSURE REGRESSIONS

Group	Variables													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1 BMYL														
2 BMYH									*	*	*		*	
3 BMOL														
4 BMYH														
5 BFYL														
6 BFYH														
7 BFOL														
8 BFOH	*	*	*	*	*	*	*	*						
9 WMYL	*	*	*	*	*	*	*	*	*				*	
10 WMYH							*	*			*			
11 WMOL														
12 WMOH				*		*		*			*		*	
13 WFYL														
14 WFYH				*		*								
15 WFOL														
16 WFOH	*	*			*			*	*	*	*	*		*

TABLE 34

VARIABLES WITH HIGHEST LOADINGS ON FACTORS SIGNIFICANT IN DIASTOLIC BLOOD PRESSURE REGRESSIONS

Group	Variables													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1 BMYL														
2 BMYH										*	*		*	
3 BMOL														
4 BMOH														
5 BFYL														
6 BFYH														
7 BFOL						*		*	*	*	*		*	
8 BFOH														
9 WMYL	*		*	*			*	*	*					
10 WMYH														
11 WMOL														
12 WMOH														
13 WFYL														
14 WFYH														
15 WFOL		*			*					*		*	*	*
16 WFOH	*	*			*			*	*	*	*	*		*

TABLE 35

NUMBER OF TIMES SELECTED FOR EACH OF FOURTEEN ATTITUDE VARIABLES FOR SYSTOLIC AND DIASTOLIC BLOOD PRESSURE REGRESSIONS ON FACTORS

Regression type	Variable Number													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Systolic	3	3	2	4	3	4	3	5	3	2	4	1	3	1
Diastolic	2	2	1	1	2	1	1	3	3	4	3	2	3	2
Total	5	5	3	5	5	5	4	8	6	6	7	3	6	3

The variables most often loaded highest on factor scores yielding significant regressions are, from Table 35, variables 8(whites changed by force or persuasion), 9(hate), 10(fear), 11(shame), and 13(tenseness in interracial situations).

Of the variables mentioned above, variable 13 is the only one that was found to be one of the variables selected most often as a significant predictor by the single variate regressions. Looking at Tables 18 and 19, pages 98-99, we see that variable 13 also correlates (significantly) with blood pressure more often than is the average for all variables. These tables show 28 significant correlations for systolic and diastolic blood pressure, giving on the average one for each variable. Variable 13 accounts for three of the significant correlations.

Variable 13 has, among those variables loading highly on significant factors, higher than average loadings, and loads best onto a significant rather than nonsignificant factor for 5 of the 9 groups in which the factor score

regressions give significant R^2 values. Tenseness in interracial situations is the one variable that we find, by the different methods considered in this thesis, to be consistently related to elevated blood pressure.

The hypothesis that tenseness relating to interracial contact is associated with elevated blood pressure is substantiated by the consistency of findings for the original correlation matrices, the single variable regressions, and the factor score regressions. It is not a hypothesis that would have been strongly suggested by any of these three pieces of information alone. The importance of multiple methods of observation of data will be discussed in Chapter V.

By grouping the variables as we did for the single variate regressions, we may be able to get at a better method of comparison of variable types selected. The purposes for this variable grouping are discussed beginning on page 113, with the proposed grouping and its justification immediately following. The actual variable sets employed (Personal-A; Social-B) are listed on page 117 ff. Table 36 describes the data for the factor score regressions which corresponds to the figures in Table 27, page 119, for the single variable regressions. We show in this table, by group, the number of variables of type A and type B related to significant systolic and diastolic blood pressure prediction. These variables are, from Tables 33 and 34, the variables with their highest loadings on statistically significant factors.

TABLE 36

NUMBER OF A(PERSONAL) AND B(SOCIAL) VARIABLES SELECTED, BY GROUP, FOR SYSTOLIC, DIASTOLIC, AND ALL REGRESSIONS ON FACTORS

Group	Systolic		Diastolic		All regressions	
	Personal (A)	Social (B)	Personal (A)	Social (B)	Personal (A)	Social (B)
1 BMYL	0	0	0	0	0	0
2 BMYH	3	1	2	1	5	2
3 BMOL	0	0	0	0	0	0
4 BMOH	0	0	0	0	0	0
5 BFYL	0	0	0	0	0	0
6 BFYH	0	0	0	0	0	0
7 BFOL	0	0	3	3	3	3
8 BFOH	2	6	0	0	2	6
9 WMYL	5	5	2	4	7	9
10 WMYH	0	3	0	0	0	3
11 WMOL	0	0	0	0	0	0
12 WMOH	1	4	0	0	1	4
13 WFYL	0	0	0	0	0	0
14 WFYH	0	2	0	0	0	2
15 WFOL	0	0	6	0	6	0
16 WFOH	7	2	7	2	4	4
Total	18	23	20	10	36	33

There is some tendency in these data for systolic regressions to be related to social type predictor variables and diastolic regressions to personal type predictor variables. This tendency finds no support in the data on single variate regressions. From Table 27 we found virtually equal frequency of selection of personal and social variables for significant single variable regressions.

A second aspect of these data that is of interest is whether any relationship can be found between variable types selected and demographic status by race, sex, age, and

education. For the single variable regressions considered, it was possible to characterize the subgroups as A or B types on the basis of significant variables. In this case, there are two groups (7, diastolic, and 9, systolic) where both types of variables are equally represented in frequency and fairly equally represented in significant factor loadings. Tabulation by demographic status is repeated here in Table 37 as it was done in Table 28, except that groups 7 and 9 are counted in both A and B groups.

TABLE 37

NUMBER OF GROUPS OF TYPE A(PERSONAL) AND TYPE B(SOCIAL) SELECTED FOR SYSTOLIC, DIASTOLIC, AND COMBINED REGRESSIONS, BY RACE, SEX, AGE, AND EDUCATION

Control	Systolic		Diastolic		Either	
	A	B	A	B	A	B
Race:						
Black	1	1	2	1	2	4
White	2	4	2	1	3	4
Sex:						
Male	2	3	1	1	2	3
Female	1	2	3	1	3	6
Age:						
≤ 40	2	3	1	1	2	2
> 40	1	2	3	1	3	7
Education:						
Low	1	1	2	2	3	2
High	2	4	2	0	2	4

Defining groups:

Systolic	A) 2, 9, 16	B) 8, 9, 10, 12, 14
Diastolic	A) 2, 7, 15, 16	B) 7, 9
Either	A) 2, 7, 9, 15, 16	B) 7, 8, 9, 10, 12, 14

These data are not indicative of any strong tendency for the selection of variable types A and B to be associated with any of the demographic controls used here. The differences by sex are not inconsistent with the tendency noted earlier, for B variables to be more often significant for men and A variables for women, but there is no definitive support for that hypothesis here. We will now consider a few somewhat more structured comparisons of regression and factor analysis.

Regression vs. Factor Analysis.

Prediction of blood pressure. The first question to be considered is the relative success in prediction of systolic and diastolic blood pressure using regression on single variates and regression on factors. In terms of R^2, the per cent of variance explained by the regression, for all sixteen subgroups, the single variate regressions all have larger R^2 values than the factor score regressions on two, three, four, or five factors. The R^2 values averaged over all sixteen groups, for systolic and diastolic regressions, are given in Table 38, for single variate regressions on the first variate and on all variates included in each case, and for all of the factor score regressions (on all factors).

Clearly, the individual attitude variables provide better prediction of both systolic and diastolic blood pressure than any of the factor scores. By increasing the number of factors, we can increase the predictive power of

TABLE 38

AVERAGE R^2 VALUES FOR SYSTOLIC AND DIASTOLIC REGRESSIONS ON FOURTEEN ATTITUDE VARIABLES AND FACTORS COMPOSED OF THE VARIABLES, FOR SIXTEEN SUBGROUPS

Regressions	Single variate regressions		Factor score regressions			
	1 variable	All variables	2 factors	3 factors	4 factors	5 factors
Systolic	.0645	.2259	.0458	.0582	.0808	.0943
Diastolic	.0626	.2239	.0440	.0553	.0725	.0780

the factor regressions. But as we increase the number of factors, they will be composed of smaller and smaller numbers of highly loading variates, so that we are essentially approaching the individual variate situation. In these data, we have to use at least four factors for the predictive power of all of the factor scores together to exceed that using one individual variable (Compare column 1 and 5.).

Gordon (25) suggests the use of multiple regression for predictive purposes only, as opposed to comparing coefficients or R^2's at each step to evaluate relative strengths of contributions made by variates. Problems arising from the latter procedure are described briefly on page 114. For prediction only, the individual variates provide higher total R^2 values than the constructed factor scores for these data.

If we turn to the significant R^2 values, the single variable regressions are again more successful than the factor score regressions. Using the individual variates as

predictors, we obtain significant systolic blood pressure predictions in 12 of the sixteen subgroups and significant diastolic predictions in 9 subgroups. The corresponding values for the factor score regressions are 7 and 5. For the factor score regressions, in one case (group 1, systolic) in which there is no significant regression, it seems possible that significance would be achieved if additional factors were rotated. Combining the variables into factors for these particular data does not appear to help either in terms of total predictability or in frequency of significant prediction among the sample subgroups.

Variables as factor representatives. It was suggested earlier that variables selected by single variate step-wise regression be considered as representatives of sets of variables, and such sets were defined for these data for comparative purposes. We have defined factors as sets of variables in the two, three, four, and five factor rotation cases by assigning each variable to the factor on which it loads most highly. We would now like to see how well these factors are represented by the variables selected individually as predictors of blood pressure. If the factors are constructed in such a way that they actually do represent independent concepts composed of combinations of single variables, do the first few variables selected by the single variate regressions represent these distinct concepts?

Let us hold the number of variables selected (by the single variable regression) constant and equal to the number of factors rotated for the same group. Then if two variables appear on the same factor, on the basis of assignment by factor loadings, ideally we expect the selection of one of them as a blood pressure predictor to preclude selection of the second. This is in accordance with the notion that step-wise regression variables selected can be thought of as representatives of sets of variables.

The extent to which this pattern holds is expressed by the figures in Table 39. This table presents the number of factors represented in each subgroup by the step-wise regressions on systolic and diastolic blood pressure. These tabulations are for all sixteen subgroups. Those for significant cases only will follow shortly.

An example which demonstrates the assignment of values in this table follows. Consider systolic blood pressure prediction in group 1. The single variables selected are, in order of selection: 6, 10, 14, 7, 8, 2, 12, 3, 4, 9, 11, 5. The factors are composed as follows:

2 factors:
1) 2, 3, 4, 5, 9, 10, 12, 13
2) 1, 6, 7, 8, 11, 14

3 factors:
1) 2, 5, 10, 11, 13
2) 1, 6, 7, 8, 9, 14
3) 3, 4, 12

4 factors:
1) 2, 5, 10, 13
2) 6, 7, 8, 9
3) 3, 4
4) 1, 11, 12, 14

TABLE 39

NUMBER OF FACTORS REPRESENTED BY STEP-WISE REGRESSION VARIABLES, FOR SYSTOLIC AND DIASTOLIC REGRESSIONS IN SIXTEEN SUBGROUPS, FOR 2-5 FACTOR ROTATIONS

Group	Systolic									
	2 factors	3 factors	4 factors	5 factors	No. of single vars. selected	2 factors	3 factors	4 factors	5 factors	No. of single vars. selected
1 BMYL	2	2	3	4	1	2	2	4	5	0
2 BMYH	2	2	3*	3*	1	2	3	4*	3*	0
3 BMOL	2	3	4	4	0	1	3	3	3	1
4 BMOH	1	2	2	3	0	1	2	2	3	0
5 BFYL	2+	2+	3+	3	4	2	2	3	3	0
6 BFYH	1	2	2	2	1	2	2	2	2	0
7 BFOL	2	3	3	3	0	2	2*	2*	3*	1
8 BFOH	2*+	3*	3*	4*	2	1+	2	4	3	2
9 WMYL	2*+	3*+	3	3*	3	1*+	2*+	3+	3	4
10 WMYH	1+	3	3*	3*	2	2+	2+	3	4	3
11 WMOL	1+	2+	2+	2+	5	2	2	2	3	1
12 WMOH	2*	2*	3	3	1	2	2	3	2	0
13 WFYL	2	1	2	2	0	2	2	3	3	0
14 WFYH	2	2	3*	3*	1	1+	2+	2+	4	4
15 WFOL	1	2	3	3	1	2	2	4	4*	1
16 WFOH	1*	2*	2*	3	1	1*+	2*+	3*	3*	3

*One factor score is a significant blood pressure predictor.

+These cases correspond to significant prediction for single variables. That is, for example, for group 5, the "+" on "2" under 2 factors means that 2 variables are significant in the original regressions, and both of the 2 factors are represented by those variables.

5 factors:
1) 2, 5, 10, 13
2) 1, 11, 14
3) 3, 4
4) 6, 12
5) 7, 8, 9

For the two factor case, we consider variables 6 and 10, the first two variables selected by the single variable regression. Since each of these variables appears on a different one of the 2 factors, we say that <u>two</u> factors are represented (of two possible). For the four factor case, we consider variables 6, 10, 14, 7. These represent three of the four factors rotated, i.e., factors 1, 2, and 4, and the score is thus 3. The "1" in the last column under systolic blood pressure for group 1 signifies that one variable only, i.e., variable 6, was significant in the single variate regression for systolic blood pressure; the "0" in the last column under diastolic blood pressure indicates that no significance was found for the single variate regression for diastolic blood pressure.

One point of possible confusion should be clarified. In groups where there is significance with more than one predictor, there is not necessarily a unique set of variables giving significant prediction. This can be observed in Appendix II, part A. Consider group 5, for example. There are three sets of variables giving a significant R^2 for systolic blood pressure:

1) 13
2) 13, 2
3) 13, 2, 4, 7

The "number of single variables selected" in Table 39 refers to the largest number of variables constituting a set for which the R^2 is significant.

It is not apparent from this table that in all or even in most cases the regression variables selected individually do represent distinct factors. In many cases all or most of the factors are represented, but there are also many cases where some are not. There is no trend for the individual variates to cluster together, however. These data represent all single variate regressions. We may be able to make somewhat more substantial conclusions by looking at those cases where prediction is significant, for either variables or factor scores.

For 2, 3, 4, and 5 factor rotations, the average number of factors represented is given in Table 40. The values are shown for all groups from Table 39, groups in which the single variate regressions give significant prediction (marked "+"), and groups in which the factor score regressions give significant prediction (marked "*"). In each case the tabled value is simply the mean of the appropriate figures from the corresponding column in Table 39. The number of cases included for calculation of each average is given in parentheses.

We first consider those cases in which single variate regressions give significant blood pressure level prediction. In each case we consider only the factor score rotation with the number of factors corresponding to the number of significant individual variables. Thus at this point we are not

TABLE 40

AVERAGE NUMBER OF FACTORS REPRESENTED BY STEP-WISE REGRESSION VARIABLES, FOR SYSTOLIC AND DIASTOLIC REGRESSIONS IN SIXTEEN SUBGROUPS, FOR 2-5 FACTOR ROTATIONS

Subgroups represented	Systolic				Diastolic			
	2 factors	3 factors	4 factors	5 factors	2 factors	3 factors	4 factors	5 factors
All subgroups	1.6(16)	2.3(16)	2.8(16)	3.0(16)	1.6(16)	2.1(16)	2.9(16)	3.2(16)
Significant single variate subgroups (+)	1.6(5)	2.3(3)	2.5(2)	2.0(1)	1.2(5)	2.7(4)	2.5(2)	--
Significant factor score subgroups (*)	1.8(4)	2.5(4)	3.0(5)	3.2(5)	1.0(2)	2.0(3)	3.0(3)	3.3(4)

considering cases where there is only one significant predictor variable (that case will be discussed shortly). These values are marked "+" in Table 39 and are averaged on the second line in Table 40.

Clearly, there is no sharp indication that the significant single variate regressions do any better than all the regressions as far as representation of factors is concerned. Table 40 does not indicate any higher average factor representation for groups represented by these regressions (second line) than for the other cases presented.

We now consider the cases in which factor score regressions are significant. These are marked "*" in Table 36 and are averaged on the third line in Table 40. These cases are not different from average as far as factor representation is concerned. That is, groups in which factor scores are significant predictors do not account for most of the scores indicating best possible agreement in Table 39.

The correspondence we do find between the single variate regressions and the factor rotations is in the occurrence of significance of single variates when the rotated factor scores give significant prediction. Except in one instance, group 2, where the diastolic blood pressure is significant for the factor score regression and there is no significant single variable regression, we always find significance of some single variate or group of variates where the factor score provides a significant predictor.

In eleven cases (7 systolic and 4 diastolic), therefore, significance occurs simultaneously with both kinds of regression analyses. Furthermore, we find that the group of variables represented by the significant factor score (each variable assigned to its highest loading factor) includes the single most important predictor in all of these cases except systolic regression in group 10. In this instance the significant factor score includes the significant variable added on the second step in the step-wise regression.

Thus in general we find that in terms of statistically significant predictions of systolic and diastolic blood pressure using the attitude variables included in this study, regressions on single variates are much more likely to yield significance than regressions on factor scores composed of linear combinations of these variates. Furthermore, when the factor scores are significant predictors, they are, except in one case, composed of variables which include those which are significant individually. Although the factors tend to be composed of quite highly loading variates, which may provide dimensions we can interpret, they do not yield factor scores that are nearly as successful as the single variates themselves.

A comparison of subgroups where both types of regressions are significant with other groups may help us gain more insight into any demographic factors that are important in these data. Table 41 shows, for each group, the single variate and factor score regressions giving significant prediction, for both systolic and diastolic blood pressure.

TABLE 41

SIGNIFICANT SYSTOLIC AND DIASTOLIC BLOOD PRESSURE PREDICTION FOR SIXTEEN DEMOGRAPHIC SUBGROUPS, BY SINGLE VARIATE REGRESSIONS AND FACTOR SCORE REGRESSIONS

Group	Systolic		Diastolic	
	Single variate regressions	Factor score regressions	Single variate regressions	Factor score regressions
1 BMYL	x			
2 BMYH	x	x		x
3 BMOL			x	
4 BMOH				
5 BFYL	x			
6 BFYH	x			
7 BFOL			x	x
8 BFOH	x	x	x	
9 WMYL	x	x	x	x
10 WMYH	x	x	x	
11 WMOL	x		x	
12 WMOH	x	x		
13 WFYL				
14 WFYH	x	x	x	
15 WFOL	x		x	x
16 WFOH	x	x	x	x

There are two groups, 9(white, male, $\leq$ 40, low education) and 16(white, female, $>$ 40, high education) where both types of regressions are significant for both systolic and diastolic regressions--both white, but otherwise not similar. If we now consider, in addition to groups 9 and 16, those cases where significance occurs for factor scores and single variate regressions, either for systolic or diastolic measurements or both, we have these groups:

2: black, male, $\leq$ 40, high education
7: black, female, > 40, low education
8: black, female, > 40, high education
9: white, male, $\leq$ 40, low education
10: white, male, $\leq$ 40, high education
12: white, male, > 40, high education
14: white, female, $\leq$ 40, high education
15: white, female, > 40, low education
16: white, female, > 40, high education

These are the 9 groups where we find significance by both types of regressions, and for which we thus have most confidence in the actual existence of a relationship of these variables with blood pressure level. Just as when we considered the two regression types separately, we find more successful prediction of blood pressure for whites. We also find here more success for high education groups. The single variate regressions in their entirety are consistent with this, although not highly supportive of the education difference. There also seems to be a tendency for significance to be associated with those under age 40 for men and over 40 for women. This trend goes along with that observed earlier for the single variate regressions as well as for the factor score regressions.

Perhaps this sex difference in the age groups in which blood pressure can be predicted is related to the tendency for type A(personal) variables to be more often significant predictors for women and type B(social) variables to be more often significant for men. It is unclear how the characteristics of sex, age, and variable type might be interrelated.

Related Hypotheses.

One hypothesis that has not yet been considered is that level of systolic or diastolic blood pressure is correlated, either positively or negatively, with the degree of prejudice held by an individual. It should be recalled that the fourteen attitude variables were coded in such a way that higher values indicate greater social distance feelings, less experienced interracial contact or desire for contact, tenseness in interracial situations, less willingness to acknowledge racial inequality, pessimism about future race relations, etc.

If extent of prejudice is not associated with blood pressure level, we would expect approximately equal numbers of positive and negative correlations of the attitude variables with blood pressure level. A much greater than expected frequency of positive correlations would indicate higher blood pressure levels among more prejudiced individuals. Conversely, a preponderance of negative correlations would provide evidence of higher blood pressure levels among less prejudiced individuals.

The association between degree of prejudice and blood pressure level will be examined within groups defined by race, sex, age, or education, as well as for the entire sample. We have, in Chapter II, found differences in the extent of prejudice by race, sex, age, and education, especially by race. Blacks in this particular sample express much less prejudice, as we define it, than do whites.

Therefore, blacks who evidence high levels of prejudice and whites who express little prejudice are individuals acting differently from their peers (defined by race, in this instance). They are nonconformists with respect to the race relations attitudes commonly held among members of their own races.

It is probable that these nonconformists are frequently put in positions where they are expected to defend their opinions against a majority in opposition. The hostility or fear caused by such situations may lead to stress that is associated with elevated blood pressure. One plausible hypothesis, therefore, is that stress, expressed in elevations of blood pressure, is more common among individuals whose attitudes differ from those of their peers than those who conform to their peers in opinions. This hypothesis of stress related blood pressure levels due to nonconformity would be supported by a finding of negative correlations between blood pressure and attitudes for whites and positive correlations for blacks, since prejudice is "in" for whites and "out" for blacks in this particular sample.

From the correlation matrices for the sixteen subgroups given in Appendix I, part G, we have tabulated the number of positive and number of negative correlations between the attitude variables and systolic and diastolic blood pressure. If the extent of prejudice does not relate to blood pressure level, we should find about equal frequencies of positive and negative correlations. The data are given in Table 42, for

all sixteen groups and for systolic and diastolic measurements.

TABLE 42

FREQUENCY OF POSITIVE AND NEGATIVE CORRELATIONS OF FOURTEEN ATTITUDE VARIABLES WITH SYSTOLIC AND DIASTOLIC BLOOD PRESSURE, FOR SIXTEEN SAMPLE SUBGROUPS

Group	Systolic		Diastolic	
	(+)	(-)	(+)	(-)
1 BMYL	8	6	9	5
2 BMYH	10	4	5	9
3 BMOL	10	4	5	9
4 BMOH	8	6	8	6
5 BFYL	8	6	8	6
6 BFYH	9	5	7	7
7 BFOL	9	5	8	6
8 BFOH	7	7	5	9
9 WMYL	3	11	3	11
10 WMYH	5	9	5	9
11 WMOL	8	6	9	5
12 WMOH	8	6	9	5
13 WFYL	6	8	5	9
14 WFYH	5	9	7	7
15 WFOL	13	1	12	2
16 WFOH	4	10	2	12
Total	121	103	107	117

The total number of positive correlations is 228, and the number of negative correlations is 220. For the entire sample, then, we find almost equal frequencies, or no relationship between degree of prejudice and blood pressure.

The frequency of positive correlations is higher than the negative frequency for systolic blood pressure and lower for diastolic blood pressure. To test whether the number of

positive correlations is really significantly higher than expected for systolic blood pressure and lower for diastolic blood pressure, we can use a chi-square goodness of fit test, with an expected number of positive correlations in each category (systolic or diastolic, for each group) equal to 7. The computed values do not approach the critical value $\chi^2(.95) = 25.00$ with 15 degrees of freedom required for rejection of the hypothesis of no difference. The actual computed chi-square statistics are $\chi^2 = 12.71$ for systolic blood pressure and $\chi^2 = 14.27$ for diastolic blood pressure.

Looking at frequencies between race, sex, age, and education groups, we do find some differences. Again, chi-square goodness of fit tests are used. We attempt to measure, in the case of race, for example, the agreement between the distributions of positive correlations for blacks and whites. That is, we use as each expected value, in computation of the test statistic, not a hypothetical number of expected positive correlations, but rather the observed value for the subgroup which corresponds on all demographic criteria except the one being measured. For example, when differences by race are examined, group 1 corresponds to group 9, since these two groups are comprised of males under 40 with low education and differ only by race. For each black subgroup, we will compare the observed frequency of positive correlations with the observed value for the corresponding white group matched on sex, age, and education, that is, the expected values for blacks given no difference by race. A

similar procedure is followed for sex, age, and education comparisons.

The data for these comparisons are given in Tables 43 - 46. Adjacent categories are combined where necessary to obtain "expected" frequencies of at least 5. Chi-square values are presented in each case.

TABLE 43

DIFFERENCE IN NUMBER OF POSITIVE CORRELATIONS OF ATTITUDE VARIABLES WITH BLOOD PRESSURE, BY RACE

	Systolic		Diastolic	
Group	Black	White	Black	White
1(9)	8	3	9	3
2(10)	10	5	5	5
3(11)	10	8	5	9
4(12)	8	8	8	9
5(13)	8	6	8	5
6(14)	9	5	7	7
7(15)	9	13	8	12
8(16)	7	4	5	2
χ^2 Value	χ^2 = 16.93 (S)		χ^2 = 8.26 (NS)	

TABLE 44

DIFFERENCE IN NUMBER OF POSITIVE CORRELATIONS OF ATTITUDE VARIABLES WITH BLOOD PRESSURE, BY SEX

Group	Systolic		Diastolic	
	Male	Female	Male	Female
1(5)	8	8	9	8
2(6)	10	9	5	7
3(7)	10	9	5	8
4(8)	8	7	8	5
9(13)	3	6	3	5
10(14)	5	5	5	7
11(15)	8	13	9	12
12(16)	8	4	9	2
χ^2 value	χ^2 = 1.92 (NS)		χ^2 = 6.13 (NS)	

TABLE 45

DIFFERENCE IN NUMBER OF POSITIVE CORRELATIONS OF ATTITUDE VARIABLES WITH BLOOD PRESSURE, BY AGE

Group	Systolic		Diastolic	
	≤ 40	> 40	≤ 40	> 40
1(3)	8	10	9	5
2(4)	10	8	5	8
5(7)	8	9	8	8
6(8)	9	7	7	5
9(11)	3	8	3	9
10(12)	5	8	5	9
13(15)	6	13	5	12
14(16)	5	4	7	2
χ^2 value	χ^2 = 7.92 (NS)		χ^2 = 11.19 (NS)	

TABLE 46

DIFFERENCE IN NUMBER OF POSITIVE CORRELATIONS OF ATTITUDE VARIABLES WITH BLOOD PRESSURE, BY EDUCATION

Group	Systolic		Diastolic	
	Low	High	Low	High
1(2)	8	10	9	5
3(4)	10	8	5	8
5(6)	8	9	8	7
7(8)	9	7	8	5
9(10)	3	5	3	5
11(12)	8	8	9	9
13(14)	6	5	5	7
15(16)	13	4	12	2
χ^2 value	χ^2 = 13.33 (S)		χ^2 = 14.18 (S)	

Chi-square tests on these groups are nonsignificant for sex and for age. However, we do find statistically significant differences by race and by education in the frequency of positive correlations. For blacks, there are significantly more positive correlations of the attitude variables with systolic blood pressure than for whites. The difference in the diastolic case, though in the same direction, is not significant. The indication is that blacks with elevated blood pressure are more likely to be those expressing a higher degree of prejudice, while whites with elevated blood pressure are more likely to be individuals with low prejudice, as measured by the attitude questions. This is the association hypothesized to exist due to stress producing pressure on

nonconforming individuals, as described above.

The education differences do not support the hypothesis. Individuals with low education show more positive correlations between extent of prejudice and blood pressure than those with high education, both for systolic and diastolic recordings. But these individuals are conformists within their educational groups in terms of race relations attitudes. Since we found earlier that more highly educated people show less prejudice, this finding contradicts the idea that a stress situation producing elevated blood pressure is associated with nonconformity to one's peer group (in this case, those with similar education). This original hypothesis is further contradicted by the fact that differences in number of positive correlations accounting for significance by education are more often due to differences for those in the over 40 age group than in the younger group. That is, increased prejudice appears to be positively associated with blood pressure more for those over 40 than those under 40, within education groups. This is seen also when we ignore education and look just at age, though it is not a statistically significant difference.

If we consider this same kind of analysis for only those attitude variables significantly different by race, sex, age, and education, we find similar relationships. This reduces the expected frequencies so that χ^2 tests are no longer applicable, but the tendencies are in the same directions as those found using all of the variables.

Looking at the correlations from the point of view of the different variables, we do not find any differences in frequencies of positive and negative correlations. Table 47 gives the frequencies of positive and negative correlations by variables.

TABLE 47

FREQUENCY OF POSITIVE AND NEGATIVE CORRELATIONS OF FOURTEEN ATTITUDE VARIABLES WITH SYSTOLIC AND DIASTOLIC BLOOD PRESSURE

Variable	Systolic		Diastolic	
	(+)	(-)	(+)	(-)
1	10	6	9	7
2	10	6	8	8
3	9	7	5	11
4	4	12	4	12
5	4	12	4	12
6	11	5	8	8
7	10	6	10	6
8	11	5	9	7
9	10	6	6	10
10	7	9	7	9
11	9	7	9	7
12	9	7	8	8
13	10	6	9	7
14	7	9	9	7

No differences in sign frequencies are found between systolic and diastolic measurements. No differences are found between the type A and type B variables, as distinguished earlier. There are not enough variables or groups here to

provide large enough frequencies to make comparisons by race, sex, age, and education.

Summary.

Briefly, we find one difference which is supported by the data no matter which way we look at it. This is the tendency for significant prediction to occur more often for whites than for blacks. The one demographic difference in variable types which is suggested by the data is a greater tendency for social type variates to be better predictors for men and personal type variates for women. One variable, 13, which is related to tenseness in interracial situations, is significant in several groups and is positively related with blood pressure.

Looking only at those groups in which we have significant prediction both by single variables and by factor score regressions, we find greater occurrence of high education groups as well as whites. We also find that these groups tend to be either males under 40 or females over 40.

Considering the sums of signs of correlations as measures of the relationship of the extent of prejudice to blood pressure, we find more positive correlations between degree of prejudice and blood pressure for blacks than for whites. We also find more positive correlations for groups with low education than for those with high education. A more complete summary and discussion will be the subject of Chapter V.

CHAPTER V

SUMMARY AND CONCLUSIONS

Summary.

Substantive results. In the data under consideration, we have found, for demographically defined groups, differences in systolic and diastolic blood pressure levels which are consistent with earlier reported studies. Of the four demographic variates considered--race, sex, age, and education--age is the most important determinant of blood pressure level. Blood pressure rises with age for all groups. For this sample, as was found in earlier work, blacks had higher blood pressure levels than whites, and males had higher blood pressure than females. No difference by education was found.

Examination of the race relations attitude variables also revealed relationships with race, sex, age, and education expected on the basis of earlier studies. The most important discriminator of the four demographic variates used here, in terms of the attitude variables, is race. Whites were found to express greater prejudice than blacks, less willingness for integration, less interracial contact, more fear and tension in interracial situations, less perception of racial inequalities in rent and pay, more reliance

on law and order rather than attempts to change social conditions as a means of handling civil disturbances. These differences were statistically significant for twelve of the fourteen attitude variables included.

Attitude differences were present also for groups defined by sex, age, and education. None of these divisions resulted in differences which were as strong as those found on the basis of race, but the relationships found support those described in earlier studies of prejudice. The tendencies were for more prejudice among women, older people, and individuals with relatively low education.

Correlation patterns among the attitude variables were similar for all of the demographic subgroups, although the correlations were somewhat lower for blacks than for whites. The highest intercorrelations were for variables dealing with personal aspects of race relations. Experiences of interracial contact, both personal and social, were positively correlated with preference and willingness for interracial contact, and with a decrease in feelings of tenseness or fear in interracial situations. For those variables dealing with social issues rather than personal feelings, the intercorrelations among items were somewhat lower.

The consideration of the race relations attitude variables as predictors of systolic and diastolic blood pressure level, using regression, factor analysis, and the square root method, did not reveal many clear and striking relationships. The one tendency which was observed throughout, using any method of analysis, was the tendency for prediction

to be more successful for whites than for blacks. One variable, the expressed degree of tenseness in interracial situations, was frequently a significant blood pressure predictor.

We did not find any striking differences between systolic and diastolic blood pressure level prediction. Systolic prediction tended to be significant slightly more often than diastolic. We did not find particular variables (or types of variables, when personal vs. social variables were considered) which were important for systolic prediction but not for diastolic, or the reverse. The R^2 values, giving the per cent of variance accounted for by the linear regression, were very similar for systolic and diastolic blood pressure.

In order to examine the significant predictor variables in the single variate regressions, we divided the variables into two sets, those dealing with personal feelings and desires concerning race relations, and those having to do with more impersonal, social issues. We found that significant prediction within any particular demographic subgroup was usually attributable to only one of these types of variables. We then looked for differences in variable (type) selection by race, sex, age, and education. The only difference we found was a suggestion that men are more likely to select the social type variables and women the personal type.

Repeating the regression analysis using factor scores, we found that the factor scores were less often successful than the original variates in producing significant prediction.

Looking at the same variable sets (personal vs. social) examined in the single variate regressions, we did not find any indications of strong demographic influences in the selection of variable types.

Considering groups in which significant prediction was obtained both by regression of systolic or diastolic blood pressure on single variates as well as by regression on factor scores, we found more success among whites than among blacks. We also found more success for those groups representing the higher educational levels. There was also a tendency for these groups to be composed of males under 40 and females over 40.

One last hypothesis examined was that the extent of prejudice might be useful as a predictor of blood pressure level. In general, the data were coded so that positive correlations of attitude variables with blood pressure indicated a positive relationship between blood pressure level and increased prejudice. Although we found no difference in the number of positive vs. negative correlations for the entire sample or for systolic vs. diastolic blood pressure level, we did find some differences by race and education. Blacks showed more positive correlations of extent of prejudice with systolic blood pressure than whites. For low education groups, there was greater frequency of positive correlations between both systolic and diastolic blood pressure level and extent of prejudice than for high education groups.

Methodological results. One of the original methodological intentions of the thesis was to compare variables selected by the square root method with the variables chosen by regression analysis. In addition, we wished to see whether variables selected by these methods could be considered representatives of sets of variables which could be determined by factor analysis. Thus, hypothetically, we should be able to identify variables selected in the step-wise regressions (or square root procedures) with factors established through factor analysis, with each variable assigned to the factor on which it loaded most highly.

Comparing the square root analysis with the single variate regression analysis, we found very similar results, both in terms of variables actually selected and order of variables selected. In all cases where the regression gave significant prediction of systolic or diastolic blood pressure, the corresponding (in order and number) variables selected by the square root method were identical.

Comparing the regression in each of the demographic subgroups with the corresponding factor analysis, we could not establish a correspondence. The comparison was made in each case by examining a fixed number of variables selected by regression (say the first x variables selected) and a factor analysis with rotation on x factors. We considered the degree to which the x variables represented the x factors, with each variable assigned to the factor on which it loaded most highly, as a measure of variable representation of factors. No such pattern of representation was observed,

either for all of the demographic groups or for the groups where significant blood pressure prediction was observed.

Considering only those cases where factor score regressions were significant, we found, except in one case, that the single variate regressions were significant. Furthermore, for the groups in which the factor score regression was significant and the single variate regression was significant, the significant factor score predictor included among its most highly loading variables the single most important variable selected by the single variate regression. Thus we did find some identification of variables with factors in those cases where prediction was successful using either the single variate regression or the factor score regression.

Discussion.

The general intention of all investigations such as the one reported here is to look for differences (genetic, health, life style, etc.) which may be helpful in explaining the differences in blood pressure among groups defined demographically. One focus of these efforts has been on the search for stress producing factors in the environment--in this case, an environment determined to a large extent by race, sex, age, and education. The race relations attitude variables used in this study were intended to measure one possible stress producing area of concern, which might be an intervening factor in the development of elevated systolic or diastolic blood pressure.

We did not find any evidence that there is a strong

relationship between the attitude variables used here and blood pressure level, for any of the sixteen sample subgroups considered. The one relationship that was consistently found when the data were examined several ways is the greater success in predicting blood pressure for whites than for blacks. This difference is not one that would have been anticipated by the present author. If anything, it seems that in terms of stress, blacks in this society are more frequently exposed to stress producing situations which might be reflected in their attitudes relating to race relations. The postulation that personal variables are more important for whites and social variables for blacks finds no support in these data.

It may be that we asked the wrong questions. Instead of trying to use the race relations attitudes or extent of prejudice as predictors, we might in the future try to get more directly at the level of concern an individual expresses about each of these questions. Instead of asking whether one is willing to have integration, we might ask a person to judge the relative importance of success at integration, racial harmony, or the reduction in prejudice in comparison with other areas of concern in his life. We then might look at those individuals who list race relations as high on their scales of importance to see if attitudes about these variables can be used as blood pressure predictors for them more successfully than for other individuals.

There is some evidence in these data to support the type of analysis suggested above. Of all the questions used

in the analyses, the question referring to the actual degree of tenseness in interracial situations correlated with blood pressure more consistently than any of the other variables. This was the only question specifically asking the respondent's degree of concern (i.e., level of tenseness) about a particular race relations issue. The greater success in prediction in both single variate and factor score regressions for high education groups would also be consistent with the suggested analysis above. If individuals with relatively high education levels are more concerned about race relations than people with low education, we would expect more ability to predict blood pressure by race relations questions, as found in these data.

We may, in future studies, want to look at other types of stress producing variables to see whether greater predictability is obtained for whites than for blacks. Greater predictability for whites in all kinds of stress situations, such as those pertaining to job satisfaction, family life, etc., might lead to a hypothesis of some kind of racial difference in the relationship of psychological stress to blood pressure level.

The measures used in this study may also be examined in another study. It would be of interest to try other, different sets of questions that attempt to measure race relations attitudes, to see whether predictability remains consistently higher for whites. Perhaps some more indirect measures of prejudice, as opposed to direct questions, would

reveal a difference in the relationship with blood pressure by race. These could take the form, for example, of asking a respondent which of several options he would take in a hypothetical interracial situation. This is certainly an area that needs further investigation.

The fact that the cases of successful prediction here tended to occur among younger age groups for men and older groups for women is also of interest. This finding is confounded with the suggestion of prediction due to attitudes about social variables for men and personal variables for women. Again, we might want to examine different kinds of stress variables to see whether stress in general appears to be more predictive of level of blood pressure for younger men and for older women, or whether that finding here relates to the particular set of questions chosen. The sex difference in the types of variables chosen could be more related to age than to sex, as discussed earlier. This could be investigated by considering groups defined by both age and sex. The suggestion that personal variates are more important for men and social variates for women was not strongly supported by the analyses here, and needs to be further studied.

Some tendencies relating to systolic-diastolic blood pressure differences discussed in Chapter I were not borne out here. In these data, systolic blood pressure level was slightly more successfully predicted by the attitude questions than diastolic blood pressure level. This is in contrast to the data presented by Kasl and Cobb (39), who found significant

relationships between stress and diastolic blood pressure level, but not between stress and systolic blood pressure. The contrasting results indicate a necessity for more studies, repeated on systolic and diastolic measurements simultaneously.

Several comments are suggested by the methodological findings. The data used in this thesis did not provide a high degree of predictability of blood pressure on the basis of the race relations attitudes. It would be instructive to do the same kind of comparisons for other types of data, particularly data where the predictive capabilities of the independent variables are much higher than they are for the attitude variables used here, and where several variables are significant predictors and several well defined factors can be established.

The square root method and the single variate regressions can be done simultaneously on different sets of data, as they were done here, and their similarity evaluated. It might be feasible to do simulation studies for the comparison of these methods with factor analysis. We considered the extent to which significant variables loaded better onto significant factors than onto other factors. Models could be devised to estimate the distribution of a few of several variables across factors that would be expected by chance. These expected values could then be compared with those actually obtained from the data.

The use of a larger number of subjects would facilitate

the handling of statistical comparisons. If we looked at only one demographic variable at a time, for example (such as race), we could divide the population into two groups. These could then be randomly split into as many subgroups as feasible, and identical analyses repeated in each subgroup. This would provide a set of replicates for statistical tests.

The need for prospective studies was discussed by Ostfeld and Shekelle (53). They suggested controlled experiments where efforts would be made to reduce stress of all kinds for the experimental subjects, over a long period of time, to see whether blood pressure levels were affected. Prospective studies of this kind of data are very difficult to do, but obviously needed. One group of individuals that could be investigated more readily than others, it seems to this author, assuming the physiological problems of aging could be handled, is the aged. It would not be difficult to set up controlled experiments for patients in nursing homes, for example, who are already living in an atmosphere that is controlled to some extent. By treating experimental groups in ways designed to reduce stress, e.g. getting the patients actively involved in projects and discussions, etc., we might see whether blood pressure levels could be reduced. Conversely, we might find this kind of forced participation leads to increased blood pressure.

With regard to other groups of people, it is very difficult to set up experiments which would allow a great deal of control over the environmental stresses to which the

individuals are subjected. Perhaps if focus is made on one aspect of stress, such as job or marital problems, and concentrated effort is made to alleviate stress producing situations for the subjects, by involved counselling, etc., we could alter blood pressure levels. It seems to this author that concentration on one particular aspect of stress, such as that due to job dissatisfaction, would allow more control over extraneous variables in the environment than attempts to help individuals reduce stress in all areas of their lives.

Special occupational groups, such as people in particular industries, or individuals involved in comprehensive health care plans might provide groups for study. Use of these special groups rather than general populations would allow us to reduce some of the dissimilarities among the individuals in terms of variables not to be considered. These groups would also tend to provide the long-term availability for repeated study required for such an investigation.

Another possibility is that we not define a specific type of problem to be investigated for all of the subjects, but rather try to ascertain from each individual the part of his life that seems to be the greatest source of stress, as he perceives it. Individuals could then be randomly assigned to control and experimental groups, and the effort to reduce stress for any one of the experimental subjects would be specifically directed toward that aspect of the individual's life that he himself has defined as most stressful.

Obviously there is need for further study on the etiology of hypertension. The studies related to socio-psychological stress are among those giving the least conclusive information about variables associated with blood pressure level. This thesis provides some support for the hypothesis that there is an association between at least one possible stress producing area of life, race relations attitudes, and blood pressure level. The specific nature of this association remains to be investigated.

The possibility that psychologically derived stress factors are actually causally related to blood pressure level, either directly or by interrelationship with other factors such as sex and age, remains to be examined by means of controlled prospective studies. Eventual demonstration of such a relationship would suggest attempts to manipulate psychological factors as a means of influencing blood pressure level, as well as indicating need for the study of psychological factors in association with other health indicators.

APPENDIX I

QUESTIONNAIRE ITEMS AND SUMMARY DATA

A. Original questionnaire items

Following is a list of the original questionnaire items as presented to the interview respondents. Wording changes for black respondents are given in parentheses.

1. Would you prefer to live in a neighborhood with only white (Negro) families or in a neighborhood that had both white and Negro families? Would you...

   1) Definitely prefer both.
   2) Prefer both.
   3) Prefer all white (Negro).
   4) Definitely prefer all white (Negro).

2-5. People have very different feelings about how close they would like to get with persons of another race. Please answer "yes" or "no" to these questions. Would you be willing...

(2) (a) ...to work on a daily basis with a Negro (white) person?

0) yes 1) no

(3) (b) ...to live next door to a Negro (white) person?

0) yes 1) no

(4) (c) ...to accept a Negro (white) person into a private social club of all whites (Negroes)?

0) yes 1) no

(5) (d) ...to have a Negro (white) person marry someone in your family?

0) yes 1) no

6. If a Negro were to get the same house or apartment as a white person, do you feel he would pay...

   1) Much more rent than the white person would pay.
   2) Slightly more rent.
   3) The same rent.
   4) Less rent.

7. Do you feel if a Negro does the same work as a white person, he will be paid...

   1) A lot less money than the white person.
   2) Slightly less.
   3) The same.
   4) More.

8. Some people say that white and Negro children should go to the same schools; others feel that they will learn more and be happier in separate schools. Do you think they should go to...

   0) The same schools.
   1) To separate schools.

9. Do you believe that equality for all races will be achieved in this city in...

   1) The near future.
   2) The distant future.
   3) Not at all.

10. In general do you think that civil disturbances between the races help or hurt relations between Negroes and whites?

   1) Help.
   2) No change.
   3) Don't know.
   4) Hurt.

11. What do you feel is the best way of dealing with such disturbances--by changing the conditions of Negro life in the central city or by stronger enforcement of the laws by the police department or what?

   1) Change conditions of Negro life in the city.
   2) Both.
   3) Stronger law enforcement by police.

12. In the end, do you think white people will take a better attitude toward Negroes mainly because they will be forced to by Negro action or mainly because they can be persuaded that this is the only right thing to do?

   1) Mainly because they will be forced to.
   2) Both.
   3) Mainly because they can be persuaded.

13-18. Now I'd like to read a few statements about whites and Negroes that people have honest differences of opinion about. Please tell me for each statement whether you agree or disagree. The first statement is...

(13) (a) "Many times Negroes (whites) are so unreasonable I really wonder if I want more integration with them."

0) Disagree 1) Agree

(14) (b) "I am most at ease when I am with whites (Negroes) and there are no Negroes (whites) present."

0) Disagree 1) Agree

(15) (c) "At times, I strongly dislike being a white (Negro) person in this country."

0) Disagree 1) Agree

(16) (d) "When I'm in a place where all of the people are Negro (white), I feel I'm in enemy territory."

0) Disagree 1) Agree

(17) (e) "Sometimes I hate Negro (white) people."

0) Disagree 1) Agree

(18) (f) "Certain times whites (Negroes) act in such bad ways that I feel ashamed of being white (Negro)."

0) Disagree 1) Agree

19. Now, tell me, do you belong to any clubs or other groups like a union or a church where you have contact with Negro (white) people outside of your work?

0) Yes 1) No

20. Have you ever done anything socially with a Negro (white) person, like going to a movie or to a sports event?

0) Yes 1) No

21. When you are around Negro (white) people, how tense or worried are you that they might say or do something which insults whites (Negroes) or yourself? Would you say very tense, somewhat tense, slightly tense, or not tense at all?

1) Never around Negroes (whites).
2) Not tense at all.
3) Slightly tense.
4) Somewhat tense.
5) Very tense.

22. Do you ever have any Negro (white) persons over to your house to visit?

0) Yes 1) No

23. Do you know any Negro (white) people whom you think of as good friends--someone to whom you can say what you really think?

0) Yes 1) No

24. Would you like to be good friends with more Negro (white) people? Would you say definitely yes, yes, no, or definitely no?

0) Definitely yes.
1) Yes.
2) Don't care.
3) No.
4) Definitely no.

B. Missing observation tabulation

Following is a tabulation of missing observations, by item number, for the questions listed in A. Five cases with several or all items missing were eliminated. For the remaining 1004, each missing observation was replaced with the most frequent answer on that item for the respondent's race-sex-age-education group.

Item	No. missing observations	% missing observations
1	10	1.0%
2	0	0.0
3	1	0.1
4	4	0.4
5	5	0.5
6	5	0.5
7	2	0.2
8	2	0.2
9	13	1.3
10	17	1.7
11	12	1.2
12	19	1.9
13	3	0.3
14	1	0.1
15	1	0.1
16	7	0.7
17	2	0.2
18	0	0.0
19	2	0.2
20	1	0.1
21	1	0.1
22	2	0.2
23	0	0.0
24	1	0.1
Total	= 109	0.4% (Average per item, for all items combined)
No. of cases = 1004		

C. Constructed analysis variables

Following is a list of the analysis variables constructed by combining responses from the original items given in A. Numbers on the left are the numbers assigned to the analysis variables: numbers in parentheses refer to the original list in A. See part D of this appendix for an explanation of variable 2.

1. (Variable 1, unchanged)
Would you prefer to live in a neighborhood with only white (Negro) families or in a neighborhood that had both white and Negro families? Would you...

1) Definitely prefer both.
2) Prefer both.
3) Prefer all white (Negro).
4) Definitely prefer all white (Negro).

2. (Variables 2-5, combined)
People have very different feelings about how close they would like to get with persons of another race. Would you be willing...

1) ...to have a Negro (white) person marry someone in your family?

2) for blacks and 3) for whites ... to accept a Negro (white) person into a private social club of all whites (Negroes)?

3) for blacks and 2) for whites ... to live next door to a Negro (white) person?

4) ...to work on a daily basis with a Negro (white) person?

5) ...to do none of the above?

Respondents were coded according to the earliest question in this list for which they answered "yes." Notice the reversal of scaling for questions 2 and 3 for blacks and whites. The justification for this procedure will be explained in D.

3. (variable 6, unchanged)
If a Negro were to get the same house or apartment as a white person, do you feel he would pay...

1) Much more rent than the white person would pay.
2) Slightly more rent.
3) The same rent.
4) Less rent.

4. (Variable 7, unchanged)
Do you feel if a Negro does the same work as a white person, he will be paid...

1) A lot less money than the white person.
2) Slightly less.
3) The same.
4) More.

5. (Variables 8 and 19, combined)
What is the extent of your contact with Negroes (whites) in clubs or groups and your feelings about school integration?

1) Do have contact in group situations, and do believe that schools should be integrated.
2) Have contact or believe in integration, but not both.
3) Have no contact in group situations, and feel that separate schools should be maintained.

This question was an attempt to measure the interaction between actual and desired contact, in terms of the extent of both feelings.

6. (Variable 9, unchanged)
Do you believe that equality for all races will be achieved in this city in...

1) The near future.
2) The distant future.
3) Not at all.

7. (Variables 10 and 11, combined)
What is your feeling about civil disturbances, in terms of their effect on race relations and how they should be handled?

1) Civil disturbances help race relations, and should be handled by changing conditions of Negro life in the city.
2) Combinations of 1 and 3.
3) Civil disturbances hurt race relations, and should be handled by stronger law enforcement by police.

8. (Variable 12, unchanged)
In the end, do you think white people will take a better attitude toward Negroes mainly because they will be forced to by Negro action or mainly because they can be persuaded that this is the only right thing to do?

1) Mainly because they will be forced to.
2) Both.
3) Mainly because they can be persuaded.

9. (Variables 13 and 17, combined)
Negative attitude toward Negroes (whites).

1) Disagree with both of the following statements: "Many times Negroes (whites) are so unreasonable I really wonder if I want more integration with them;" "Sometimes I hate Negro (white) people."
2) Disagree with one of the above statements, but not both.
3) Agree with both of the above statements.

10. (Variables 14 and 16, combined)
Feelings of uneasiness and fear in the presence of Negroes (whites).

1) Disagree with both of the following statements: "I am most at ease when I am with whites (Negroes) and there are no Negroes (whites) present;" "When I'm in a place where all of the people are Negro (white), I feel I'm in enemy territory."
2) Disagree with one of the above statements, but not both.
3) Agree with both of the above statements.

11. (Variables 15 and 18, combined)
Feelings of shame or dislike for one's own race.

1) Agree with both of the following statements: "At times, I strongly dislike being a white (Negro) person in this country;" "Certain times whites (Negroes) act in such bad ways that I feel ashamed of being white (Negro)."
2) Disagree with one of the above statements, but not both.
3) Disagree with both of the above statements.

12. (Variables 20, 22, and 23, combined)
Extent of interpersonal contact with Negroes (whites).

1) Have experienced all of the following--have done something socially with a Negro (white) person, like going to a movie or a sports event; have Negro (white) persons over to your house to visit; know some Negro (white) person whom you think of as a good friend, someone to whom you can say what you really think.
2) Have experienced two of the above, but not all.
3) Have experienced only one of the above.
4) Have experienced none of the above.

13. (Variable 21, unchanged)
When you are around Negro (white) people, how tense or worried are you that they might say or do something which insults whites (Negroes) or yourself? Would you say very tense, somewhat tense, slightly tense, or not tense at all?

1) Never around Negroes (whites).
2) Not tense at all.
3) Slightly tense.
4) Somewhat tense.
5) Very tense.

14. (Variable 24, recoded)
Would you like to be good friends with more Negro (white) people? Would you say definitely yes, yes, no, or definitely no?

1) Definitely yes.
2) Yes.
3) Don't care.
4) No.
5) Definitely no.

D. Guttman social distance scale

The original questions 2-5 (analysis variable 2) were designed as a scale to measure social distance feelings. Theoretically, these statements can be ordered along a (Guttman) scale of decreasing acceptance, so that a consistent individual will answer with a series of "yes" responses followed by a series of "no" answers. This set of questions did scale with a high degree of consistency, with the middle two items reversed for blacks and whites. Thus the set was combined into one measure of social distance, analysis variable 2, described in section C. Cross tabulation of responses to these questions by race is presented below.

Blacks

		No. responses	Percent
1)	Will marry (1-4).....	319	62.5%
2)	Will admit to social club (2-4).....	126	24.7
3)	Will live next door to whites (3-4)...	34	6.7
4)	Will work with whites (4).....	6	1.2
5)	None of the above.....	2	0.4
6)	Inconsistent responses.....	23	4.5
		510	

Whites

		No. responses	Percent
1)	Will marry (1-4).....	23	4.7%
2)	Will live next door to Negroes (2-4)	212	42.9
3)	Will admit to social club (3-4)	95	19.2
4)	Will work with Negroes (4)	111	22.5
5)	None of the above	17	3.4
6)	Inconsistent responses	36	7.3
		494	

For example, under "Blacks," 126 respondents or 24.7% of the black respondents answered that they would not be willing to have a white person marry someone in their family, but would accept the other three levels of interaction with whites. An inconsistent black respondent might, for example, be willing to have intermarriage, to live next door towhites, and to work with them, but not to allow them into an all black club. The existence of several exclusively all black clubs in Detroit as a carry over from a Southern tradition, plus the advantage of residential integration for blacks as a means of obtaining better housing, probably accounts for the racial difference in relative positions on the scale for these two items.

E. Subgroup means for age and education

Following are the mean and standard deviation in age and education for each of the sixteen demographic subgroups constructed by race, sex, age, and education divisions.

Group	Age				Education			
	Mean		Std. dev.		Mean		Std. dev.	
	Y	O	Y	O	L	H	L	H
1-BMYL	34.0		3.3		9.7		3.1	
2-BMYH	33.1		3.8			14.0		2.1
3-BMOL		47.5		4.1	9.0		1.7	
4-BMOH		46.2		4.5		12.8		1.7
5-BFYL	33.7		3.8		11.2		1.2	
6-BFYH	34.2		3.9			13.6		2.0
7-BFOL		48.8		4.6	9.1		1.5	
8-BFOH		46.9		5.1		13.1		1.6
9-WMYL	34.5		4.2		9.4		1.6	
10-WMYH	33.2		4.5			12.9		1.5
11-WMOL		48.2		5.0	8.7		1.5	
12-WMOH		48.2		4.7		12.9		1.8
13-WFYL	34.3		4.1		9.8		1.8	
14-WFYH	35.2		4.2			12.4		1.0
15-WFOL		48.9		5.0	9.3		1.5	
16-WFOH		48.4		4.5		12.3		1.0
Totals	34.0	47.9	3.4	4.8	9.5	13.0	4.0	3.0

F. Distribution of variable responses

The following tabulation gives the frequency distribution and percentage distribution of responses to the fourteen analysis variables (see part C) by race, sex, age, and education. Frequencies appear in parentheses.

Variable 1 Response Codes

Control	N	1	2	3	4
Race:					
Black	510	22.6(115)	65.5(334)	10.6(54)	1.4(7)
White	494	0.6(3)	10.1(50)	59.9(296)	29.4(145)
Sex:					
Male	495	12.5(62)	40.0(198)	29.7(147)	17.8(88)
Female	509	11.0(56)	36.5(186)	39.9(203)	12.6(64)
Age:					
≤ 40	485	12.2(59)	40.8(198)	34.0(165)	13.0(63)
> 40	519	11.4(59)	35.8(186)	35.7(185)	17.2(89)
Education:					
Low	504	12.9(65)	37.7(190)	34.3(173)	15.1(76)
High	500	10.6(53)	38.8(194)	35.4(177)	15.2(76)

Variable 2 Response Codes

Control	N	1	2	3	4	5
Race:						
Black	510	65.5(334)	26.1(133)	6.9(35)	1.2(6)	0.4(2)
White	494	4.9(24)	49.4(244)	19.8(98)	22.5(111)	3.4(17)
Sex:						
Male	495	40.0(198)	32.9(163)	11.7(58)	13.3(66)	2.0(10)
Female	509	31.4(160)	42.0(214)	14.7(75)	10.0(51)	1.8(9)
Age:						
≤ 40	485	37.9(184)	38.6(187)	13.8(67)	7.4(36)	2.3(11)
> 40	519	33.5(174)	36.6(190)	12.7(66)	15.6(81)	1.5(8)
Education:						
Low	504	36.3(183)	36.1(182)	11.5(58)	13.9(70)	2.2(11)
High	500	35.0(175)	39.0(195)	15.0(75)	9.4(47)	1.6(8)

Variable 3 Response Codes

Control	N	1	2	3	4
Race:					
Black	510	39.4(201)	44.1(225)	14.5(74)	2.0(10)
White	494	5.9(29)	18.8(93)	68.2(337)	7.1(35)
Sex:					
Male	495	22.8(113)	30.3(150)	41.6(206)	5.3(26)
Female	509	23.0(117)	33.0(168)	40.3(205)	3.7(19)
Age:					
≤ 40	485	24.1(117)	35.5(172)	35.7(173)	4.7(23)
> 40	519	21.8(113)	28.1(146)	45.9(238)	4.2(22)
Education:					
Low	504	21.2(107)	30.6(154)	42.7(215)	5.6(28)
High	500	24.6(123)	32.8(164)	39.2(196)	3.4(17)

Variable 4 Response Codes

Control	N	1	2	3	4
Race:					
Black	510	12.2(62)	41.4(211)	45.9(234)	0.6(3)
White	494	0.6(3)	5.3(26)	93.1(460)	1.0(5)
Sex:					
Male	495	6.1(30)	22.6(112)	70.7(350)	0.6(3)
Female	509	6.9(35)	24.6(125)	67.6(344)	1.0(5)
Age:					
≤ 40	485	7.8(38)	27.4(133)	63.5(308)	1.2(6)
> 40	519	5.2(27)	20.0(104)	74.4(386)	0.4(2)
Education:					
Low	504	5.6(28)	22.2(112)	71.2(359)	1.0(5)
High	500	7.4(37)	25.0(125)	67.0(335)	0.6(3)

Variable 5 Response Codes

Control	N	1	2	3
Race:				
Black	510	57.3(292)	42.2(215)	0.6(3)
White	494	22.9(113)	54.4(269)	22.7(112)
Sex:				
Male	495	48.9(242)	41.4(205)	9.7(48)
Female	509	32.0(163)	54.8(279)	13.2(67)
Age:				
≤ 40	485	41.0(199)	48.3(234)	10.7(52)
> 40	519	39.7(206)	48.2(250)	12.1(63)
Education:				
Low	504	36.1(182)	49.8(251)	14.1(71)
High	500	44.6(223)	46.6(233)	8.8(44)

Variable 6 Response Codes

Control	N	1	2	3
Race:				
Black	510	30.6(156)	55.5(283)	13.9(71)
White	494	29.4(145)	57.1(282)	13.6(67)
Sex:				
Male	495	28.1(139)	55.6(275)	16.4(81)
Female	509	31.8(162)	57.0(290)	11.2(57)
Age:				
≤ 40	485	29.7(144)	54.0(262)	16.3(79)
> 40	519	30.3(157)	58.4(303)	11.4(59)
Education:				
Low	504	36.9(186)	49.6(250)	13.5(68)
High	500	23.0(115)	63.0(315)	14.0(70)

Variable 7 Response Codes

Control	N	1	2	3
Race:				
Black	510	29.8(152)	65.7(335)	4.5(23)
White	494	1.2(6)	58.3(288)	40.5(200)
Sex:				
Male	495	18.0(89)	57.8(286)	24.2(120)
Female	509	13.6(69)	66.2(337)	20.2(103)
Age:				
≤ 40	485	17.7(86)	60.2(292)	22.1(107)
> 40	519	13.9(72)	63.8(331)	22.4(116)
Education:				
Low	504	15.7(79)	56.4(284)	27.9(141)
High	500	15.8(79)	67.8(339)	16.4(82)

Variable 8 Response Codes

Control	N	1	2	3
Race:				
Black	510	23.9(122)	23.9(122)	52.2(266)
White	494	17.2(85)	11.3(56)	71.5(353)
Sex:				
Male	495	23.2(115)	16.0(79)	60.8(301)
Female	509	18.1(92)	19.5(99)	62.5(318)
Age:				
≤ 40	485	23.3(113)	19.4(94)	57.3(278)
> 40	519	18.1(94)	16.2(84)	65.7(341)
Education:				
Low	504	19.3(97)	16.9(85)	63.9(322)
High	500	22.0(110)	18.6(93)	59.4(297)

Variable 9 Response Codes

Control	N	1	2	3
Race:				
Black	510	38.6(197)	45.5(232)	15.9(81)
White	494	27.3(135)	53.0(262)	19.6(97)
Sex:				
Male	495	28.7(142)	49.3(244)	22.0(109)
Female	509	37.3(190)	49.1(250)	13.6(69)
Age:				
≤ 40	485	31.6(153)	48.7(236)	19.8(96)
> 40	519	34.5(179)	49.7(258)	15.8(82)
Education:				
Low	504	32.5(164)	51.0(257)	16.5(83)
High	500	33.6(168)	47.4(237)	19.0(95)

Variable 10 Response Codes

Control	N	1	2	3
Race:				
Black	510	44.7(228)	35.1(179)	20.2(103)
White	494	19.4(96)	31.0(153)	49.6(245)
Sex:				
Male	495	30.3(150)	33.5(166)	36.2(179)
Female	509	34.2(174)	32.6(166)	33.2(169)
Age:				
≤ 40	485	31.6(153)	34.0(165)	34.4(167)
> 40	519	33.0(171)	32.2(167)	34.9(181)
Education:				
Low	504	29.2(147)	33.1(167)	37.7(190)
High	500	35.4(177)	33.0(165)	31.6(158)

Variable 11 Response Codes

Control	N	1	2	3
Race:				
Black	510	13.7(70)	41.8(213)	44.5(227)
White	494	4.1(20)	54.5(269)	41.5(205)
Sex:				
Male	495	10.3(51)	44.7(221)	45.1(223)
Female	509	7.7(39)	51.3(261)	41.1(209)
Age:				
≤ 40	485	9.3(45)	47.8(232)	42.9(208)
> 40	519	8.7(45)	48.2(250)	43.2(224)
Education:				
Low	504	7.7(39)	47.2(238)	45.0(227)
High	500	10.2(51)	48.8(244)	41.0(205)

Variable 12 Response Codes

Control	N	1	2	3	4
Race:					
Black	510	47.1(240)	26.1(133)	18.8(96)	8.0(41)
White	494	9.1(45)	21.1(104)	31.0(153)	38.9(192)
Sex:					
Male	495	31.9(158)	26.9(133)	26.5(131)	14.8(73)
Female	509	25.0(127)	20.4(104)	23.2(118)	31.4(160)
Age:					
≤ 40	485	30.7(149)	23.7(115)	24.5(119)	21.0(102)
> 40	519	26.2(136)	23.5(122)	25.1(130)	25.2(131)
Education:					
Low	504	21.8(110)	22.8(115)	28.2(142)	27.2(137)
High	500	35.0(175)	24.4(122)	21.4(107)	19.2(96)

Variable 13 Response Codes

Control	N	1	2	3	4	5
Race:						
Black	510	0.6(3)	80.4(410)	13.1(67)	4.5(23)	1.4(7)
White	494	4.5(22)	59.3(293)	24.9(123)	7.1(35)	4.3(21)
Sex:						
Male	495	1.6(8)	71.9(356)	17.0(84)	6.5(32)	3.0(15)
Female	509	3.3(17)	68.2(347)	20.8(106)	5.1(26)	2.6(13)
Age:						
≤ 40	485	2.7(13)	70.3(341)	19.8(96)	4.3(21)	2.9(14)
> 40	519	2.3(12)	69.8(362)	18.1(94)	7.1(37)	2.7(14)
Education:						
Low	504	2.0(10)	65.3(329)	20.4(103)	8.1(41)	4.2(21)
High	500	3.0(15)	74.8(374)	17.4(87)	3.4(17)	1.4(7)

Variable 14 Response Codes

Control	N	1	2	3	4	5
Race:						
Black	510	9.4(48)	36.9(188)	42.8(218)	8.0(41)	2.9(15)
White	494	4.1(20)	38.5(190)	26.3(130)	25.1(124)	6.1(30)
Sex:						
Male	495	9.1(45)	43.4(215)	30.3(150)	13.5(67)	3.6(18)
Female	509	4.5(23)	32.0(163)	38.9(198)	19.3(98)	5.3(27)
Age:						
≤ 40	485	5.2(25)	38.1(185)	37.7(183)	14.0(68)	5.0(24)
> 40	519	8.3(43)	37.2(193)	31.8(165)	18.7(97)	4.1(21)
Education:						
Low	504	7.3(37)	39.7(200)	30.6(154)	16.9(85)	5.6(28)
High	500	6.2(31)	35.6(178)	38.8(194)	16.0(80)	3.4(17)

G. Subgroup correlation matrices

Following are the correlation matrices for each group for all fourteen analysis variables and systolic and diastolic blood pressure.

Group 1-BMYL

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Systolic	Diastolic
1	1.00	.13	.13	-.15	.03	.11	-.06	-.07	.16	.17	.04	.21	.16	.31	.07	.05
2		1.00	-.15	-.19	.21	.12	-.22	.14	.25	.36	-.07	.23	.40	.18	-.11	-.22
3			1.00	.37	-.08	-.09	-.07	.03	-.14	-.01	-.05	-.18	.03	-.13	.00	.04
4				1.00	-.09	-.24	.06	.02	-.23	-.17	.10	-.12	-.16	-.16	-.10	-.12
5					1.00	.09	-.02	.06	.16	.16	-.11	.10	.27	.06	-.02	-.06
6						1.00	-.17	-.27	.17	.15	.15	-.16	.15	.26	.25	.05
7							1.00	.34	-.20	-.16	-.18	-.08	-.08	-.35	.09	.04
8								1.00	-.19	-.10	-.07	-.07	-.06	-.17	.06	.08
9									1.00	.40	.10	.14	.14	.34	-.05	-.03
10										1.00	-.18	.19	.28	.14	-.13	-.09
11											1.00	.15	-.17	.32	.15	.04
12												1.00	.00	.19	.03	.09
13													1.00	.02	-.06	-.06
14														1.00	.18	.15
Systolic															1.00	.75
Diastolic																1.00

Group 2-BMYH

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Systolic	Diastolic
1	1.00	.26	.13	-.06	.08	-.03	.01	-.20	.17	.20	.20	.21	.17	.36	.01	.05
2		1.00	.16	.17	-.07	.21	-.07	.14	.20	.11	.05	.19	.05	.37	.13	-.09
3			1.00	.33	.13	-.15	-.11	.23	-.06	-.04	.21	.06	.06	.09	.05	-.07
4				1.00	.08	-.16	-.04	.33	-.29	-.13	.13	.05	-.18	-.16	-.04	-.10
5					1.00	.15	.14	-.13	-.05	.03	-.12	.33	-.09	.21	.12	-.04
6						1.00	.18	-.22	.10	.12	-.13	.05	-.04	.36	-.01	.09
7							1.00	.01	-.02	.08	-.27	.12	.05	-.04	.01	-.00
8								1.00	-.15	-.10	.08	-.05	.02	-.29	.02	-.03
9									1.00	.19	-.10	-.07	.21	.27	.14	.11
10										1.00	-.27	.16	.34	-.04	.16	.20
11											1.00	-.14	-.18	.06	-.09	-.15
12												1.00	.06	.22	.17	.24
13													1.00	-.04	.29	.21
14														1.00	-.01	-.11
Systolic															1.00	.66
Diastolic																1.00

Group 3-BMOL

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Systolic	Diastolic
1	1.00	.17	-.19	-.43	.13	.08	.12	-.22	.11	.19	.08	.02	-.33	.10	.04	.01
2		1.00	.05	-.33	.11	.12	-.01	-.02	.38	.28	.08	.17	.18	.29	.07	-.12
3			1.00	.40	.01	.09	-.22	.22	-.00	-.08	.08	-.10	-.00	.04	-.10	-.26
4				1.00	-.02	-.05	-.06	.27	-.31	-.27	-.05	-.08	-.04	-.07	-.23	-.23
5					1.00	.02	.14	.23	.00	.10	-.16	.21	.17	-.09	.23	.21
6						1.00	-.06	-.00	.23	-.18	.04	-.02	-.13	.29	.22	-.00
7							1.00	.15	-.09	.11	.07	.15	-.00	-.04	.15	.09
8								1.00	.02	-.12	-.01	.10	.12	-.01	.05	.05
9									1.00	.15	-.01	-.09	.09	.29	.08	-.04
10										1.00	-.52	.20	.26	-.08	-.10	-.01
11											1.00	.05	-.14	.07	.14	-.00
12												1.00	.27	.23	.09	.04
13													1.00	.02	.06	-.04
14														1.00	-.05	-.22
Systolic															1.00	.78
Diastolic																1.00

Group 4–BMOH

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Systolic	Diastolic
1	1.00	.11	-.08	-.03	.02	.21	-.02	.04	.13	.50	-.25	.01	.00	.20	.20	.23
2		1.00	.01	-.07	.16	-.18	-.03	-.30	.24	.17	-.10	.05	.13	.09	.21	.16
3			1.00	.35	-.24	-.14	.06	-.02	.01	-.26	.03	.26	-.14	-.07	.10	-.05
4				1.00	-.14	-.07	.08	.12	-.31	-.36	.21	.13	-.13	.25	-.09	-.05
5					1.00	-.10	-.06	-.11	.07	.15	-.03	-.04	.09	-.01	-.06	-.03
6						1.00	.00	.05	-.04	.08	-.17	.07	-.13	.09	.15	.11
7							1.00	.11	-.08	-.18	-.12	.18	-.00	-.32	.04	.01
8								1.00	-.22	-.08	-.09	.00	.12	-.11	-.21	-.20
9									1.00	.25	-.17	-.06	-.00	.08	.00	.02
10										1.00	-.47	-.10	.14	.07	.14	.23
11											1.00	-.27	-.09	.07	.14	.07
12												1.00	-.05	.24	-.09	-.06
13													1.00	-.18	-.08	-.07
14														1.00	-.02	.03
Systolic															1.00	.86
Diastolic																1.00

Group 5-BFYL

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Systolic	Diastolic
1	1.00	-.09	.00	.19	-.03	.11	-.07	.03	.03	.08	.08	.09	-.26	.18	.06	.02
2		1.00	-.05	-.16	.19	-.02	-.12	-.12	.09	.20	-.03	.23	.17	.48	.20	.21
3			1.00	.16	-.30	.08	-.17	.08	.08	-.25	.17	-.24	.01	-.07	-.04	-.13
4				1.00	-.30	-.07	.13	.18	.11	-.26	.02	-.36	-.07	-.29	-.19	-.15
5					1.00	-.10	.18	-.28	-.08	.19	-.17	.36	.05	.26	.12	.08
6						1.00	-.09	-.14	.08	-.04	.06	-.02	.10	.23	-.01	-.14
7							1.00	.27	-.12	-.24	-.17	-.03	.00	-.11	.14	.16
8								1.00	.04	.04	.03	-.06	.02	-.14	-.03	-.07
9									1.00	.18	.00	-.21	.27	.15	.01	.04
10										1.00	-.15	.47	.24	.30	.00	.03
11											1.00	-.17	-.07	-.05	-.09	-.01
12												1.00	-.08	.24	.23	.24
13													1.00	.22	-.27	-.13
14														1.00	.12	.04
Systolic															1.00	.76
Diastolic																1.00

Group 6-BFYH

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Systolic	Diastolic
1	1.00	.40	-.04	-.10	.07	-.04	-.12	-.01	.40	.41	-.03	.35	-.16	.26	.06	-.03
2		1.00	.08	.02	.24	.10	-.05	-.19	.37	.30	.16	.50	-.25	.45	.05	-.06
3			1.00	.36	.28	-.16	-.04	.26	-.00	-.07	-.13	.03	.11	.04	-.02	.12
4				1.00	.10	-.14	.03	.18	-.20	-.36	-.01	-.07	-.11	-.04	-.22	-.14
5					1.00	.05	-.02	.31	.04	.06	-.08	.23	-.02	.08	-.25	-.21
6						1.00	-.12	-.16	.11	.26	.15	.03	.08	.35	.16	.03
7							1.00	-.15	-.10	-.13	-.06	-.06	.15	.07	-.11	.01
8								1.00	-.15	-.22	-.04	.05	.01	-.23	-.13	-.08
9									1.00	.42	-.07	.10	-.08	.14	.10	-.03
10										1.00	-.01	.33	.34	.17	.09	.05
11											1.00	.11	-.12	.20	.19	-.04
12												1.00	-.13	.37	.06	.14
13													1.00	-.10	.05	.07
14														1.00	.03	.05
Systolic															1.00	.79
Diastolic																1.00

Group 7-BFOL

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Systolic	Diastolic
1	1.00	.34	-.04	-.04	-.27	-.05	-.12	.11	.30	.33	.02	.24	.10	.38	-.01	-.08
2		1.00	-.27	-.16	-.04	-.17	-.15	.10	.31	.31	.01	.34	.16	.26	.01	.08
3			1.00	.60	-.20	.00	.27	.17	-.16	-.16	.10	.08	-.13	-.07	.10	-.03
4				1.00	-.20	.12	.32	.23	-.32	-.37	.23	-.11	-.23	-.10	.12	.12
5					1.00	-.12	-.19	.01	-.01	-.00	-.08	.14	.25	.04	-.18	.10
6						1.00	-.25	-.05	-.25	-.17	.20	.07	-.27	.17	.03	.01
7							1.00	-.01	-.12	-.12	-.18	-.20	-.11	-.30	.13	.14
8								1.00	-.36	-.31	.18	-.10	-.02	-.09	.02	.20
9									1.00	.46	-.26	.35	.45	.18	-.18	-.34
10										1.00	-.38	.31	.35	.20	.03	-.21
11											1.00	-.02	-.25	.04	-.00	.16
12												1.00	.23	.42	.08	-.02
13													1.00	.09	-.18	-.15
14														1.00	.13	.13
Systolic															1.00	.73
Diastolic																1.00

Group 8-BFOH

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Systolic	Diastolic
1	1.00	-.08	.19	.13	-.01	-.10	-.09	.10	.00	.09	.19	.10	.11	.28	.01	-.12
2		1.00	-.33	-.19	.07	.15	.13	-.07	.01	.34	-.08	.09	.15	.20	-.19	-.15
3			1.00	.31	-.15	-.13	-.00	-.08	-.09	.00	.14	.10	-.05	.01	.31	.22
4				1.00	-.07	-.06	.08	.14	.04	.16	.01	.06	.07	-.04	.14	.10
5					1.00	-.02	.01	-.02	-.04	.10	-.05	.25	-.16	-.02	-.07	-.06
6						1.00	-.09	-.06	.09	-.02	-.12	-.02	-.01	.28	-.17	-.13
7							1.00	.26	-.05	.10	-.07	-.26	.11	-.12	-.05	-.02
8								1.00	-.06	-.12	.06	.09	-.09	.05	.10	.20
9									1.00	.34	-.45	.24	.39	.09	-.12	-.18
10										1.00	-.18	.28	.46	.11	-.02	-.06
11											1.00	.00	-.32	-.05	.15	.14
12												1.00	.17	.12	.30	.14
13													1.00	-.11	.07	-.10
14														1.00	-.05	-.13
Systolic															1.00	.84
Diastolic																1.00

Group 9-WMYL

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Systolic	Diastolic
1	1.00	.55	.14	.03	.46	.11	.23	-.29	.25	.40	.09	.26	.51	.43	-.20	-.08
2		1.00	.27	.10	.48	.11	.22	-.20	.13	.42	.20	.33	.41	.49	-.21	-.09
3			1.00	.38	.21	.05	-.05	-.10	.16	.14	.11	.03	.12	.19	-.21	-.16
4				1.00	.17	-.05	.13	-.08	.01	-.12	.09	.11	.09	.21	-.23	-.29
5					1.00	.26	.01	-.13	.13	.28	.22	.10	.39	.23	-.24	-.16
6						1.00	-.04	.14	-.00	.27	-.04	.24	.12	.19	-.28	-.14
7							1.00	-.21	.19	.01	-.26	-.05	.11	.06	-.32	-.31
8								1.00	-.16	.07	-.02	.04	-.06	-.26	-.05	.07
9									1.00	.28	-.11	-.08	-.07	.04	-.22	-.19
10										1.00	.13	.37	.32	.41	-.13	-.00
11											1.00	.08	-.06	.29	.24	.29
12												1.00	.24	.51	.03	.07
13													1.00	.35	-.18	-.09
14														1.00	-.06	-.04
Systolic															1.00	.79
Diastolic																1.00

Group 10-WMYH

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Systolic	Diastolic
1	1.00	.63	.03	.06	.43	-.06	.28	-.06	.27	.33	.05	.30	.15	.43	-.10	-.03
2		1.00	.13	.05	.36	-.19	.43	.10	.32	.38	-.01	.34	.30	.55	.04	.11
3			1.00	.15	.11	.06	-.08	-.00	.06	-.03	.14	.17	.03	-.16	-.17	-.10
4				1.00	.20	-.12	.17	.17	.08	.12	-.05	.33	.23	-.02	-.29	.03
5					1.00	.10	.34	.06	.33	.34	-.10	.50	.13	.30	-.13	-.21
6						1.00	-.06	.04	-.03	-.26	-.13	.05	-.10	-.19	.03	-.03
7							1.00	.26	.01	.29	-.09	.17	.14	.28	.03	.07
8								1.00	.10	-.11	-.11	.02	.11	.01	.24	.11
9									1.00	.32	.01	.08	.29	.25	-.20	-.19
10										1.00	.10	.38	.23	.41	-.24	-.14
11											1.00	-.01	-.04	-.04	-.15	-.23
12												1.00	.50	.35	-.18	-.08
13													1.00	.26	.06	.23
14														1.00	-.03	-.03
Systolic															1.00	.68
Diastolic																1.00

Group 11-WMOL

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Systolic	Diastolic
1	1.00	.41	.32	.04	.33	.08	.21	-.03	.04	.13	.02	.26	.10	.31	.20	.12
2		1.00	.09	-.07	.40	.28	.19	-.17	.02	.28	-.05	.30	.20	.33	-.01	.03
3			1.00	.45	.02	-.09	.26	-.14	-.00	.23	-.00	.09	-.04	.09	.00	-.11
4				1.00	-.09	-.10	.01	-.06	-.00	.06	-.13	-.16	-.07	-.03	-.18	-.25
5					1.00	.17	.27	-.16	.06	.24	.03	.22	.19	.39	-.16	-.07
6						1.00	.05	-.09	-.00	.06	-.17	.20	.05	.08	.10	.04
7							1.00	-.16	.02	.17	-.07	.27	.26	.20	-.14	-.17
8								1.00	-.04	-.08	-.08	-.19	-.16	-.11	.12	.12
9									1.00	.01	.02	-.12	.07	.04	.07	.04
10										1.00	-.08	.32	.37	.20	-.00	.07
11											1.00	.04	-.08	-.12	.03	.15
12												1.00	-.01	.47	-.14	-.04
13													1.00	.14	.06	.08
14														1.00	.07	.15
Systolic															1.00	.82
Diastolic																1.00

Group 12-WMOH

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Systolic	Diastolic
1	1.00	.44	.07	.01	.27	.17	.05	-.03	.08	.13	.33	.36	.17	.42	-.07	.04
2		1.00	.23	.21	.36	.04	.28	-.09	.33	.46	.09	.51	.20	.52	.04	.03
3			1.00	.30	.13	.04	.02	-.10	.12	.12	.29	.21	.07	.22	.22	.12
4				1.00	.24	-.12	.21	.11	.31	.20	.28	.17	-.03	.05	.03	-.10
5					1.00	-.02	-.09	-.12	.07	.19	.09	.28	.14	.24	-.03	.00
6						1.00	-.16	-.04	.08	.16	-.13	-.05	.05	.19	.07	-.08
7							1.00	.02	.13	.19	.12	.21	.18	.12	-.05	.05
8								1.00	.01	-.09	.17	.02	-.13	.10	.09	.06
9									1.00	.42	.07	.15	.10	.19	.12	-.07
10										1.00	-.16	.51	.33	.44	-.15	-.18
11											1.00	.18	-.13	.16	.29	.21
12												1.00	.25	.49	-.09	-.15
13													1.00	.16	-.12	.01
14														1.00	.05	.08
Systolic															1.00	.68
Diastolic																1.00

Group 13-WFYL

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Systolic	Diastolic
1	1.00	.32	.08	.05	.14	-.01	.28	.01	.31	.12	.12	.25	.35	.32	.01	.01
2		1.00	.24	.27	.36	-.12	.33	.00	.19	.20	.10	.30	.37	.55	.04	.01
3			1.00	.24	.19	-.05	.17	-.20	.08	-.12	.23	-.01	-.05	.11	.08	.16
4				1.00	-.02	.05	.21	.02	.06	.03	.19	-.02	.28	.11	-.04	-.02
5					1.00	.09	.08	-.12	.24	.13	-.05	.23	.09	.35	-.08	-.09
6						1.00	.00	.01	.15	.14	-.06	-.08	-.05	-.07	-.02	-.01
7							1.00	.11	.08	.34	-.03	.06	.27	.33	.01	-.01
8								1.00	-.01	-.28	.19	.01	.15	.10	.01	-.06
9									1.00	.23	.23	-.03	.03	.25	-.08	-.01
10										1.00	-.11	.02	.34	.24	-.03	-.05
11											1.00	.04	-.21	.01	-.06	-.10
12												1.00	.02	.36	-.02	-.16
13													1.00	.31	.05	.13
14														1.00	-.01	.00
Systolic															1.00	.83
Diastolic																1.00

Group 14-WFYH

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Systolic	Diastolic
1	1.00	.44	.23	.41	.08	.01	.16	-.23	.39	.20	.23	.36	.05	.52	-.00	.08
2		1.00	.09	.03	.20	-.03	.14	-.18	.06	.23	.22	.33	.16	.38	-.06	-.02
3			1.00	.35	-.11	.05	-.09	.34	.18	.13	-.02	.09	-.06	.19	-.18	-.18
4				1.00	-.11	-.36	.13	.04	.02	.15	-.01	.25	-.11	-.01	-.20	-.14
5					1.00	-.21	-.18	-.15	.13	.17	.13	.21	.19	.31	-.22	-.21
6						1.00	-.02	.03	.18	-.12	.03	-.27	.01	-.06	.27	.22
7							1.00	-.38	.13	.04	.15	-.03	-.07	.03	.21	.09
8								1.00	-.04	-.12	-.44	-.21	.13	-.12	-.06	-.06
9									1.00	.22	.11	.18	-.07	.22	.12	.16
10										1.00	-.11	.16	.08	.29	.00	.09
11											1.00	.46	.02	.34	-.03	.02
12												1.00	-.02	.41	-.22	-.08
13													1.00	.10	.19	.23
14														1.00	-.14	-.05
Systolic															1.00	.83
Diastolic																1.00

Group 15-WFOL

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Systolic	Diastolic
1	1.00	.37	.21	-.05	.36	.01	.03	-.18	.11	-.02	.14	.12	.18	.36	.02	.19
2		1.00	.01	.09	.39	.01	.08	-.29	.25	.32	.12	.34	.28	.47	.05	.08
3			1.00	.34	-.05	.10	.05	-.17	.05	-.04	.12	-.16	-.13	-.14	-.06	-.01
4				1.00	.04	.12	.07	-.04	.06	-.01	-.02	-.07	-.08	-.12	.04	-.01
5					1.00	.14	.17	-.14	.18	.30	.05	.35	.33	.50	.12	.13
6						1.00	-.16	.09	-.06	.08	-.04	.07	-.00	.08	.10	.15
7							1.00	-.22	.28	.28	.16	.06	.19	.13	.13	.22
8								1.00	-.17	-.07	.08	-.04	-.28	-.11	.09	.01
9									1.00	.29	.12	-.14	.06	.09	.19	.18
10										1.00	.13	.29	.32	.34	.24	.23
11											1.00	.05	-.06	.11	.07	.12
12												1.00	.30	.45	.23	.19
13													1.00	.41	.13	.27
14														1.00	.08	.12
Systolic															1.00	.73
Diastolic																1.00

Group 16-WFOH

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Systolic	Diastolic
1	1.00	.49	-.04	.19	.08	.03	.11	-.15	.11	.33	.10	.26	.25	.47	-.18	-.32
2		1.00	.07	.10	.42	-.19	-.04	-.14	.07	.41	.14	.42	.16	.49	-.27	-.28
3			1.00	.36	-.01	-.12	.11	-.06	.15	.09	.12	.02	-.06	.16	.10	.20
4				1.00	-.04	-.06	.11	.02	-.07	.18	.27	.17	-.04	.33	-.14	-.03
5					1.00	.03	-.23	-.01	.17	.38	.21	.48	.08	.23	-.27	-.29
6						1.00	-.20	.21	-.03	-.12	.01	.01	.34	-.06	.10	-.06
7							1.00	-.05	.23	.04	-.14	-.02	-.06	.17	-.03	-.02
8								1.00	-.14	-.12	-.03	-.16	-.04	-.18	-.06	-.02
9									1.00	.25	-.18	.06	.17	.09	.02	-.03
10										1.00	.19	.54	.17	.41	-.05	-.12
11											1.00	.24	-.11	.31	-.15	-.13
12												1.00	.15	.51	-.17	-.32
13													1.00	.17	.08	.01
14														1.00	-.12	-.20
Systolic															1.00	.80
Diastolic																1.00

APPENDIX II

REGRESSION ANALYSIS DATA

A. Step-wise regression results

Following are the stepwise regression results for systolic and diastolic blood pressure regressed on the fourteen analysis variables listed in Appendix I, part C. Significant F values are marked "*".

Group 1-BMYL

Systolic blood pressure regression:

Step	Variable entered	R	R^2	Increase in R^2	F value
1	6	.2500	.0625	.0625	4.46*
2	10	.3040	.0924	.0299	2.17
3	14	.3350	.1122	.0198	1.45
4	7	.3754	.1409	.0287	2.14
5	8	.3863	.1492	.0083	0.61
6	2	.4037	.1630	.0138	1.02
7	12	.4203	.1767	.0137	1.02
8	3	.4249	.1805	.0038	0.28
9	4	.4304	.1852	.0047	0.34
10	9	.4334	.1879	.0026	0.19
11	11	.4353	.1895	.0017	0.12
12	5	.4358	.1900	.0004	0.03

Prediction equation: $y = 102.28 - 3.03x_2 + 1.71x_3 - 1.99x_4 - 0.65x_5 + 6.07x_6 + 3.32x_7 + 2.34x_8 - 1.28x_9 - 2.05x_{10} + 0.91x_{11} + 1.78x_{12} + 3.10x_{14}$

Equation for significant R^2: $y = 115.73 + 4.92x_6$

Diastolic blood pressure regression:

Step	Variable entered	R	R^2	Increase in R^2	F value
1	2	.2225	.0495	.0495	3.49
2	14	.2926	.0856	.0361	2.61
3	8	.3318	.1101	.0245	1.79
4	4	.3625	.1314	.0213	1.57
5	12	.3822	.1460	.0146	1.08
6	3	.3938	.1550	.0090	0.66
7	6	.4027	.1622	.0071	0.52
8	11	.4066	.1653	.0032	0.23
9	10	.4108	.1687	.0034	0.24
10	13	.4138	.1712	.0025	0.17
11	5	.4181	.1748	.0036	0.25
12	1	.4200	.1764	.0016	0.11

Prediction equation: $y = 78.50 - 0.74x_1 - 5.33x_2 + 1.41x_3 - 2.19x_4 - 1.35x_5 + 1.64x_6 + 2.46x_8 - 0.79x_{10} - 1.16x_{11} + 2.02x_{12} + 1.06x_{13} + 2.36x_{14}$

No R^2 value is significant.

Group 2-BMYH

Systolic blood pressure regression:

Step	Variable entered	R	R^2	Increase in R^2	F value
1	13	.2883	.0831	.0831	5.98*
2	12	.3240	.1049	.0218	1.59
3	5	.3399	.1155	.0106	0.77
4	2	.3577	.1280	.0124	0.90
5	14	.3705	.1372	.0093	0.67
6	9	.3840	.1474	.0102	0.73
7	1	.3917	.1534	.0059	0.42
8	6	.3936	.1549	.0015	0.11
9	4	.3950	.1560	.0011	0.07
10	10	.3961	.1569	.0009	0.06
11	11	.3975	.1580	.0011	0.07

Prediction equation: $y = 101.23 - 2.06X_1 + 2.95X_2 - 0.66X_4 + 3.93X_5 - 1.00X_6 + 1.64X_9 + 0.66X_{10} + 0.61X_{11} + 1.61X_{12} + 6.95X_{13}$

Equation for significant R^2: $y = 106.74 + 7.55X_{13}$

Diastolic blood pressure regression:

Step	Variable entered	R	R^2	Increase in R^2	F value
1	12	.2365	.0559	.0559	3.91
2	13	.3040	.0924	.0365	2.62
3	14	.3436	.1181	.0256	1.86
4	9	.3744	.1402	.0221	1.62
5	6	.4022	.1618	.0216	1.60
6	2	.4218	.1779	.0161	1.20
7	5	.4376	.1915	.0135	1.00
8	7	.4456	.1986	.0071	0.52
9	10	.4505	.2030	.0044	0.32
10	1	.4538	.2059	.0029	0.21
11	11	.4546	.2067	.0008	0.05

Prediction equation: $y = 76.51 - 0.68X_1 - 2.14X_2 - 2.10X_5 + 2.38X_6 - 1.66X_7 + 1.78X_9 + 0.85X_{10} - 0.38X_{11} + 3.41X_{12} + 2.36X_{13} - 2.05X_{14}$

No R^2 value is significant.

Group 3-BMOL

Systolic blood pressure regression:

Step	Variable entered	R	R^2	Increase in R^2	F value
1	4	.2279	.0519	.0519	3.07
2	5	.3187	.1016	.0496	3.04
3	6	.3807	.1450	.0434	2.74
4	11	.4121	.1698	.0248	1.59
5	14	.4281	.1832	.0135	0.86
6	7	.4411	.1946	.0114	0.72
7	10	.4507	.2031	.0085	0.53
8	13	.4592	.2108	.0078	0.48
9	12	.4617	.2131	.0023	0.14
10	9	.4624	.2138	.0006	0.04
11	1	.4627	.2141	.0003	0.02
12	8	.4630	.2144	.0003	0.02
13	2	.4633	.2146	.0002	0.01

Prediction equation: $y = 125.90 - 0.49X_1 - 0.42X_2 - 6.69X_4 + 6.68X_5 + 6.20X_6 + 4.01X_7 + 0.43X_8 + 0.72X_9 - 3.46X_{10} + 2.09X_{11} + 1.08X_{12} - 1.48X_{13} - 2.57X_{14}$

No R^2 value is significant.

Diastolic blood pressure regression:

Step	Variable entered	R	R^2	Increase in R^2	F value
1	3	.2591	.0671	.0671	4.03*
2	14	.3365	.1133	.0461	2.86
3	5	.3869	.1497	.0364	2.31
4	4	.4176	.1744	.0247	1.59
5	2	.4411	.1946	.0202	1.31
6	8	.4512	.2036	.0090	0.58
7	6	.4572	.2090	.0054	0.34
8	10	.4604	.2120	.0029	0.18
9	12	.4627	.2141	.0021	0.13
10	13	.4653	.2165	.0025	0.15
11	1	.4706	.2215	.0050	0.29
12	11	.4711	.2219	.0004	0.03

Prediction equation: $y = 109.77 - 1.60X_1 - 2.43X_2 - 3.04X_3 - 5.75X_4 + 4.76X_5 + 1.34X_6 + 1.58X_8 - 0.45X_{10} + 0.53X_{11} + 0.80X_{12} - 1.37X_{13} - 2.75X_{14}$

Equation for significant R^2: $y = 96.30 - 4.58X_3$

Group 4-BMOH

Systolic blood pressure regression:

Step	Variable entered	R	R^2	Increase in R^2	F value
1	8	.2099	.0441	.0441	2.58
2	1	.2960	.0876	.0435	2.62
3	11	.3453	.1192	.0316	1.94
4	2	.3744	.1402	.0210	1.29
5	6	.4144	.1717	.0315	1.98
6	3	.4356	.1898	.0180	1.13
7	10	.4621	.2136	.0238	1.51
8	7	.4801	.2305	.0169	1.08
9	4	.4950	.2450	.0145	0.92
10	9	.5089	.2590	.0140	0.89
11	12	.5142	.2644	.0054	0.34
12	5	.5189	.2692	.0048	0.29
13	13	.5213	.2717	.0025	0.15

Prediction equation: $y = 83.09 + 6.48X_1 + 9.93X_2 + 7.21X_3 - 6.93X_4 - 4.12X_5 + 9.38X_6 + 6.61X_7 - 4.02X_8 - 5.24X_9 + 7.13X_{10} + 9.54X_{11} - 2.68X_{12} - 2.19X_{13}$

No R^2 value is significant.

Diastolic blood pressure regression:

Step	Variable entered	R	R^2	Increase in R^2	F value
1	10	.2312	.0534	.0534	3.16
2	11	.3043	.0926	.0392	2.37
3	8	.3403	.1158	.0232	1.42
4	1	.3717	.1382	.0224	1.38
5	6	.3859	.1489	.0108	0.66
6	7	.3990	.1592	.0103	0.62
7	2	.4101	.1682	.0090	0.54
8	5	.4187	.1753	.0071	0.42
9	9	.4241	.1799	.0046	0.27
10	13	.4285	.1836	.0037	0.22
11	14	.4308	.1856	.0020	0.11

Prediction equation: $y = 67.66 + 2.83X_1 + 2.81X_2 - 2.29X_5 + 2.51X_6 + 1.93X_7 - 2.20X_8 - 1.29X_9 + 4.60X_{10} + 3.55X_{11} - 1.41X_{13}$

No R^2 value is significant.

Group 5-BFYL

Systolic blood pressure regression:

Step	Variable entered	R	R^2	Increase in R^2	F value
1	13	.2701	.0729	.0729	4.96*
2	2	.3711	.1377	.0648	4.66*
3	4	.4115	.1693	.0316	2.32
4	7	.4543	.2064	.0371	2.80*
5	9	.4719	.2227	.0163	1.24
6	12	.4857	.2359	.0132	1.00
7	3	.4900	.2401	.0042	0.32
8	11	.4938	.2438	.0037	0.28
9	10	.4956	.2457	.0018	0.13
10	1	.4964	.2464	.0007	0.05
11	6	.4968	.2468	.0004	0.03
12	5	.4971	.2471	.0003	0.02
13	8	.4973	.2473	.0002	0.01

Prediction equation: $y = 120.05 + 0.75X_1 + 4.71X_2 + 1.22X_3 - 4.05X_4 - 0.76X_5 + 0.41X_6 + 5.87X_7 - 0.33X_8 + 3.66X_9 - 1.06X_{10} - 1.63X_{11} + 2.21X_{12} - 8.59X_{13}$

Equation for significant R^2:

$y = 127.09 + 5.35X_2 - 4.08X_4 + 5.38X_7 - 8.30X_{13}$

Diastolic blood pressure regression:

Step	Variable entered	R	R^2	Increase in R^2	F value
1	12	.2419	.0585	.0585	3.92
2	7	.2955	.0873	.0288	1.96
3	2	.3439	.1183	.0309	2.14
4	13	.3746	.1403	.0220	1.54
5	9	.3982	.1586	.0182	1.28
6	4	.4125	.1701	.0116	0.81
7	6	.4275	.1828	.0126	0.88
8	5	.4381	.1919	.0092	0.64
9	8	.4584	.2101	.0182	1.26
10	11	.4622	.2137	.0036	0.24
11	14	.4655	.2167	.0030	0.20
12	1	.4675	.2185	.0018	0.12
13	3	.4690	.2200	.0015	0.10
14	10	.4714	.2222	.0022	0.14

Prediction equation: $y = 77.73 + 1.06X_1 + 3.36X_2 - 0.74X_3 - 2.34X_4 - 2.33X_6 + 5.37X_7 - 2.02X_8 + 3.09X_9 - 0.90X_{10} + 0.93X_{11} + 2.52X_{12} - 2.43X_{13} - 1.02X_{14}$

No R^2 value is significant.

Group 6-BFYH

Systolic blood pressure regression:

Step	Variable entered	R	R^2	Increase in R^2	F value
1	5	.2518	.0634	.0634	4.20*
2	4	.3158	.0998	.0363	2.46
3	11	.3602	.1298	.0300	2.07
4	3	.3906	.1526	.0228	1.59
5	6	.4135	.1710	.0184	1.29
6	12	.4208	.1770	.0061	0.42
7	14	.4304	.1852	.0082	0.56
8	1	.4367	.1907	.0055	0.37
9	10	.4402	.1937	.0030	0.20
10	8	.4453	.1983	.0046	0.30
11	13	.4497	.2022	.0040	0.26
12	7	.4563	.2082	.0060	0.38
13	9	.4614	.2129	.0047	0.30
14	2	.4633	.2146	.0017	0.11

Prediction equation: $y = 113.21 + 2.77X_1 + 1.32X_2 + 5.16X_3 - 5.57X_4 - 9.01X_5 + 5.46X_6 - 3.18X_7 - 1.84X_8 + 1.72X_9 - 4.74X_{10} + 4.50X_{11} + 2.37X_{12} + 6.66X_{13} - 3.07X_{14}$

Equation for significant R^2:

$y = 132.42 - 8.02X_5$

Diastolic blood pressure regression:

Step	Variable entered	R	R^2	Increase in R^2	F value
1	5	.2139	.0457	.0457	2.97
2	12	.2870	.0824	.0366	2.44
3	3	.3481	.1212	.0388	2.65
4	4	.3937	.1550	.0338	2.36
5	2	.4086	.1670	.0119	0.83
6	8	.4148	.1721	.0051	0.35
7	6	.4189	.1755	.0034	0.23
8	10	.4230	.1790	.0035	0.24
9	11	.4255	.1810	.0011	0.07
10	1	.4268	.1821	.0011	0.07
11	9	.4275	.1828	.0006	0.04
12	13	.4278	.1830	.0003	0.02
13	14	.4281	.1833	.0003	0.02

Prediction equation: $y = 87.13 - 0.42X_1 - 1.70X_2 + 5.43X_3 - 3.32X_4 - 6.54X_5 + 1.63X_6 - 1.19X_8 - 0.49X_9 - 1.25X_{10} - 0.86X_{11} + 3.52X_{12} + 0.81X_{13} - 0.30X_{14}$

No R^2 value is significant.

Group 7-BFOL

Systolic blood pressure regression:

Step	Variable entered	R	R^2	Increase in R^2	F value
1	13	.1836	.0337	.0337	2.16
2	14	.2367	.0560	.0223	1.44
3	7	.2875	.0826	.0266	1.74
4	9	.3137	.0984	.0158	1.03
5	5	.3420	.1169	.0185	1.22
6	12	.3656	.1337	.0167	1.10
7	10	.3813	.1454	.0117	0.77
8	1	.3926	.1541	.0087	0.57
9	6	.4010	.1608	.0067	0.43
10	11	.4021	.1617	.0009	0.06
11	4	.4034	.1627	.0011	0.07
12	3	.4052	.1642	.0015	0.09
13	8	.4055	.1644	.0003	0.02
14	2	.4060	.1648	.0004	0.02

Prediction equation: $y = 161.84 - 5.92X_1 - 0.99X_2 - 2.24X_3 + 3.12X_4 - 11.95X_5 - 4.73X_6 + 5.24X_7 + 0.86X_8 - 10.51X_9 + 5.46X_{10} - 1.53X_{11} + 4.43X_{12} - 5.71X_{13} + 6.11X_{14}$

No R^2 value is significant.

Diastolic blood pressure regression:

Step	Variable entered	R	R^2	Increase in R^2	F value
1	9	.3358	.1128	.1128	7.88*
2	2	.3890	.1514	.0386	2.77
3	14	.4171	.1739	.0226	1.64
4	7	.4507	.2032	.0292	2.16
5	5	.4694	.2204	.0172	1.28
6	10	.4831	.2334	.0130	0.97
7	3	.4880	.2381	.0047	0.35
8	11	.4932	.2432	.0051	0.37
9	8	.4957	.2458	.0025	0.18
10	1	.4987	.2487	.0030	0.21
11	6	.5003	.2503	.0016	0.11
12	12	.5010	.2510	.0007	0.05
13	13	.5016	.2516	.0006	0.04
14	4	.5020	.2520	.0004	0.02

Prediction equation: $y = 73.21 - 1.85X_1 + 2.96X_2 - 2.42X_3 + 0.66X_4 + 2.92X_5 - 1.47X_6 + 6.38X_7 + 1.38X_8 - 7.42X_9 - 1.32X_{10} + 1.99X_{11} + 0.53X_{12} - 0.71X_{13} + 3.98X_{14}$

Equation for significant R^2:

$y = 99.68 - 7.88X_9$

Group 8-BFOH

Systolic blood pressure regression:

Step	Variable entered	R	R^2	Increase in R^2	F value
1	3	.3076	.0946	.0946	6.48*
2	12	.4105	.1685	.0739	5.42*
3	9	.4443	.1974	.0289	2.16
4	2	.4677	.2187	.0213	1.61
5	13	.4863	.2365	.0178	1.35
6	5	.4966	.2466	.0101	0.77
7	6	.5062	.2563	.0096	0.73
8	1	.5156	.2659	.0096	0.72
9	8	.5208	.2712	.0053	0.40
10	11	.5239	.2744	.0032	0.23
11	14	.5251	.2758	.0013	0.10
12	10	.5260	.2767	.0009	0.07
13	4	.5269	.2776	.0009	0.06

Prediction equation: $y = 119.56 - 6.02X_1 - 4.71X_2 + 5.09X_3 + 1.63X_4 - 3.55X_5 - 4.38X_6 + 2.11X_8 - 5.98X_9 - 1.60X_{10} + 2.44X_{11} + 8.55X_{12} + 6.67X_{13} + 1.32X_{14}$

Equation for significant R^2: $y = 105.53 + 7.23X_3 + 6.76X_{12}$

Diastolic blood pressure regression:

Step	Variable entered	R	R^2	Increase in R^2	F value
1	3	.2183	.0477	.0477	3.10
2	8	.3076	.0946	.0470	3.16*
3	1	.3635	.1322	.0375	2.59
4	9	.3890	.1513	.0192	1.33
5	12	.4184	.1750	.0237	1.67
6	14	.4295	.1845	.0095	0.66
7	5	.4369	.1909	.0064	0.44
8	2	.4431	.1964	.0055	0.38
9	6	.4465	.1994	.0030	0.20
10	7	.4496	.2021	.0027	0.18
11	10	.4520	.2043	.0022	0.15
12	13	.4535	.2056	.0013	0.08
13	11	.4541	.2062	.0005	0.03

Prediction equation: $y = 93.15 - 5.17X_1 - 1.52X_2 + 2.90X_3 - 2.29X_5 - 1.31X_6 - 1.54X_7 + 4.14X_8 - 3.15X_9 + 1.44X_{10} + 0.54X_{11} + 2.57X_{12} - 0.84X_{13} - 1.35X_{14}$

Equation for significant R^2:

$y = 67.66 + 3.64\ X_3 + 4.06X_8$

Group 9-WMYL

Systolic blood pressure regression:

Step	Variable entered	R	R^2	Increase in R^2	F value
1	7	.3228	.1042	.1042	6.05*
2	6	.4364	.1904	.0862	5.43*
3	3	.4846	.2349	.0444	2.90*
4	11	.5132	.2634	.0285	1.90
5	5	.5414	.2931	.0297	2.02
6	4	.5563	.3095	.0164	1.11
7	12	.5659	.3203	.0108	0.73
8	2	.5742	.3297	.0095	0.63
9	9	.5813	.3379	.0081	0.54
10	10	.5827	.3395	.0016	0.11
11	13	.5833	.3402	.0007	0.05
12	14	.5840	.3411	.0008	0.05
13	8	.5843	.3414	.0003	0.02
14	1	.5845	.3417	.0003	0.02

Prediction equation: $y = 186.84 - 0.54X_1 - 1.75X_2 - 2.04X_3 - 11.55X_4 - 1.97X_5 - 6.44X_6 - 5.94X_7 - 0.47X_8 - 1.94X_9 - 0.81X_{10} + 5.24X_{11} + 2.48X_{12} - 0.45X_{13} + 0.48X_{14}$

Equation for significant R^2: $y = 173.79 - 4.78X_3 - 6.75X_6 - 10.03X_7$

Diastolic blood pressure regression:

Step	Variable entered	R	R^2	Increase in R^2	F value
1	7	.3111	.0968	.0968	5.57*
2	4	.4014	.1611	.0644	3.91*
3	11	.4761	.2267	.0655	4.24*
4	5	.5081	.2582	.0315	2.08
5	6	.5185	.2688	.0106	0.70
6	12	.5316	.2826	.0138	0.90
7	9	.5404	.2920	.0094	0.61
8	14	.5429	.2947	.0027	0.17
9	3	.5445	.2965	.0018	0.11
10	1	.5461	.2982	.0017	0.10
11	8	.5463	.2985	.0003	0.02
12	13	.5466	.2988	.0003	0.02
13	2	.5468	.2990	.0002	0.01

Prediction equation: $y = 114.09 + 0.70X_1 - 0.22X_2 - 0.73X_3 - 9.85X_{11} - 2.13X_5 - 1.99X_6 - 3.61X_7 - 0.28X_8 - 1.33X_9 + 4.81X_{11} + 1.55X_{12} + 0.22X_{13} - 0.79X_{14}$

Equation for significant R^2:

$y = 111.19 - 11.08X_4 - 3.91X_7 + 4.21X_{11}$

Group 10-WMYH

Systolic blood pressure regression:

Step	Variable entered	R	R^2	Increase in R^2	F value
1	4	.2933	.0860	.0860	4.80*
2	8	.4149	.1721	.0861	5.20*
3	9	.4618	.2132	.0411	2.56
4	13	.4926	.2426	.0294	1.86
5	12	.5170	.2673	.0247	1.58
6	11	.5308	.2817	.0145	0.93
7	2	.5419	.2936	.0119	0.76
8	10	.5509	.3034	.0098	0.62
9	3	.5595	.3130	.0096	0.60
10	14	.5614	.3151	.0021	0.13
11	5	.5631	.3171	.0020	0.12
12	1	.5657	.3200	.0029	0.17
13	7	.5682	.3228	.0028	0.16

Prediction equation: $y = 157.27 - 1.21X_1 + 2.57X_2 - 2.21X_3 - 8.78X_4 + 1.72X_5 - 1.55X_7 + 3.50X_8 - 4.32X_9 - 1.62X_{10} - 1.73X_{11} - 2.31X_{12} + 3.99X_{13} - 0.63X_{14}$

Equation for significant R^2: $y = 141.61 - 10.17X_4 + 4.12X_8$

Diastolic blood pressure regression:

Step	Variable entered	R	R^2	Increase in R^2	F value
1	13	.2282	.0521	.0521	2.80
2	9	.3512	.1233	.0712	4.06*
3	12	.4291	.1842	.0608	3.65*
4	11	.4764	.2269	.0428	2.66*
5	2	.5101	.2602	.0332	2.11
6	5	.5211	.2716	.0114	0.72
7	8	.5259	.2766	.0050	0.31
8	14	.5299	.2808	.0043	0.26
9	3	.5338	.2849	.0041	0.25
10	4	.5351	.2863	.0014	0.08
11	6	.5368	.2882	.0019	0.11
12	7	.5381	.2895	.0013	0.07
13	10	.5385	.2899	.0004	0.02

Prediction equation: $y = 86.50 + 2.61X_2 - 1.15X_3 + 1.40X_4 - 1.97X_5 + 0.61X_6 - 0.73X_7 + 0.69X_8 - 3.74X_9 - 0.30X_{10} - 3.30X_{11} - 2.31X_{12} + 4.77X_{13} - 0.81X_{14}$

Equation for significant R^2:

$y = 87.48 - 3.59X_9 - 3.47X_{11} - 2.67X_{12} + 5.64X_{13}$

Group 11-WMOL

Systolic blood pressure regression:

Step	Variable entered	R	R^2	Increase in R^2	F value
1	1	.1969	.0388	.0388	2.66
2	5	.3058	.0935	.0547	3.93*
3	4	.3732	.1393	.0457	3.40*
4	12	.4240	.1798	.0405	3.11*
5	14	.4603	.2119	.0322	2.53*
6	6	.4817	.2320	.0201	1.60
7	10	.4941	.2442	.0122	0.96
8	7	.5037	.2537	.0096	0.76
9	2	.5100	.2601	.0063	0.50
10	11	.5150	.2653	.0052	0.40
11	3	.5175	.2678	.0026	0.20
12	8	.5188	.2692	.0013	0.10
13	13	.5199	.2703	.0011	0.08
14	9	.5208	.2712	.0009	0.07

Prediction equation: $y = 164.18 + 8.91X_1 - 1.71X_2 + 2.16X_3 - 20.32X_4 - 7.55X_5 + 4.74X_6 - 3.96X_7 + 1.12X_8 + 0.88X_9 + 2.88X_{10} + 2.53X_{11} - 7.18X_{12} + 0.81X_{13} + 4.69X_{14}$

Equation for significant R^2: $y = 180.10 + 8.79X_1 - 19.12X_4 - 7.40X_5 - 6.53X_{12} + 4.08X_{14}$

Diastolic blood pressure regression:

Step	Variable entered	R	R^2	Increase in R^2	F value
1	4	.2537	.0644	.0644	4.54*
2	7	.3013	.0908	.0264	1.89
3	14	.3485	.1215	.0307	2.24
4	12	.3723	.1386	.0172	1.25
5	1	.3991	.1593	.0207	1.53
6	5	.4294	.1844	.0251	1.88
7	10	.4571	.2090	.0246	1.87
8	11	.4842	.2345	.0255	1.97
9	6	.4924	.2425	.0080	0.61
10	8	.4967	.2467	.0042	0.32
11	2	.4978	.2478	.0011	0.08
12	3	.4989	.2489	.0011	0.08
13	13	.4994	.2494	.0005	0.04

Prediction equation: $y = 103.78 + 3.62X_1 - 0.52X_2 - 0.64X_3 - 12.60X_4 - 3.72X_5 + 1.70X_6 - 2.99X_7 + 0.98X_8 + 3.02X_{10} + 4.22X_{11} - 3.58X_{12} + 0.35X_{13} + 3.77X_{14}$

Equation for significant R^2:

$y = 118.97 - 11.92X_4$

Group 12-WMOH

Systolic blood pressure regression:

Step	Variable entered	R	R^2	Increase in R^2	F value
1	11	.2873	.0826	.0826	5.85*
2	1	.3384	.1145	.0319	2.31
3	6	.3713	.1379	.0234	1.71
4	3	.3915	.1533	.0154	1.13
5	10	.4079	.1664	.0131	0.96
6	9	.4354	.1895	.0232	1.72
7	2	.4532	.2053	.0158	1.17
8	4	.4667	.2178	.0125	0.93
9	12	.4715	.2223	.0044	0.33
10	14	.4762	.2267	.0044	0.32
11	7	.4800	.2304	.0037	0.26
12	8	.4825	.2328	.0024	0.17

Prediction equation: $y = 122.53 - 5.61X_1 + 2.93X_2 + 3.51X_3 - 6.17X_4 + 3.16X_6 - 2.11X_7 + 0.95X_8 + 3.40X_9 - 3.65X_{10} + 8.92X_{11} - 1.49X_{12} + 1.01X_{14}$

Equation for significant R^2: $y = 113.29 + 7.64X_{11}$

Diastolic blood pressure regression:

Step	Variable entered	R	R^2	Increase in R^2	F value
1	11	.2078	.0432	.0432	2.93
2	12	.2856	.0816	.0384	2.67
3	14	.3257	.1061	.0245	1.73
4	4	.3501	.1225	.0164	1.16
5	6	.3664	.1342	.0117	0.82
6	3	.3843	.1477	.0134	0.95
7	2	.3964	.1571	.0095	0.66
8	10	.4026	.1621	.0050	0.34
9	13	.4115	.1693	.0072	0.49
10	7	.4161	.1731	.0038	0.26
11	8	.4193	.1758	.0027	0.18
12	5	.4211	.1773	.0015	0.10
13	1	.4230	.1790	.0017	0.11
14	9	.4245	.1802	.0013	0.08

Prediction equation: $y = 88.20 - 0.82X_1 + 1.56X_2 + 2.22X_3 - 7.17X_4 + 0.73X_5 - 1.67X_6 + 1.72X_7 + 0.78X_8 - 0.68X_9 - 1.44X_{10} + 4.47X_{11} - 3.23X_{12} + 1.63X_{13} + 1.59X_{14}$

No R^2 value is significant.

Group 13-WFYL

Systolic blood pressure regression:

Step	Variable entered	R	R^2	Increase in R^2	F value
1	5	.0812	.0066	.0066	0.36
2	3	.1258	.0158	.0092	0.50
3	11	.1533	.0235	.0077	0.41
4	2	.1662	.0276	.0041	0.22
5	4	.1836	.0337	.0061	0.31
6	9	.1908	.0364	.0027	0.14
7	13	.1957	.0383	.0019	0.09
8	10	.1976	.0391	.0008	0.04
9	6	.1994	.0397	.0007	0.03

Prediction equation: $y = 126.41 + 1.27x_2 + 2.37x_3 - 4.29x_4 - 2.90x_5 + 0.53x_6 - 1.19x_9 - 0.63x_{11} - 1.49x_{11} + 0.96x_{13}$

No R^2 value is significant.

Diastolic blood pressure regression:

Step	Variable entered	R	R^2	Increase in R^2	F value
1	3	.1577	.0249	.0249	1.38
2	12	.2208	.0488	.0239	1.33
3	13	.2629	.0691	.0203	1.14
4	4	.2837	.0805	.0114	0.63
5	5	.3045	.0927	.0122	0.67
6	11	.3182	.1013	.0086	0.47
7	10	.3268	.1068	.0055	0.30
8	8	.3342	.1117	.0049	0.26
9	14	.3390	.1149	.0032	0.17
10	9	.3413	.1165	.0016	0.08
11	1	.3429	.1176	.0011	0.05
12	6	.3445	.1187	.0011	0.05
13	7	.3448	.1189	.0002	0.01

Prediction equation: $y = 89.91 - 0.63x_1 + 2.63x_3 - 3.53x_4 - 2.26x_5 + 0.44x_6 - 0.33x_7 - 1.26x_8 + 0.76x_9 - 1.76x_{10} - 1.37x_{11} - 1.57x_{12} + 2.49x_{13} + 0.70x_{14}$

No R^2 value is significant.

Group 14-WFYH

Systolic blood pressure regression:

Step	Variable entered	R	R^2	Increase in R^2	F value
1	6	.2744	.0753	.0753	4.40*
2	7	.3481	.1212	.0459	2.77
3	13	.4032	.1626	.0414	2.57
4	5	.4367	.1907	.0281	1.77
5	3	.4735	.2242	.0335	2.16
6	9	.4947	.2447	.0206	1.33
7	12	.5093	.2594	.0147	0.95
8	4	.5141	.2643	.0048	0.31
9	14	.5177	.2680	.0038	0.24
10	1	.5237	.2742	.0062	0.39
11	10	.5287	.2795	.0052	0.32
12	2	.5324	.2835	.0040	0.24
13	11	.5331	.2841	.0007	0.04

Prediction equation: $y = 133.47 + 3.56X_1 - 1.21X_2 - 3.05X_3 - 11.54X_4 - 4.23X_5 + 2.67X_6 + 4.66X_7 + 2.35X_9 + 1.80X_{10} + 0.81X_{11} - 1.21X_{12} + 3.87X_{13} - 2.51X_{14}$

Equation for significant R^2: $y = 103.26 + 6.10X_6$

Diastolic blood pressure regression:

Step	Variable entered	R	R^2	Increase in R^2	F value
1	13	.2269	.0515	.0515	2.93
2	5	.3444	.1186	.0671	4.04*
3	9	.4089	.1672	.0486	3.04*
4	3	.4765	.2270	.0598	3.95*
5	6	.4919	.2419	.0149	0.98
6	10	.5058	.2559	.0139	0.92
7	1	.5080	.2581	.0022	0.14
8	4	.5108	.2609	.0028	0.18
9	14	.5147	.2649	.0040	0.25
10	2	.5176	.2679	.0030	0.19
11	11	.5213	.2717	.0038	0.23
12	12	.5215	.2720	.0002	0.01

Prediction equation: $y = 83.38 + 2.58X_1 - 0.79X_2 - 3.44X_3 - 5.21X_4 - 4.32X_5 + 1.53X_6 + 2.31X_9 + 2.15X_{10} + 1.35X_{11} - 0.19X_{12} + 3.16X_{13} - 1.15X_{14}$

Equation for significant R^2:

$y = 78.95 - 3.82X_3 - 4.69X_5 + 3.82X_9 + 3.48X_{13}$

Group 15-WFOL

Systolic blood pressure regression:

Step	Variable entered	R	R^2	Increase in R^2	F value
1	10	.2388	.0570	.0570	4.11*
2	12	.2910	.0847	.0276	2.02
3	9	.3377	.1141	.0294	2.19
4	8	.3653	.1334	.0194	1.45
5	2	.3785	.1433	.0098	0.74
6	6	.3870	.1498	.0065	0.48
7	13	.3931	.1545	.0048	0.35
8	14	.3996	.1597	.0051	0.37
9	7	.4048	.1639	.0042	0.30
10	1	.4071	.1657	.0018	0.13
11	4	.4093	.1675	.0018	0.13
12	3	.4110	.1689	.0014	0.10
13	11	.4119	.1697	.0008	0.05
14	5	.4128	.1704	.0007	0.04

Prediction equation: $y = 58.68 + 2.27X_1 - 2.11X_2 - 1.41X_3 + 3.87X_4 - 0.96X_5 + 2.88X_6 + 2.20X_7 + 3.52X_8 + 6.40X_9 + 2.85X_{10} + 0.91X_{11} + 6.06X_{12} + 1.92X_{13} - 1.85X_{14}$

Equation for significant R^2: $y = 113.13 + 5.58X_{10}$

Diastolic blood pressure regression:

Step	Variable entered	R	R^2	Increase in R^2	F value
1	13	.2711	.0735	.0735	5.39*
2	7	.3194	.1020	.0286	2.13
3	6	.3665	.1343	.0323	2.46
4	1	.3918	.1535	.0192	1.47
5	8	.4125	.1701	.0166	1.20
6	9	.4322	.1868	.0167	1.29
7	12	.4452	.1982	.0114	0.88
8	14	.4624	.2139	.0157	1.22
9	5	.4688	.2198	.0059	0.46
10	10	.4743	.2250	.0052	0.40
11	2	.4803	.2307	.0058	0.43
12	11	.4843	.2346	.0038	0.29
13	3	.4861	.2363	.0017	0.13

Prediction equation: $y = 32.52 + 4.60X_1 - 1.14X_2 - 0.76X_3 - 1.65X_5 + 3.24X_6 + 3.27X_7 + 1.73X_8 + 2.89X_9 + 1.36X_{10} + 1.37X_{11} + 2.42X_{12} + 2.94X_{13} - 1.49X_{14}$

Equation for significant R^2:

$y = 71.18 + 3.19X_{13}$

Group 16-WFOH

Systolic blood pressure regression:

Step	Variable entered	R	R^2	Increase in R^2	F value
1	2	.2743	.0753	.0753	5.53*
2	5	.3218	.1035	.0283	2.11
3	4	.3473	.1206	.0171	1.28
4	3	.3878	.1504	.0298	2.28
5	10	.4111	.1690	.0186	1.44
6	13	.4260	.1815	.0125	0.96
7	7	.4353	.1895	.0080	0.61
8	1	.4414	.1949	.0054	0.41
9	8	.4467	.1996	.0047	0.35
10	6	.4518	.2041	.0045	0.33
11	11	.4556	.2075	.0034	0.25
12	14	.4602	.2118	.0043	0.31
13	12	.4622	.2136	.0018	0.13
14	9	.4624	.2138	.0002	0.01

Prediction equation: $y = 205.70 - 6.12X_1 - 5.06X_2 + 5.90X_3 - 14.68X_4 - 9.23X_5 + 3.45X_6 - 5.18X_7 - 2.65X_8 - 0.54X_9 + 5.54X_{10} - 3.45X_{11} - 1.42X_{12} + 2.17X_{13} + 2.58X_{14}$

Equation for significant R^2: $y = 147.70 - 6.86X_2$

Diastolic blood pressure regression:

Step	Variable entered	R	R^2	Increase in R^2	F value
1	1	.3227	.1042	.1042	7.91*
2	5	.4192	.1757	.0716	5.82*
3	3	.4569	.2088	.0331	2.76*
4	12	.4780	.2285	.0197	1.66
5	10	.4980	.2480	.0195	1.66
6	13	.5120	.2622	.0142	1.21
7	8	.5171	.2674	.0052	0.44
8	7	.5211	.2715	.0041	0.35
9	11	.5228	.2734	.0019	0.15
10	2	.5244	.2750	.0017	0.14
11	6	.5272	.2780	.0029	0.24
12	14	.5294	.2803	.0023	0.18
13	9	.5307	.2817	.0014	0.11
14	4	.5314	.2824	.0007	0.06

Prediction equation: $y = 124.39 - 8.09X_1 - 1.44X_2 + 3.89X_3 - 1.48X_4 - 4.16X_5 - 1.54X_6 - 2.76X_7 - 1.16X_8 - 0.91X_9 + 3.06X_{10} - 1.48X_{11} - 3.46X_{12} + 2.14X_{13} + 1.05X_{14}$

Equation for significant R^2:

$y = 108.27 - 8.17X_1 + 3.57X_3 - 5.71X_5$

B. Comparison of square root analysis with step-wise regression analysis

Following are, for each group, on the first line, the variables selected by step-wise regression, in order of selection, and on the second line, the variables selected by the square root method, in order of selection. The first pair of lists for each group gives variables selected for systolic blood pressure prediction, and the second pair of lists gives variables selected for diastolic blood pressure prediction. Vertical lines mark the point after which significance was not retained as further variables were added. The absence of any line means that no significance was obtained.

Group 1-BMYL

Systolic												
Regression	6	10	14	7	8	2	12	3	4	9	11	5
Square root	6	10	14	7	8	2	12	3	4			
Diastolic												
Regression	2	14	8	4	12	3	6	11	10	13	5	1
Square root	2	14	8	4	12	3	6	11	10			

Group 2-BMYH

Systolic											
Regression	13	12	5	2	14	9	1	6	4	10	11
Square root	13	12	5	2	1	9	14				
Diastolic											
Regression	12	13	14	9	6	2	5	7	10	1	11
Square root	12	13	14	6	9	2	5	7	10		

Group 3-BMOL

Systolic													
Regression	4	5	6	11	14	7	10	13	12	9	1	8	2
Square root	4	5	6	11	14	7	10	13					
Diastolic													
Regression	3	14	5	4	2	8	6	10	12	13	1	11	
Square root	3	14	5	4	2	8	6	11					

Group 4-BMOH

Systolic													
Regression	8	1	11	2	6	3	10	7	4	9	12	5	13
Square root	8	1	11	6	2	3	4	9	10	7	5	12	
Diastolic													
Regression	10	11	8	1	6	7	2	5	9	13	14		
Square root	10	8	11	1	6	7	2	5	9	13			

Group 5-BFYL

Systolic													
Regression	13	2	4	7	9	12	3	11	10	1	6	5	8
Square root	13	2	4	7	9	12	3	11					
Diastolic													
Regression	12	7	2	13	9	4	6	5	8	11	14	1	3	10
Square root	12	7	2	13	9	6	4	8	5	11			

Group 6-BFYH

Systolic													
Regression	5	4	11	3	6	12	14	1	10	8	13	7	9	2
Square root	5	4	11	3	6	1	14	12						
Diastolic													
Regression	5	12	3	4	2	8	6	10	11	1	9	13	14	
Square root	5	12	3	4	2	6	8							

Group 7-BFOL

Systolic													
Regression	13	14	7	9	5	12	10	1	6	11	4	3	8	2
Square root	13	14	7	9	5	12	10	1	6					
Diastolic													
Regression	9	2	14	7	5	10	3	11	8	1	6	12	13	4
Square root	9	2	14	7	5	10	3	11						

Group 8-BFOH

Systolic													
Regression	3	12	9	2	13	5	6	1	8	11	14	10	4
Square root	3	12	9	2	13	5	6	1	8				
Diastolic													
Regression	3	8	1	9	12	14	5	2	6	7	10	13	11
Square root	3	8	1	9	12	14	5	2	6				

Group 9-WMYL

Systolic															
Regression	7	6	3	11	5	4	12	2	9	10	13	14	8	1	
Square root	7	6	3	11	5	4	12	9	2						
Diastolic															
Regression	7	4	11	5	6	12	9	14	3	1	8	13	2		
Square root	7	4	11	5	6	12	9								

Group 10-WMYH

Systolic														
Regression	4	8	9	13	12	11	2	10	3	14	5	1	7	
Square root	4	8	9	13	12	11	2	10	3					
Diastolic														
Regression	13	9	12	11	2	5	8	14	3	4	6	7	10	
Square root	13	9	12	11	2	5	8	14	3					

Group 11-WMOL

Systolic															
Regression	1	5	4	12	14	6	10	7	2	11	3	8	13	9	
Square root	1	5	4	12	14	6	10	7	11	2					
Diastolic															
Regression	4	7	14	12	1	5	10	11	6	8	2	3	13		
Square root	4	7	14	11	12	10	5	1	6	8					

Group 12-WMOH

Systolic														
Regression	11	1	6	3	10	9	2	4	12	14	7	8		
Square root	11	1	6	3	10	9	2	4	7	8	12			
Diastolic														
Regression	11	12	14	4	6	3	2	10	13	7	8	5	1	9
Square root	11	12	14	4	6	3	7	2	10	13				

Group 13-WFYL

Systolic														
Regression	5	3	11	2	4	9	13	10	6					
Square root	5	3	11	2	4									
Diastolic														
Regression	3	12	13	4	5	11	10	8	14	9	1	6	7	
Square root	3	12	13	11	5	4	10	8						

Group 14-WFYH

Systolic													
Regression	6	7	13	5	3	9	12	4	14	1	10	2	11
Square root	6	7	13	3	5	9	12	4	14	10	1	2	
Diastolic													
Regression	13	5	9	3	6	10	1	4	14	2	11	12	
Square root	13	5	9	3	6	10							

Group 15-WFOL

Systolic														
Regression	10	12	9	8	2	6	13	14	7	1	4	3	11	5
Square root	10	12	9	8	2	6	13	14	7					
Diastolic														
Regression	13	7	6	1	8	9	12	14	5	10	2	11	3	
Square root	13	9	6	7	1	8	12	14	11	2	10	5		

Group 16-WFOH

Systolic														
Regression	2	5	4	3	10	13	7	1	8	6	11	14	12	9
Square root	2	5	4	3	13	10	7	8	1	6	11			
Diastolic														
Regression	1	5	3	12	10	13	8	7	11	2	6	14	9	4
Square root	1	5	3	12	13	10	8	7						

APPENDIX III

FACTOR ANALYSIS DATA

A. Subgroup unrotated factor matrices

Following are the unrotated factor matrices for the fourteen analysis variables, for each group. The highest loading for each variable is underlined in each case.

Group 1-BMYL

Variable	Factor 1	2	3	4	5	6	7	8
1	.34	.05	-.08	.23	.09	.35	-.07	-.01
2	.53	-.34	.03	.15	.14	-.20	-.05	-.08
3	-.22	.04	-.50	.26	.06	.08	.03	-.02
4	-.40	.14	-.27	.28	.00	-.15	.07	.07
5	.26	-.26	-.00	-.01	.07	-.07	.04	.18
6	.38	.18	-.14	-.37	.18	.05	.01	.02
7	-.41	-.31	.22	-.05	.05	.22	.09	.08
8	-.26	-.36	.22	.19	.28	-.01	.11	-.07
9	.56	.05	.02	-.01	-.12	.01	.22	.02
10	.52	-.25	-.15	.06	-.19	.02	.13	-.04
11	.09	.52	.15	.13	.18	-.09	.04	.05
12	.31	.01	.30	.35	-.17	.01	-.11	.06
13	.38	-.36	-.25	-.03	.11	-.02	-.11	.07
14	.53	.38	.09	.11	.14	.05	.04	-.01

Group 2-BMYH

Variable	Factor 1	2	3	4	5	6	7	8
1	.43	.32	-.11	.16	.28	.13	.04	.04
2	.33	.46	-.02	.18	-.34	.08	-.04	-.01
3	-.10	.50	.10	.14	.09	-.18	.06	-.01
4	-.36	.45	.27	.01	-.09	.03	.03	-.04
5	.22	.12	.38	-.29	.19	-.12	.00	-.01
6	.43	-.08	.05	-.26	-.31	.01	.10	-.04
7	.13	-.20	.33	-.06	-.06	.05	.08	.12
8	-.42	.23	.17	.26	-.23	-.03	-.02	.06
9	.42	-.09	-.24	.21	-.09	-.14	-.03	.03
10	.35	-.17	.20	.38	.04	.05	.04	-.09
11	-.20	.40	-.37	-.07	.14	.06	.06	.00
12	.31	.20	.39	-.04	.13	.08	-.10	.00
13	.23	-.14	.06	.48	.08	-.07	.02	.01
14	.62	.33	-.16	-.25	-.06	-.07	-.02	.03

Group 3-BMOL

Variable	Factor 1	2	3	4	5	6	7	8
1	.44	-.37	-.26	-.05	.22	.05	.16	-.01
2	.53	-.02	.36	.01	-.07	-.04	.17	-.02
3	-.31	.04	.38	.25	.07	.03	.29	-.04
4	-.67	.20	.17	.09	.13	.15	.06	.04
5	.07	.35	.15	-.19	.16	-.19	-.05	-.12
6	.09	-.28	.31	.10	.21	.00	-.17	-.06
7	.10	.10	-.12	-.39	.20	-.08	.02	.09
8	-.22	.25	.31	-.16	.19	-.17	.05	.06
9	.43	-.14	.32	.23	-.03	-.20	-.06	.07
10	.56	.49	-.19	.20	.06	.08	.17	.03
11	-.15	-.50	.19	-.38	-.21	-.05	.19	.00
12	.24	.25	.19	-.40	.02	.26	-.01	-.04
13	.15	.48	.23	-.07	-.29	-.00	-.06	.02
14	.26	-.22	.43	.00	.08	.24	-.13	.06

Group 4-BMOH

Variable	Factor 1	2	3	4	5	6	7
1	.45	.34	.08	.18	.12	.18	-.16
2	.28	.05	-.27	-.37	.14	-.02	-.09
3	-.37	.30	.02	-.34	-.03	.27	.09
4	-.52	.36	-.07	.06	.25	.08	-.08
5	.24	-.16	-.14	-.07	.13	-.21	-.07
6	.13	.20	.19	.30	-.24	-.06	-.07
7	-.17	-.01	.41	-.23	-.01	-.06	-.24
8	-.15	-.01	.40	.24	.17	.02	.12
9	.39	.01	-.20	-.24	-.19	.12	.03
10	.78	.09	.06	.08	.10	.12	.03
11	-.47	-.26	-.41	.18	.03	.05	-.09
12	-.10	.49	.16	-.26	-.03	-.27	.07
13	.16	-.22	.12	-.10	.30	-.06	.10
14	.06	.50	-.42	.22	.04	-.15	.05

Group 5-BFYL

Variable	Factor 1	2	3	4	5	6	7	8
1	-.00	.05	**-.39**	.36	.28	-.08	-.02	.01
2	**.46**	.22	.07	-.10	.11	.25	-.19	-.02
3	**-.32**	**.33**	-.09	-.07	-.04	.16	.02	-.02
4	**-.51**	.07	.07	.21	.20	-.07	-.18	-.04
5	**.52**	-.32	.05	-.18	.16	-.10	-.08	.04
6	.06	**.28**	-.16	-.09	.15	-.10	.28	-.03
7	-.14	**-.42**	.34	.03	.32	.06	.10	.01
8	-.25	-.05	.25	**.41**	-.00	.23	.10	.02
9	.03	**.43**	.23	.13	.06	-.16	-.07	.02
10	**.60**	.11	.08	.39	-.23	-.10	-.00	.01
11	-.19	.20	**-.21**	-.05	-.05	.12	.02	.08
12	**.61**	-.29	-.17	.19	-.10	.10	.06	-.03
13	.21	.32	**.45**	-.07	-.04	-.05	.08	-.00
14	**.59**	.32	-.05	-.01	.31	.10	.04	.01

Group 6-BFYH

Variable	Factor 1	2	3	4	5	6	7	8
1	**.58**	.12	-.10	-.30	.04	-.05	.05	.12
2	**.70**	.29	.15	.01	.13	.02	.00	-.10
3	-.08	**.47**	-.29	.18	.17	.15	.08	.00
4	-.25	**.46**	.07	.11	.16	.13	.14	.01
5	.15	**.43**	-.24	.16	-.10	.02	-.19	-.04
6	.28	-.24	.10	**.35**	-.22	.24	-.06	.03
7	-.12	-.07	.07	.15	**.33**	-.20	-.13	.02
8	-.25	**.43**	-.29	-.03	-.30	-.05	-.03	.05
9	**.51**	-.08	-.15	-.26	.11	.25	-.07	-.01
10	**.65**	-.33	-.42	.05	-.03	-.03	.09	-.03
11	.13	-.01	**.31**	.14	-.19	-.04	.13	-.04
12	**.56**	.29	.00	.06	-.10	-.31	.02	-.02
13	-.11	-.32	**-.48**	.34	.10	-.08	.06	.01
14	**.54**	.08	.28	.33	.08	.02	-.02	.10

Group 7-BFOL

Variable	Factor 1	2	3	4	5	6	7
1	.38	.47	.17	-.06	-.27	.11	-.08
2	.48	.29	.03	-.28	-.19	-.15	.15
3	-.42	.29	.47	.09	.29	.05	-.04
4	-.58	.34	.34	-.01	.14	-.04	.01
5	.16	-.27	-.26	-.22	.41	.01	.07
6	-.20	.29	-.38	.34	.05	.09	.01
7	-.31	-.20	.50	.02	-.09	-.06	.14
8	-.29	.23	-.01	-.54	-.03	.14	-.01
9	.69	-.04	.25	.10	.02	-.15	-.17
10	.68	-.04	.22	.14	-.06	.15	.07
11	-.31	.36	-.27	-.09	-.01	-.18	-.11
12	.47	.37	.04	.05	.34	-.08	.11
13	.50	-.16	.16	-.22	.25	.06	-.14
14	.39	.45	-.16	.10	.11	.06	.05

Group 8-BFOH

Variable	Factor 1	2	3	4	5	6	7	8
1	.02	.42	.24	.14	.16	-.06	-.17	-.15
2	.36	-.37	.18	.31	.03	-.20	.02	.06
3	-.17	.55	-.05	-.08	.05	-.10	.19	.01
4	.02	.43	-.15	.09	.07	.08	.17	.06
5	.06	-.11	.22	.14	-.38	.17	.13	-.13
6	.13	-.23	.22	-.12	.27	.05	.13	.09
7	.03	-.09	-.41	.42	.10	.07	.09	-.04
8	-.11	.10	-.05	.34	.10	.38	-.13	.08
9	.60	.08	-.08	-.24	.05	.20	-.04	-.03
10	.65	.16	.01	.21	-.08	-.18	.11	-.01
11	-.48	.17	.21	.21	-.09	-.22	-.09	.07
12	.34	.28	.36	.01	-.31	.15	-.04	.12
13	.62	.15	-.27	-.01	.03	-.14	-.17	.02
14	.16	.02	.48	.06	.38	.06	.06	-.04

Group 9-WMYL

Variable	Factor 1	2	3	4	5	6	7	8
1	.72	.21	.18	.01	.04	-.15	-.03	-.05
2	.74	.08	-.02	.01	.00	-.08	-.02	.14
3	.31	.12	-.37	.20	-.02	.24	-.09	-.04
4	.19	.17	-.49	-.08	.10	.28	.00	.01
5	.58	.04	-.08	.32	.25	-.09	.13	.01
6	.25	-.28	.16	.11	.08	.21	.21	-.03
7	.16	.46	.18	-.21	.01	.12	.06	.11
8	-.24	-.41	.11	.15	.13	.20	-.10	.09
9	.20	.34	.17	.27	-.30	.15	-.01	-.03
10	.59	-.23	.27	.18	-.20	.10	-.09	.01
11	.21	-.26	-.38	.14	-.14	-.29	.00	.05
12	.46	-.37	.03	-.29	-.08	.15	.01	.01
13	.57	.00	.13	-.10	.36	-.02	-.14	-.06
14	.69	-.16	-.16	-.27	-.20	-.01	.04	-.05

Group 10-WMYH

Variable	Factor 1	2	3	4	5	6	7	8
1	.64	.23	.02	.25	.03	-.08	.09	-.06
2	.75	.23	.10	.03	-.08	-.18	.22	.00
3	.07	-.27	-.17	.22	-.08	-.32	.08	.03
4	.25	-.40	.01	-.18	-.01	-.18	-.13	-.08
5	.61	-.19	.13	.33	.04	.07	-.20	-.01
6	-.16	-.25	.19	.35	-.02	.20	.09	.05
7	.47	.03	.44	-.14	.12	-.14	-.09	.05
8	.09	-.19	.36	-.18	-.22	-.07	.02	.03
9	.42	.05	-.14	.09	-.47	.12	-.13	.01
10	.59	.14	-.21	-.09	.09	.02	-.26	.05
11	-.02	.10	-.29	.03	.02	-.22	-.02	.07
12	.63	-.44	-.18	.01	.24	.10	.09	.02
13	.46	-.27	-.17	-.30	-.14	.14	.17	.02
14	.62	.28	.01	-.10	.08	.19	.08	-.00

Group 11-WMOL

Variable	Factor 1	2	3	4	5	6	7	8
1	.52	-.15	.19	.26	.02	.08	.08	-.09
2	.61	.11	.01	.17	-.10	-.08	.14	.01
3	.28	-.66	.09	-.02	.03	-.03	.04	-.03
4	-.02	-.59	-.03	.02	-.15	-.03	-.03	.09
5	.56	.14	-.02	.20	.08	.01	-.04	.05
6	.24	.23	.00	.03	-.29	-.22	.03	-.03
7	.45	-.12	-.11	-.05	.11	-.05	-.19	-.17
8	-.27	.06	.05	.07	-.14	.30	.08	-.10
9	.03	-.01	-.12	.19	.07	.00	-.07	.10
10	.48	-.09	-.29	-.24	-.01	.11	.18	.05
11	-.07	.04	.15	.03	.40	-.06	.12	.03
12	.57	.15	.30	-.34	.02	-.01	.01	-.01
13	.34	.07	-.51	-.01	.08	.04	-.01	-.03
14	.58	.09	.16	-.02	-.06	.18	-.17	.12

Group 12-WMOH

Variable	Factor 1	2	3	4	5	6	7	8
1	.51	.08	.46	.05	-.01	.11	.14	.06
2	.76	-.05	.02	.01	-.08	.04	.14	-.13
3	.32	.26	-.05	-.26	-.01	.14	-.25	-.04
4	.33	.40	-.38	-.16	.01	-.05	.05	.03
5	.41	.05	.12	-.27	-.25	-.18	.10	.03
6	.09	-.26	.20	-.18	.30	.11	-.01	.02
7	.28	.09	-.27	.36	-.09	.16	.03	-.03
8	-.04	.23	-.01	.22	.28	-.19	.01	.03
9	.40	-.01	-.32	-.11	.23	.07	.16	.03
10	.64	-.37	-.27	-.02	.10	-.06	-.06	.04
11	.23	.63	.16	.05	.05	.08	-.03	.05
12	.69	-.00	.04	.16	-.10	-.14	-.15	.02
13	.31	-.29	-.05	.08	-.17	.12	-.06	.12
14	.66	-.06	.23	.07	.20	-.07	-.09	-.06

Group 13-WFYL

Variable	Factor 1	2	3	4	5	6	7	8	9
1	.52	.06	.05	-.06	.19	-.28	.14	-.14	-.04
2	.71	.14	.00	-.06	-.17	.05	.01	.09	.03
3	.22	.39	-.23	.23	-.27	.02	.01	-.12	.03
4	.29	.17	.15	.38	-.18	.08	.06	.08	-.10
5	.41	.05	-.32	-.20	-.00	.21	.09	-.04	.02
6	-.02	-.13	-.13	.14	.24	.21	.04	-.08	-.13
7	.50	-.10	.14	.19	-.04	-.01	-.26	-.17	.00
8	.01	.19	.58	-.10	.24	.17	-.05	-.03	.02
9	.35	.12	-.22	.13	.43	.02	.08	.01	.06
10	.41	-.50	-.20	.20	.13	-.05	-.15	.12	-.00
11	.07	.55	.02	.18	.22	-.10	-.07	.12	-.01
12	.32	.12	-.04	-.41	-.06	-.07	-.07	.04	-.14
13	.53	-.33	.36	.12	-.10	-.01	.21	.03	.02
14	.68	.04	.02	-.23	.01	.08	-.08	.03	.03

Group 14-WFYH

Variable	Factor 1	2	3	4	5	6	7	8	9
1	.76	-.21	-.09	.24	.05	.12	-.20	-.07	-.04
2	.53	.06	.14	.01	.08	.29	.07	.08	-.06
3	.19	-.56	.05	.17	-.18	-.01	.14	.03	.02
4	.30	-.55	-.46	-.22	.01	.03	-.07	.02	.01
5	.30	.17	.38	-.28	.12	-.14	-.11	.01	.02
6	-.16	.13	.13	.59	-.10	.05	-.00	.04	-.04
7	.19	.19	-.43	.18	.21	.10	.09	.01	.10
8	-.38	-.57	.34	.01	-.15	.06	-.00	.02	.05
9	.36	-.10	.07	.39	.09	-.34	-.09	.07	.04
10	.34	-.16	.13	-.04	.40	-.11	.16	.05	-.03
11	.49	.39	-.11	.00	-.39	-.01	.02	.05	.05
12	.62	.07	-.01	-.25	-.24	-.12	.03	.07	-.04
13	.06	.04	.32	-.08	.08	.25	-.10	.09	.08
14	.67	.01	.31	.05	-.05	.03	.11	-.15	.05

Group 15-WFOL

Variable	Factor 1	2	3	4	5	6	7	8
1	.43	.18	.36	-.23	.20	-.00	.07	-.01
2	.65	.12	.11	-.03	.02	-.07	-.22	.00
3	-.05	.54	.26	.09	-.06	.13	.04	-.03
4	-.03	.38	.14	.25	-.21	.01	-.04	.04
5	.64	-.02	.12	.08	-.00	-.10	.12	.05
6	.05	-.04	.25	.30	-.11	-.11	.08	-.03
7	.29	.26	-.36	.00	.00	.15	.10	.03
8	-.31	-.29	.06	.30	.25	-.02	.03	.01
9	.27	.36	-.29	.03	.14	-.21	-.01	.00
10	.51	.00	-.30	.29	-.03	-.00	-.01	-.04
11	.14	.15	-.03	.13	.34	.17	-.02	-.01
12	.50	-.33	.09	.12	-.08	.18	-.08	.02
13	.54	-.13	-.11	-.13	-.23	.03	.08	-.03
14	.71	-.21	.10	.01	.09	.01	.04	-.00

Group 16-WFOH

Variable	Factor 1	2	3	4	5	6	7	8
1	.55	-.01	-.23	.27	-.25	.05	.03	-.01
2	.68	.07	-.04	-.10	-.25	.20	.04	.01
3	.16	-.39	.08	.02	.29	.18	-.06	-.00
4	.30	-.39	.23	.27	.14	.05	.03	-.02
5	.49	.36	.17	-.31	.15	.08	.04	.03
6	-.09	.43	.00	.41	.20	-.02	-.00	.02
7	.05	-.42	-.34	.02	.04	-.13	.10	.03
8	-.21	.13	.15	.14	.10	.06	.24	.00
9	.19	-.04	-.45	-.17	.29	.06	-.01	.02
10	.66	.03	-.06	-.13	.14	-.07	.05	-.06
11	.32	-.07	.46	.10	.01	-.03	-.06	.02
12	.69	.16	.12	-.09	.08	-.21	.00	-.01
13	.22	.33	-.30	.30	.10	.04	-.07	-.02
14	.73	-.17	.00	.19	-.05	-.07	-.02	.05

B. Subgroup rotated factor loadings

Following are the factor compositions based on assignment by highest loading, for 2, 3, 4, and 5 varimax rotations, for each group. The "(P)" and "(S)" designate personal and social factors, as described in Chapter IV. Asterisks indicate significant factor score prediction.

Group 1-BMYL

2 Factors:
(P) 1) 2(.63), 3(-.20), 4(-.40), 5(.37), 9(.40), 10(.56), 12(.24), 13(.53)
(S) 2) 1(.25), 6(.38), 7(-.50), 8(-.45), 11(.46), 14(.62)

3 Factors:
1) 2(.55), 5(.35), 10(.54), 11(-.38), 13(.58)
2) 1(.29), 6(.42), 7(.55), 8(-.49), 9(.40), 14(.57)
3) 3(-.55), 4(-.43), 12(.41)

4 Factors:
1) 2(.57), 5(.35), 10(.55), 13(.58)
2) 6(.52), 7(-.48), 8(-.53), 9(.32)
3) 3(-.60), 4(-.50)
4) 1(.32), 11(.36), 12(.52), 14(.48)

5 Factors:
1) 2(.61), 5(.36), 10(.53), 13(.58)
2) 1(.29), 11(.52), 14(.59)
3) 3(-.61), 4(-.51)
4) 6(-.39), 12(.50)
5) 7(-.43), 8(-.59), 9(.34)

Group 2-BMYH

2 Factors:
(P) 1) 1(.54), 2(.54), 5(.25), 12(.37), 14(.69)
(S) 2) 3(-.45), 4(-.58), 6(.33), 7(.23), 8(-.45), 9(.33), 10(.35), 11(-.44), 13(.25)

3 Factors:
1) 3(-.42), 4(-.63), 6(.30), 8(-.49), 9(.43), 13(.20)
2) 1(.53), 2(.56), 14(.67)
3) 5(.40), 7(.39), 10(.36), 11(-.50), 12(.44)

4 Factors:
1) 1(.55), 2(.57), 14(.63)
2) 3(-.44), 4(-.59), 6(.37), 8(-.55), 9(.32)
3) 5(.52), 7(.35), 12(.47)
* 4) 10(.55), 11(-.37), 13(.55)

5 Factors:
1) 2(.60), 6(.44), 14(.62)
2) 3(-.41), 4(-.59), 8(-.58)
3) 1(-.39), 7(.37), 11(-.55)
* 4) 9(.33), 10(.53), 13(.56)
5) 5(.55), 12(.51)

Group 3-BMOL

2 Factors:
(S) 1) 1(.57), 2(.48), 3(-.29), 4(-.69), 8(-.31), 9(.44), 14(.33)
(P) 2) 5(.34), 6(-.21), 7(.14), 10(.70), 11(-.51), 12(.33), 13(.50)

3 Factors:
1) 1(-.59), 3(.47), 4(.64), 8(.43)
2) 5(.35), 7(.12), 10(.67), 11(-.49), 12(.35), 13(.52)
3) 2(.57), 6(.38), 9(.53), 14(.54)

4 Factors:
1) 1(.60), 3(-.51), 4(-.65), 9(-.38)
2) 10(-.71), 11(.66)
3) 2(.57), 6(.39), 9(.57), 14(.53)
4) 5(.39), 7(.33), 12(.55), 13(.43)

5 Factors:
1) 1(.53), 3(-.51), 4(-.67), 8(-.41)
2) 10(-.69), 11(.69)
3) 2(.57), 6(.41), 9(.56), 14(.53)
4) 5(.39), 7(.43), 12(.48)
5) 13(-.57)

Group 4-BMOH

2 Factors:
(S) 1) 1(.55), 2(.28), 6(.19), 7(-.16), 8(-.14), 9(.36), 10(.75), 11(-.54)
(P) 2) 3(.42), 4(.54), 5(-.24), 12(.49), 13(-.27), 14(.44)

3 Factors:
1) 1(.54), 6(.29), 10(.59), 11(-.66)
2) 3(.45), 4(.61), 5(-.35), 12(.42), 13(-.29)
3) 2(-.37), 7(.43), 8(.42), 9(-.35), 14(-.48)

4 Factors:
1) 3(.55), 4(.41), 12(.56)
2) 7(-.37), 13(-.27), 14(.66)
3) 2(.53), 5(.24), 8(-.46), 9(.45)
4) 1(.57), 6(.32), 10(.68), 11(-.61)

5 Factors:
1) 1(.57), 10(.69), 11(-.63)
2) 3(-.55), 4(-.44), 12(-.55)
3) 7(-.41), 14(.65)
4) 8(.49), 9(-.50)
5) 2(.35), 5(.24), 6(.40), 13(.35)

Group 5-BFYL

2 Factors:
(P) 1) 2(-.40), 3(.39), 4(.51), 5(-.58), 8(.24), 10(-.56) 11(.23), 12(-.66), 14(-.50)
(S) 2) 1(.05), 6(.29), 7(-.44), 9(.43), 13(.36)

3 Factors:
1) 2(.37), 3(-.39), 4(-.51), 5(.58), 10(.53), 12(.68), 14(.47)
2) 4(.46), 13(.58)
3) 1(.32), 6(.31), 7(-.55), 8(-.25), 11(.26)

4 Factors
1) 2(.33), 3(-.42), 4(-.50), 5(.61), 10(.49), 11(-.26), 12(.67), 14(.40)
2) 6(.32), 7(.51), 8(.43)
3) 1(.51)
4) 9(.47), 13(.54)

5 Factors:
1) 10(.70), 12(.63)
2) 2(.35), 9(.48), 13(.54), 14(.45)
3) 1(.58)
4) 4(.41), 6(-.21), 8(.53)
5) 3(-.38), 5(.47), 7(.56), 11(-.32)

Group 6-BFYH

2 Factors:
(P) 1) 1(.59), 2(.75), 7(-.13), 9(.46), 10(.52), 11(.12), 12(.62), 14(.54)
(S) 2) 3(-.47), 4(-.51), 5(-.37), 6(.31), 8(-.49), 13(.27)

3 Factors:
1) 1(.59), 2(.68), 7(-.15), 9(.50), 10(.64), 12(.59), 14(.45)
2) 3(-.54), 4(-.46), 5(-.41), 6(.34), 8(-.56)
3) 11(.30), 13(-.58)

4 Factors:
1) 3(.58), 4(.42), 5(.50), 8(.49)
2) 10(.59), 13(.64)
3) 6(.42), 11(.32), 14(.68)
4) 1(-.66), 2(-.54), 7(.20), 9(-.57), 12(-.44)

5 Factors:
1) 1(.66), 2(.65), 9(.58), 10(.58), 12(.48)
2) 3(.59), 4(.43), 5(.49), 8(.44)
3) 13(-.65)
4) 6(.49), 11(.37), 14(.57)
5) 7(-.38)

Group 7-BFOL

2 Factors:
(P) 1) 1(.60), 2(.55), 7(-.37), 12(.60), 14(.59)
(S) 2) 3(.51), 4(.64), 5(-.30), 6(.35), 8(.37), 9(-.50), 10(-.49), 11(.47), 13(-.46)

3 Factors:
* 1) 6(-.51), 8(-.30), 9(.56), 10(.54), 11(-.54), 13(.46)
2) 1(.61), 2(.54), 12(.59), 14(.59)
3) 3(-.69), 4(-.68), 5(.39), 7(-.45)

4 Factors:
1) 6(-.62), 11(-.41), 13(.47)
2) 1(.62), 2(.56), 9(.44), 12(.59), 14(.57)
3) 3(.69), 4(.66), 5(-.43), 7(.44)
* 4) 8(-.65), 10(.46)

5 Factors:
1) 6(-.61), 9(.45), 10(.41), 11(-.42), 13(.49)
2) 1(.52), 2(.48), 7(-.39), 12(.65), 14(.60)
3) 3(.76), 4(.68)
* 4) 8(-.65)
5) 5(-.58)

Group 8-BFOH

2 Factors:
(P) 1) 9(.60), 10(.67), 11(-.42), 12(.40), 13(.64), 14(.16)
(S)* 2) 1(-.40), 2(.45), 3(-.58), 4(-.41), 5(.13), 6(.25), 7(.09), 8(-.12)

3 Factors:
1) 9(.60), 10(.64), 11(-.48), 13(.68)
* 2) 2(-.49), 3(.56), 4(.44), 5(-.19), 6(-.31), 8(.14)
3) 1(.39), 7(-.40), 12(.49), 14(.47)

4 Factors:
1) 9(.62), 10(.59), 11(-.52), 13(.68)
* 2) 2(-.55), 3(.56), 4(.40), 5(-.22), 6(-.27)
3) 1(.44), 12(.51), 14(.45)
4) 7(.53), 8(.35)

5 Factors:
1) 9(.63), 10(.57), 11(-.53), 13(.68)
* 2) 1(.42), 2(-.42), 3(.58), 4(.43)
3) 6(.35), 14(.63)
4) 7(.55), 8(.35)
5) 5(.43), 12(.55)

Group 9-WMYL

2 Factors:
(P) 1) 2(.58), 5(.47), 6(.37), 10(.62), 11(.32), 12(.59), 13(.47), 14(.66)
(S)* 2) 1(.56), 3(.27), 4(.25), 7(.47), 8(-.47), 9(.40)

3 Factors:
1) 1(.60), 2(.61), 5(.47), 6(.38), 10(.68), 12(.56), 13(.53), 14(.62)
* 2) 7(.52), 8(-.40), 9(.42)
3) 3(.47), 4(.55), 11(.36)

4 Factors:
1) 1(.61), 2(.61), 5(.41), 6(.34), 10(.63), 12(.60), 13(.55), 14(.67)
2) 7(.53), 8(-.45)
3) 3(.49), 4(.52), 11(.44)
4) 9(.41)

5 Factors:
1) 10(.45), 12(.62), 14(.70)
2) 7(.54), 8(-.45)
3) 3(.49), 4(.52), 11(.39)
4) 9(.55)
* 5) 1(.57), 2(.50), 5(.61), 6(.30), 13(.62)

Group 10-WMYH

2 Factors:
(P) 1) 1(.68), 2(.79), 5(.51), 6(-.23), 7(.45), 9(.41), 10(.60), 14(.68)
(S) 2) 3(.27), 4(.46), 8(.21), 11(-.10), 12(.63), 13(.41)

3 Factors:
1) 1(.67), 2(.78), 5(.46), 6(-.25), 9(.40), 10(.59), 14(.68)
2) 3(.31), 4(.43), 12(.70), 13(.48)
3) 7(.47), 8(.42), 11(-.31)

4 Factors:
1) 1(.72), 2(.77), 5(.56), 9(.41), 10(.54), 14(.62)
2) 4(.47), 12(.66), 13(.57)
* 3) 7(.50), 8(.44), 11(-.30)
4) 3(.30), 6(.45)

5 Factors:
1) 1(.71), 2(.74), 5(.57), 7(.46), 10(.53), 14(.62)
2) 4(.47), 12(.69), 13(.55)
* 3) 8(.48), 11(-.30)
4) 3(.30), 6(.46)
5) 9(.58)

Group 11-WMOL

2 Factors:
(P) 1) 1(.50), 2(.62), 5(.58), 6(.27), 7(.43), 8(-.26), 9(.03), 10(.46), 11(-.07), 12(.59), 13(.34), 14(.59)
(S) 2) 3(-.69), 4(-.58)

3 Factors:
1) 1(.53), 2(.59), 5(.54), 6(.26), 7(.37), 8(-.23), 12(.65), 14(.61)
2) 3(-.69), 4(-.58)
3) 9(.12), 10(.43), 11(-.17), 13(.59)

4 Factors:
1) 1(.58), 2(.61), 5(.57), 6(.26), 7(.33), 8(-.20), 12(.55), 14(.58)
2) 3(-.69), 4(-.58)
3) 10(.54), 11(-.17), 13(.56)
4) 9(.22)

5 Factors:
1) 1(.58), 2(.58), 5(.55), 12(.51), 14(.56)
2) 3(-.68), 4(-.59)
3) 7(.37), 8(-.25), 10(.55), 13(.55)
4) 9(.23)
5) 6(.31), 11(-.43)

Group 12-WMOH

2 Factors:
(P) 1) 1(.51), 2(.75), 3(.34), 5(.41), 7(.28), 9(.40), 10(.62), 12(.69), 14(.65)
(S)* 2) 4(.38), 6(-.27), 8(.23), 11(.62), 13(-.30)

3 Factors:
1) 1(.69), 2(.62), 5(.40), 12(.58), 14(.66)
* 2) 6(-.27), 8(.23), 11(.61), 13(-.32)
3) 3(.25), 4(.53), 7(.39), 9(.49), 10(.57)

4 Factors:
1) 1(.69), 2(.50), 5(.33), 12(.50), 14(.60),
2) 3(.46), 4(.61)
3) 9(.38), 10(.73), 13(.39)
4) 6(.35), 7(-.39), 8(-.31), 11(-.39)

5 Factors:
1) 1(.68), 2(.58), 12(.58), 14(.63)
2) 3(.46), 4(.58), 11(.45)
3) 9(.49), 10(.72), 13(.28)
4) 6(-.44), 7(.44)
5) 5(-.34), 8(.42)

Group 13-WFYL

2 Factors:

(P) 1) 1(.53), 2(.71), 4(.29), 5(.41), 7(.50), 9(.35), 12(.33), 13(.53), 14(.68)
(S) 2) 3(.39), 6(-.13), 8(.19), 10(-.51), 11(.55)

3 Factors:
1) 1(.48), 2(.61), 4(.26), 7(.53), 12(.25), 13(.68), 14(.62)
2) 3(.50), 5(.39), 9(.36), 11(.39)
3) 6(-.18), 8(.55), 10(-.52)

4 Factors:
1) 1(.39), 2(.55), 5(.51), 12(.52), 14(.62)
2) 3(.53), 4(.38), 9(.29), 11(.54)
3) 6(-.21), 8(.59), 10(-.52)
4) 7(.53), 13(.70)

5 Factors:
1) 1(.41), 2(.56), 5(.49), 12(.53), 14(.63)
2) 3(.57), 4(.41), 11(.48)
3) 8(.66)
4) 7(.52), 10(.45), 13(.71)
5) 6(.30), 9(.54)

Group 14-WFYH

2 Factors:
(P) 1) 2(.43), 5(.34), 7(.27), 8(-.67), 11(.62), 12(.46), 13(.07), 14(.49)
(S) 2) 1(.67), 3(.53), 4(.60), 6(-.20), 9(.32), 10(.36)

3 Factors:
1) 1(.64), 2(.54), 5(.43), 9(.36), 10(.38), 12(.55), 14(.74)
2) 7(.46), 8(-.75), 11(.51)
3) 3(.40), 4(.77), 6(-.22), 13(-.22)

4 Factors:
1) 1(.78), 2(.44), 3(.45), 9(.49), 10(.35), 12(.41), 14(.61)
2) 7(.39), 8(-.76), 11(.58)
3) 5(.54), 13(.33)
* 4) 4(.60), 6(-.63)

5 Factors:
1) 11(.70), 12(.58)
2) 3(-.47), 7(.48), 8(-.71)
3) 5(-.56), 13(-.33)
* 4) 4(.66), 6(-.61)
5) 1(.74), 2(.39), 9(.52), 10(.41), 14(.50)

Group 15-WFOL

2 Factors:
(P) 1) 2(.52), 5(.58), 6(.06), 10(.45), 12(.60), 13(.54), 14(.73)
(S) 2) 1(.36), 3(.45), 4(.32), 7(.36), 8(-.40), 9(.45), 11(.20)

3 Factors:
1) 1(.47), 2(.61), 5(.63), 12(.57), 13(.49), 14(.74)
2) 3(.59), 4(.40)
3) 6(-.20), 7(.52), 8(-.31), 9(.51), 10(.44), 11(.14)

4 Factors:
1) 2(.56), 5(.62), 12(.61), 13(.47), 14(.73)
2) 3(.54), 4(.46), 6(.26)
3) 7(.52), 9(.51), 10(.48), 11(.17)
4) 1(.48), 8(-.44)

5 Factors:
* 1) 2(.53), 5(.60), 10(.48), 12(.61), 13(.50), 14(.70)
2) 3(.52), 4(.51), 6(.27)
3) 2(.52), 9(.52)
4) 1(.60)
5) 8(.35), 11(.36)

Group 16-WFOH

2 Factors:
(P)* 1) 1(.54), 2(.68), 5(.54), 8(-.20), 9(.19), 10(.65), 11(.31), 12(.71), 14(.70)
(S) 2) 3(.41), 4(.43), 6(-.44), 7(.42), 13(-.30)

3 Factors:
* 1) 1(.51), 2(.67), 5(.58), 10(.64), 12(.72), 14(.67)
2) 3(.42), 4(.49), 6(-.42), 13(-.35)
3) 7(.44), 8(-.21), 9(.46), 11(-.38)

4 Factors:
* 1) 2(.64), 5(.67), 10(.62), 12(.70), 14(.52)
2) 3(.37), 4(.60), 11(.36)
3) 7(.48), 8(-.26), 9(.47)
4) 1(.40), 6(.50), 13(.55)

5 Factors:
* 1) 5(.71), 10(.53), 12(.62)
2) 6(.62), 13(.48)
3) 3(.48), 4(.60)
* 4) 1(.68), 2(.58), 8(-.22), 14(.60)
5) 7(.38), 9(.57), 11(-.35)

C. Factor score regressions

Following are the factor score regression results for systolic and diastolic and blood pressure regressed on factor scores computed from loadings on 2, 3, 4, and 5 factor rotations. Significant F values are marked "*".

Group 1-BMYL

Systolic blood pressure regression:

Rotations	Step	Factor entered	R	R^2	F value
2	1	2	.1715	.0294	2.0309
	2	1	.2009	.0404	0.7529
3	1	1	.1727	.0298	2.0608
	2	2	.2040	.0416	0.8113
	3	3	.2233	.0498	0.5627
4	1	1	.1724	.0297	2.0521
	2	2	.2159	.0466	1.1698
	3	3	.2454	.0602	0.9394
	4	4	.2466	.0608	0.0411
5	1	2	.2348	.0551	3.9077
	2	4	.2879	.0829	2.0005
	3	3	.3054	.0933	0.7435
	4	1	.3202	.1025	0.6575
	5	5	.3261	.1064	0.2721

Diastolic blood pressure regression:

Rotations	Step	Factor entered	R	R^2	F value
2	1	1	.1089	.0119	0.8038
	2	2	.1385	.0192	0.4933
3	1	1	.1487	.0221	1.5144
	2	3	.1629	.0265	0.3005
	3	2	.1663	.0276	0.0742
4	1	1	.1468	.0216	1.4764
	2	3	.1579	.0249	0.2275
	3	4	.1647	.0271	0.1478
	4	2	.1671	.0279	0.0519
5	1	1	.1272	.0162	1.1016
	2	2	.1610	.0259	0.6597
	3	3	.1700	.0289	0.1993
	4	5	.1708	.0292	0.0186
	-	-	-	-	-

Group 2-BMYH

Systolic blood pressure regression:

Rotations	Step	Factor entered	R	R^2	F value
2	1	1	.1160	.0135	0.9006
	2	2	.1563	.0244	0.7318
3	1	3	.2027	.0411	2.8277
	2	2	.2187	.0478	0.4608
	3	1	.2234	.0499	0.1388
4	1	4	.2743	.0753	5.3714 *
	2	3	.2953	.0872	0.8501
	3	1	.3102	.0962	0.6404
	4	2	.3129	.0979	0.1170
5	1	4	.2774	.0769	5.5009 *
	2	5	.2945	.0868	0.6988
	3	3	.3032	.0919	0.3628
	4	1	.3086	.0952	0.2324
	5	2	.3133	.0982	0.2024

Diastolic blood pressure regression:

Rotations	Step	Factor entered	R	R^2	F value
2	1	2	.2124	.0451	3.1197
	2	1	.2181	.0476	0.1672
3	1	3	.2158	.0466	3.2232
	2	1	.2492	.0621	1.0780
	3	2	.2684	.0720	0.6840
4	1	4	.2729	.0745	5.3093 *
	2	3	.2916	.0850	0.7494
	3	1	.3037	.0922	0.5101
	4	2	.3095	.0958	0.2475
5	1	4	.2384	.0568	3.9771
	2	3	.2952	.0871	2.1581
	3	1	.3025	.0915	0.3089
	4	2	.3079	.0948	0.2278
	5	5	.3107	.0965	0.1171

Group 3-BMOL

Systolic blood pressure regression:

Rotations	Step	Factor entered	R	R^2	F value
2	1	1	.1562	.0244	1.4004
	2	2	.1623	.0264	0.1103
3	1	3	.1704	.0290	1.6750
	2	1	.1802	.0325	0.1950
	3	2	.1841	.0339	0.0796
4	1	2	.1780	.0317	1.8324
	2	4	.2497	.0624	1.7996
	3	1	.2863	.0820	1.1532
	4	3	.3022	.0913	0.5456
5	1	4	.1795	.0322	1.8638
	2	2	.2527	.0638	1.8583
	3	1	.2815	.0793	0.9038
	4	3	.3028	.0917	0.7244
	-	-	-	-	-

Diastolic blood pressure regression:

Rotations	Step	Factor entered	R	R^2	F value
2	1	1	.0526	.0028	0.1555
	2	2	.0574	.0033	0.0287
3	1	1	.1654	.0274	1.5750
	2	3	.2016	.0406	0.7607
	-	-	-	-	-
4	1	1	.2026	.0410	2.3963
	2	3	.2598	.0675	1.5597
	3	4	.2834	.0803	0.7542
	4	2	.2888	.0834	0.1769
5	1	1	.1995	.0398	2.3206
	2	3	.2537	.0643	1.4436
	3	4	.2847	.0810	0.9803
	4	2	.2892	.0836	0.1514
	-	-	-	-	-

Group 4-BMOH

Systolic blood pressure regression:

Rotations	Step	Factor entered	R	R^2	F value
2	1	1	.1092	.0119	0.6757
	-	-	-	-	-
3	1	3	.1730	.0299	1.7269
	2	1	.1756	.0308	0.0516
	3	2	.1762	.0310	0.0116
4	1	3	.1328	.0176	1.0058
	2	2	.1619	.0262	0.4835
	3	1	.1694	.0287	0.1389
	4	4	.1762	.0311	0.1289
5	1	4	.1477	.0218	1.2497
	2	3	.1791	.0321	0.5832
	3	1	.1834	.0336	0.0866
	4	2	.1875	.0352	0.0833
	5	5	.1891	.0357	0.0315

Diastolic blood pressure regression:

Rotations	Step	Factor entered	R	R^2	F value
2	1	1	.1883	.0355	2.0590
	-	-	-	-	-
3	1	3	.2038	.0415	2.4270
	2	1	.2272	.0516	0.5836
	3	2	.2299	.0529	0.0713
4	1	4	.1263	.0159	0.9074
	2	2	.1804	.0325	0.9428
	3	3	.2172	.0472	0.8296
	4	1	.2390	.0571	0.5590
5	1	3	.1448	.0210	1.1985
	2	1	.1867	.0348	0.7917
	3	4	.2236	.0500	0.8619
	4	2	.2393	.0573	0.4082
	-	-	-	-	-

Group 5-BFYL

Systolic blood pressure regression:

Rotations	Step	Factor entered	R	R^2	F value
2	1	1	.2067	.0427	2.8120
	2	2	.2312	.0534	0.7013
3	1	1	.2264	.0513	3.4046
	2	2	.2681	.0719	1.3772
	3	3	.2708	.0733	0.0951
4	1	1	.2258	.0510	3.3847
	2	4	.2597	.0674	1.0936
	3	2	.2659	.0707	0.2142
	4	3	.2712	.0738	0.2012
5	1	4	.1686	.0284	1.8433
	2	3	.2274	.0517	1.5227
	3	5	.2606	.0679	1.0587
	4	2	.2845	.0809	0.8523
	5	1	.3031	.0918	0.7077

Diastolic blood pressure regression:

Rotations	Step	Factor entered	R	R^2	F value
2	1	1	.1998	.0399	2.6205
	2	2	.2299	.0528	0.8444
3	1	1	.2098	.0440	2.9021
	2	2	.2238	.0501	0.3960
	3	3	.2312	.0534	0.2144
4	1	1	.2193	.0481	3.1834
	2	4	.2284	.0522	0.2660
	3	2	.2309	.0533	0.0731
	-	-	-	-	-
5	1	5	.1676	.0281	1.8216
	2	1	.2076	.0431	0.9727
	3	4	.2248	.0505	0.4756
	4	2	.2343	.0549	0.2766
	5	3	.2384	.0568	0.1220

Group 6-BFYH

Systolic blood pressure regression:

Rotations	Step	Factor entered	R	R^2	F value
2	1	2	.2251	.0507	3.3085
	2	1	.2357	.0555	0.3154
3	1	2	.2340	.0548	3.5913
	2	1	.2432	.0591	0.2843
	-	-	-	-	-
4	1	1	.1895	.0359	2.3088
	2	3	.2155	.0464	0.6739
	3	2	.2377	.0565	0.6416
	4	4	.2438	.0594	0.1827
5	1	2	.1874	.0351	2.2572
	2	4	.2248	.0506	0.9909
	3	3	.2427	.0589	0.5313
	4	1	.2529	.0639	0.3188
	5	5	.2542	.0646	0.0410

Diastolic blood pressure regression:

Rotations	Step	Factor entered	R	R^2	F value
2	1	2	.0954	.0091	.5695
	-	-	-	-	-
3	1	2	.0772	.0060	0.3721
	2	3	.1001	.0100	0.2493
	-	-	-	-	-
4	1	2	.1056	.0122	0.6995
	2	1	.1144	.0131	0.1200
	3	3	.1205	.0145	0.0869
	4	4	.1245	.0155	0.0581
5	1	3	.1032	.0106	0.6672
	2	5	.1131	.0128	0.1323
	3	2	.1202	.0144	0.1004
	4	4	.1260	.0159	0.0854
	-	-	-	-	-

Group 7-BFOL

Systolic blood pressure regression:

Rotations	Step	Factor entered	R	R^2	F value
2	1	2	.1755	.0308	1.9711
	2	1	.1806	.0326	0.1141
3	1	3	.1522	.0232	1.4696
	2	1	.1809	.0327	0.6036
	3	2	.1886	.0356	0.1762
4	1	3	.1784	.0318	2.0389
	2	1	.2208	.0487	1.0834
	3	2	.2237	.0500	0.0829
	4	4	.2247	.0505	0.0278
5	1	5	.1507	.0227	1.4412
	2	3	.1987	.0395	1.0648
	3	1	.2337	.0546	0.9594
	4	2	.2353	.0554	0.0471
	5	4	.2362	.0558	0.0260

Diastolic blood pressure regression:

Rotation	Step	Factor entered	R	R^2	F value
2	1	2	.2097	.0440	2.8510
	2	1	.2232	.0498	0.3747
3	1	1	.2546	.0648	4.2975 *
	2	2	.2618	.0685	0.2431
	3	3	.2658	.0706	0.1356
4	1	4	.2829	.0801	5.3955 *
	2	1	.3145	.0989	1.2778
	3	2	.3173	.1007	0.1158
	-	-	-	-	-
5	1	4	.2701	.0730	4.8810 *
	2	1	.3120	.0974	1.6477
	3	5	.3144	.0988	0.0988
	4	2	.3162	.1000	0.0736
	5	3	.3173	.1007	0.0469

Group 8-BFOH

Systolic blood pressure regression:

Rotations	Step	Factor entered	R	R^2	F value
2	1	2	.3669	.1346	9.6453 *
	-	-	-	-	-
3	1	2	.3383	.1145	8.0144 *
	2	3	.3665	.1343	1.3969
	3	1	.3676	.1351	0.0594
4	1	2	.3182	.1013	6.9849 *
	2	3	.3591	.1289	1.9392
	3	1	.3640	.1325	0.2461
	4	4	.3685	.1358	0.2269
5	1	2	.3420	.1169	8.2111 *
	2	5	.3771	.1422	1.7953
	3	3	.3960	.1568	1.0396
	4	1	.4027	.1622	0.3793
	5	4	.4045	.1636	0.0978

Diastolic blood pressure regression:

Rotations	Step	Factor entered	R	R^2	F value
2	1	2	.2387	.0570	3.7463
	2	1	.2715	.0737	1.1008
3	1	2	.2355	.0555	3.6408
	2	1	.2738	.0750	1.2862
	-	-	-	-	-
4	1	2	.2100	.0441	2.8612
	2	1	.2611	.0682	1.5761
	3	4	.2804	.0786	0.6810
	4	3	.2814	.0792	0.0355
5	1	2	.1986	.0394	2.5454
	2	1	.2583	.0667	1.7835
	3	3	.3043	.0926	1.7117
	4	5	.3165	.1002	0.4966
	5	4	.3174	.1007	0.0344

Group 9-WMYL

Systolic blood pressure regression:

Rotations	Step	Factor entered	R	R^2	F value
2	1	2	.3437	.1181	6.9668 *
	2	1	.3472	.1206	0.1407
3	1	2	.3156	.0996	5.7523 *
	2	3	.3338	.1114	0.6775
	3	1	.3488	.1217	0.5832
4	1	4	.2538	.0644	3.5803
	2	2	.3307	.1094	2.5744
	3	1	.3459	.1196	0.5833
	4	3	.3609	.1303	0.5979
5	1	5	.2893	.0837	4.7512 *
	2	2	.3438	.1182	1.9927
	3	3	.3581	.1282	0.5778
	4	4	.3740	.1399	0.6642
	5	1	.3779	.1428	0.1636

Diastolic blood pressure regression:

Rotations	Step	Factor entered	R	R^2	F value
2	1	2	.3110	.0967	5.5692 *
	2	1	.3196	.1021	0.3064
3	1	2	.2863	.0820	4.6418 *
	2	3	.3199	.1023	1.1568
	3	1	.3222	.1038	0.0826
4	1	2	.2523	.0636	3.5343
	2	4	.3018	.0911	1.5389
	3	3	.3214	.1033	0.6823
	4	1	.3222	.1038	0.0275
5	1	2	.2488	.0619	3.4312
	2	1	.2899	.0841	1.2339
	3	3	.3098	.0960	0.6603
	4	5	.3302	.1090	0.7167
	5	4	.3325	.1106	0.0830

Group 10-WMYH

Systolic blood pressure regression:

Rotations	Step	Factor entered	R	R^2	F value
2	1	2	.1487	.0221	1.1536
	2	1	.1644	.0270	0.2516
3	1	2	.2390	.0571	3.0900
	2	3	.3100	.0961	2.1551
	3	1	.3159	.0998	0.2014
4	1	3	.2698	.0728	4.0052 *
	2	4	.3192	.1019	1.6168
	3	2	.3524	.1242	1.2494
	4	1	.3678	.1353	0.6150
5	1	3	.2824	.0797	4.4196 *
	2	4	.3245	.1053	1.4298
	3	2	.3551	.1261	1.1652
	4	1	.3634	.1321	0.3302
	5	5	.3688	.1360	0.2123

Diastolic blood pressure regression:

Rotations	Step	Factor entered	R	R^2	F value
2	1	2	.0524	.0027	0.1403
	-	-	-	-	-
3	1	3	.1429	.0204	1.0624
	2	2	.1756	.0309	0.5388
	-	-	-	-	-
4	1	4	.2282	.0521	2.8027
	2	3	.3150	.0992	2.6166
	3	1	.3196	.1022	0.1604
	-	-	-	-	-
5	1	3	.2327	.0542	2.9208
	2	4	.3191	.1018	2.6536
	3	1	.3215	.1034	0.0837
	4	5	.3219	.1036	0.0137
	-	-	-	-	-

Group 11-WMOL

Systolic blood pressure regression:

Rotations	Step	Factor entered	R	R^2	F value
2	1	2	.0525	.0028	0.1825
	2	1	.0549	.0030	0.0165
3	1	2	.0525	.0028	0.1826
	2	1	.0551	.0030	0.0182
	-	-	-	-	-
4	1	4	.1255	.0157	1.0558
	2	3	.1436	.0206	0.3239
	3	2	.1505	.0227	0.1330
	-	-	-	-	-
5	1	4	.1136	.0129	0.8627
	2	3	.1442	.0208	0.5239
	3	2	.1504	.0226	0.1204
	4	5	.1547	.0239	0.0830
	5	1	.1558	.0243	0.0232

Diastolic blood pressure regression:

Rotations	Step	Factor entered	R	R^2	F value
2	1	2	.1804	.0325	2.2191
	2	1	.1861	.0346	0.1406
3	1	2	.1797	.0323	2.2034
	2	1	.1859	.0346	0.1528
	-	-	-	-	-
4	1	2	.1769	.0313	2.1316
	2	1	.1887	.0356	0.2902
	3	4	.1921	.0369	0.0877
	4	3	.1959	.0384	0.0952
5	1	2	.1820	.0331	2.2609
	2	1	.1944	.0378	0.3152
	3	5	.2003	.0401	0.1551
	4	4	.2048	.0419	0.1190
	5	3	.2053	.0421	0.0144

Group 12-WMOH

Systolic blood pressure regression:

Rotations	Step	Factor entered	R	R^2	F value
2	1	2	.2441	.0596	4.1193 *
	2	1	.2445	.0598	0.0115
3	1	2	.2444	.0597	4.1292 *
	2	1	.2490	.0620	0.1555
	3	3	.2500	.0625	0.0323
4	1	3	.1979	.0392	2.6498
	2	2	.2619	.0686	2.0212
	3	1	.2736	.0749	0.4270
	4	4	.2757	.0760	0.0777
5	1	2	.2165	.0469	3.1953
	2	5	.2943	.0866	2.7841
	3	4	.3182	.1012	1.0269
	4	3	.3331	.1109	0.6767
	-	-	-	-	-

Diastolic blood pressure regression:

Rotations	Step	Factor entered	R	R^2	F value
2	1	2	.1817	.0330	2.2181
	2	1	.1841	.0339	0.0599
3	1	2	.1858	.0345	2.3250
	2	3	.2397	.0574	1.5557
	3	1	.2499	.0624	0.3350
4	1	3	.1999	.0400	2.7051
	2	1	.2357	.0556	1.0569
	3	4	.2533	.0642	0.5793
	4	2	.2538	.0644	0.0169
5	1	3	.2133	.0455	3.0986
	2	5	.2387	.0570	0.7789
	3	1	.2515	.0633	0.4235
	4	2	.2536	.0643	0.0692
	-	-	-	-	-

Group 13-WFYL

Systolic blood pressure regression:

Rotations	Step	Factor entered	R	R^2	F value
-	-	-	-	-	-
	-	-	-	-	-
3	1	2	.0382	.0015	0.0787
	2	3	.0506	.0026	0.0587
	-	-	-	-	-
4	1	3	.0357	.0013	0.0689
	2	1	.0439	.0019	0.0348
	3	4	.0510	.0026	0.0352
	-	-	-	-	-
5	1	5	.1006	.0101	0.5520
	2	4	.1068	.0114	0.0690
	3	1	.1107	.0123	0.0447
	-	-	-	-	-
	-	-	-	-	-

Diastolic blood pressure regression:

Rotations	Step	Factor entered	R	R^2	F value
2	1	2	.0323	.0010	0.0565
	-	-	-	-	-
3	1	2	.0353	.0012	0.0674
	2	1	.0402	.0016	0.0197
	-	-	-	-	-
4	1	1	.0712	.0051	0.2755
	2	4	.1019	.0104	0.2839
	3	3	.1075	.0116	0.0621
	4	2	.1122	.0126	0.0536
5	1	4	.0908	.0082	0.4491
	2	1	.1214	.0147	0.3489
	3	3	.1388	.0193	0.2405
	4	5	.1536	.0236	0.2262
	5	2	.1636	.0268	0.1618

Group 14-WFYH

Systolic blood pressure regression:

Rotations	Step	Factor entered	R	R^2	F value	
2	1	2	.2179	.0475	2.6928	
	-	-	-	-	-	
3	1	1	.1634	.0267	1.4813	
	2	3	.2030	.0412	0.8027	
	3	2	.2258	.0510	0.5350	
4	1	4	.3416	.1167	7.1355	*
	2	3	.3760	.1413	1.5205	
	3	2	.3843	.1477	0.3856	
	4	1	.3891	.1514	0.2249	
5	1	4	.3005	.0903	5.3617	*
	2	2	.3508	.1230	1.9765	
	3	1	.3835	.1471	1.4663	
	4	3	.4047	.1638	1.0203	
	5	5	.4065	.1653	0.0867	

Diastolic blood pressure regression:

Rotations	Step	Factor entered	R	R^2	F value
2	1	2	.1126	.0127	0.6936
	2	1	.1280	.0164	0.2002
3	1	2	.0913	.0083	0.4541
	2	3	.1230	.0151	0.3657
	3	1	.1289	.0166	0.0779
4	1	4	.2596	.0674	3.9023
	2	3	.2744	.0753	0.4521
	3	2	.2879	.0829	0.4322
	4	1	.2900	.0841	0.0665
5	1	4	.2294	.0526	2.9997
	2	2	.2690	.0724	1.1279
	3	5	.2905	.0844	0.6814
	4	1	.2975	.0885	0.2315
	5	3	.3036	.0922	0.2017

Group 15-WFOL

Systolic blood pressure regression:

Rotations	Step	Factor entered	R	R^2	F value
2	1	1	.1747	.0305	2.1397
	2	2	.1843	.0339	0.2388
3	1	3	.1517	.0230	1.6015
	2	1	.2101	.0441	1.4805
	3	2	.2280	.0520	0.5474
4	1	3	.1827	.0334	2.3492
	2	1	.2613	.0683	2.5079
	3	4	.3066	.0940	1.8724
	4	2	.3096	.0959	0.1352
5	1	1	.2034	.0414	2.9340
	2	4	.2548	.0649	1.6878
	3	3	.2843	.0808	1.1431
	4	5	.3076	.0946	0.9878
	5	2	.3101	.0962	0.1117

Diastolic blood pressure regression:

Rotations	Step	Factor entered	R	R^2	F value
2	1	1	.2251	.0507	3.6289
	2	2	.2769	.0767	1.8876
3	1	1	.2118	.0449	3.1943
	2	3	.2948	.0869	3.0824
	-	-	-	-	-
4	1	1	.2188	.0479	3.4190
	2	3	.3073	.0944	3.4432
	3	2	.3091	.0956	0.0836
	-	-	-	-	-
5	1	1	.2356	.0555	3.9947 *
	2	3	.3018	.0911	2.6254
	3	5	.3084	.0951	0.2932
	4	2	.3096	.0959	0.0528
	-	-	-	-	-

Group 16-WFOH

Systolic blood pressure regression:

Rotations	Step	Factor entered	R	R^2	F value
2	1	1	.2479	.0615	4.4538 *
	2	2	.2493	.0622	0.0498
3	1	1	.2511	.0631	4.5773 *
	2	2	.2607	.0680	0.3532
	3	3	.2662	.0709	0.2055
4	1	1	.2621	.0687	5.0147 *
	2	2	.2759	.0761	0.5402
	3	4	.2792	.0779	0.1287
	-	-	-	-	-
5	1	4	.1869	.0349	2.4620
	2	1	.2781	.0774	3.0801
	3	2	.3090	.0955	1.3246
	4	5	.3303	.1091	0.9903
	-	-	-	-	-

Diastolic blood pressure regression:

Rotations	Step	Factor entered	R	R^2	F value
2	1	1	.3660	.1339	10.5155 *
	2	2	.3817	.1457	0.9202
3	1	1	.3761	.1414	11.2006 *
	2	2	.3823	.1462	0.3734
	3	3	.3827	.1464	0.0206
4	1	1	.3545	.1257	9.7746 *
	2	4	.3806	.1448	1.4999
	3	2	.3824	.1462	0.1071
	4	3	.3828	.1465	0.0224
5	1	4	.2718	.0739	5.4237 *
	2	1	.3986	.1589	6.7750 *
	3	5	.4080	.1665	0.5988
	4	3	.4125	.1702	0.2907
	5	2	.4135	.1710	0.0587

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