A Community-Based Heart Disease Intervention: Predictors of Change

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ABSTRACT

Objectives. This paper presents a prospective examination of sociodemographic, psychosocial, and physiologic characteristics associated with positive change in cardiovascular disease risk factors during a 6-year multiple risk factor intervention study.

Methods. Data are presented on 221 women and 190 men (aged 25 through 74 years) who participated in four cohort surveys (1979 through 1985). A signal detection model was used to identify baseline variables that best divide the sample into subgroups on the basis of the probability of positive change in a composite risk factor score.

Results. Sixty-nine percent of the respondents showed a positive change in risk factor score during the intervention. The subgroup with the highest proportion of positive changers (83%) was composed of older adults (>55 years) with the highest perceived risk, highest health media use, and highest blood pressure and cholesterol levels. The subgroup with the lowest proportion of positive changers (42%) was the least educated, was the most likely to be Hispanic, and had the lowest health knowledge and self-efficacy scores.

Conclusions. The differing composition of subgroups who respond or do not respond to community cardiovascular disease interventions illustrates the need to develop specific interventions that target different age, socioeconomic, and cultural subgroups. (*Am J Public Health.* 1994; 84:767–772)

Introduction

The Stanford Five-City Project is a long-term field trial designed to test whether a comprehensive program of community organization and health education produces favorable changes in cardiovascular disease risk.[1] Changes in overall risk factors have been reported[2] and indicate a beneficial educational effect, especially with regard to blood pressure[3] and smoking.[4]

In this paper, we present prospective data on respondents from the two treatment cities. We identify those who showed favorable risk factor changes and compare their baseline sociodemographic, psychosocial, and physiologic characteristics with those of respondents who showed unfavorable changes. This procedure allows for the identification of subgroups who are most likely to respond to a community intervention like the Five-City Project, as well as subgroups who deserve special attention because of their lack of positive change.

Because intervention programs increasingly involve the targeting of multiple risk factors[1,5,6] and because the primary goal of community cardiovascular disease intervention studies is overall improvement in the community's health, we used a summary measure that incorporates multiple cardiovascular disease risk factors as our indicator of change. Using a signal detection model designed to develop optimal sequential rules,[7] we identified baseline health-related variables that best divide the sample into subgroups on the basis of the probability of positive change in risk factor status.

Our selected variables reflect the theoretical bases of the Project's education program: social learning theory,[8,9] the communication-persuasion model,[10] the social marketing model,[11] and the theory of reasoned action.[12] We evaluate knowledge and attitudes about cardiovascular disease that often accompany behavior change[13]; perceived self-efficacy about diet and exercise, which has been shown to be important in predicting behavior change[14]; perceived cardiovascular disease risk, which has been shown to be important in understanding how individuals change[15]; and health media use, which has been shown to be related to exposure to the Five-City Project campaign.[16]

Methods

The Five-City Project drew subjects from two treatment and two control cities in Northern California, ranging in population size from 35 000 to 145 000 residents (a fifth city was monitored for morbidity and mortality, but not for risk factor change). To assess change in risk factors, independent cross-sectional surveys of randomly selected households and repeated surveys of a cohort were conducted. All persons aged 12 through 74 years were eligible to participate and were invited to attend survey centers located in each community. Detailed descriptions of the study design and methodology have been published previously.[1,17,18]

This analysis focuses on adults aged 25 through 74 years living in the two treatment cities who participated in at least the baseline cohort survey (1979/80) and the final cohort survey (1984/85).

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When these subjects also participated in either or both of the interim cohort surveys (1980/81 and 1982/83), interim data were also used. Eighty-seven percent of those who participated in the baseline and final surveys also participated in both of the interim surveys.

The Education Intervention

The 6-year education intervention targeted all residents in the treatment communities and involved a multiple risk factor strategy delivered through multiple educational channels.[19] Mass media (television and radio) programs formed a major proportion of the intervention. Print media (newspaper health columns and pamphlets) were delivered through direct mail, at work sites, and through medical care givers.[20] Special emphasis was given to designing materials for those with low literacy levels and disseminating programs to low-income Spanish-speaking populations, particularly via radio.

Outcome Variable

As an overall measure of change in cardiovascular disease risk factors, we chose change in a composite risk factor function (based on the Framingham Study) that provides an estimate of all-cause mortality risk per 1000 persons in 10 years.[21] The risk function, which is sex-specific, is a combination of cigarettes per day, total plasma cholesterol, mean diastolic blood pressure, and pulse (men only). Although we recognize that an individual's response may be specific to one component of the risk score (e.g., smoking) but not to another component (e.g., cholesterol), our objective was to select an outcome indicative of overall improvement in health. Furthermore, a single outcome variable avoids problems of collinearity and multiple-hypothesis testing. It thus provides a more powerful method of assessing the simultaneous effects of multiple risk factors than do analytic methods that become impractical when separate variables are used.

Information on variables used in the risk assessment was obtained by experienced nurses and laboratory technicians. Respondents were asked if they had smoked any cigarettes in the past week. If no cigarettes were smoked, respondents received a code of zero; if one or more cigarettes were smoked, they received a code reflecting the number of cigarettes smoked per day. Although no biochemical measures were used to validate the number of cigarettes smoked per day, previous analyses have shown a high degree of accuracy between self-reported and biochemical measures for overall smoking status.[4,22] Total plasma cholesterol was derived from nonfasting venous samples and analyzed by standard methods established by the Lipid Research Clinic Program.[23] Three blood pressure measurements were taken on the right arm with a semiautomatic recorder (Sphygmetrics SR-2 automatic blood pressure recorder) that minimizes observer bias.[17] The mean of the second and third diastolic readings were used for analyses. Resting pulse was determined by direct palpation for 1 minute.

We calculated respondents' composite risk factor functions at each survey time from the values of their risk factors at that time. (The mean baseline risk score was 3.5 [SD = 1.2].) Age was held constant for each individual at his or her baseline age, allowing for the examination of change in risk due to factors targeted by the intervention. After calculating a respondent's risk function values at each survey, we employed a random regression model to fit a unique slope for each respondent.[24] On the basis of the value of their individual slopes, individuals were divided into two groups, one representing positive changers (those with a positive slope, indicating a general improvement in risk score over the course of the surveys) and one representing negative changers (those with a negative slope, indicating a worsening of risk score).

Predictor Variables

Predictor variables used in our analysis include six baseline sociodemographic variables (age, education, marital status, ethnicity, sex, city of residence) and five baseline psychosocial variables (cardiovascular disease health knowledge, health attitudes, self-efficacy, perceived risk, and health media use).

Information on sociodemographic variables and psychosocial variables was obtained from self-reported questionnaire data. Age and education were collected as continuous variables and marital status (currently married or not currently married) and ethnicity (White, Hispanic) were collected as dichotomous variables. The 2% of the sample who were Asian and the 2% who were African American were excluded from this analysis. Education was selected as the measure of socioeconomic status because education is available for all individuals regardless of employment status, has high reliability and validity, is generally stable after early adulthood,[25,26] and has recently been shown to have a stronger association with cardiovascular disease risk factors than income or occupation.[27,28]

Nine psychosocial predictor variables were initially selected for analyses—these were reduced to five by means of a principal components analysis to reduce collinearity. Health knowledge was measured on a summative scale of 17 items about cardiovascular disease risk factors (Cronbach's $\alpha = .66$). Health attitudes were measured on a summative scale encompassing four dimensions—8 physical activity items, 7 weight items, 10 nutrition items, and 10 stress management items ($\alpha = .83$). Self-efficacy was based on 13 diet and exercise items ($\alpha = .79$), and perceived cardiovascular disease risk was measured by one item (scale of 1 to 7). Health media use, which assesses the frequency with which health information is obtained from newspapers, magazines, and pamphlets sent in the mail, was based on four items and was standardized to a mean of 0 and a standard deviation of 1 ($\alpha = .70$). Higher scores reflect higher health knowledge, more positive health attitudes, higher self-efficacy, greater perceived risk, and higher health media use.

Statistical Model

A multiple logistic regression model including interaction terms is a common analytic method for identifying characteristics of respondents who show favorable risk factor changes compared with those who do not. We used this method initially, but we found many significant higher-order interaction terms, making results difficult to interpret. In addition, ordering individual subjects on a scale, as the risk score does, is not as useful for planning and implementing prevention programs as is the identification of specific subgroups. To overcome these problems, we used a signal detection model that provides more interpretable results when there are a large number of interactions.[7] This method, which is a form of recursive partitioning, uses baseline characteristics to define distinct subgroups of respondents, which are mutually exclusive and maximally discriminated from each other, on the basis of probability of positive change in risk function score.

The baseline sociodemographic and psychosocial predictor variables were entered into the signal detection analysis along with minimum and maximum values and interval cutpoints (further information is available from the authors upon request). The signal detection algorithm then examined each variable and its possible cutpoints and selected a variable and cutpoint on the basis of a combined optimal measure of sensitivity and specificity with regard to the outcome measure (cardiovascular disease risk factor change).

After choosing and splitting on the first optimally efficient variable, the signal detection program separately searched each subgroup or "branch" of the first split for the next most efficient variable and cutpoint (Figure 1). This procedure was repeated separately in each subgroup with all the remaining predictor variables. The procedure ended when (1) there were too few subjects in a subgroup for further analysis, (2) no further significant discriminating variable at ($P < .05$) could be found, or (3) no further predictor variables remained.

Results

The cohort treatment sample was composed of 221 women and 190 men aged 25 through 74 years who participated in at least the baseline and final surveys. Of those who participated in the first survey, 70.0% returned for the second survey, 58.7% for the third survey, and 54.0% for the final survey.

The baseline sample consisted predominantly of White adults (92%) who had completed at least high school (86%) and who were married (71%). Sixty-nine percent (n = 284) of the study population showed a positive change in their composite risk factor scores over the 6-year study period.

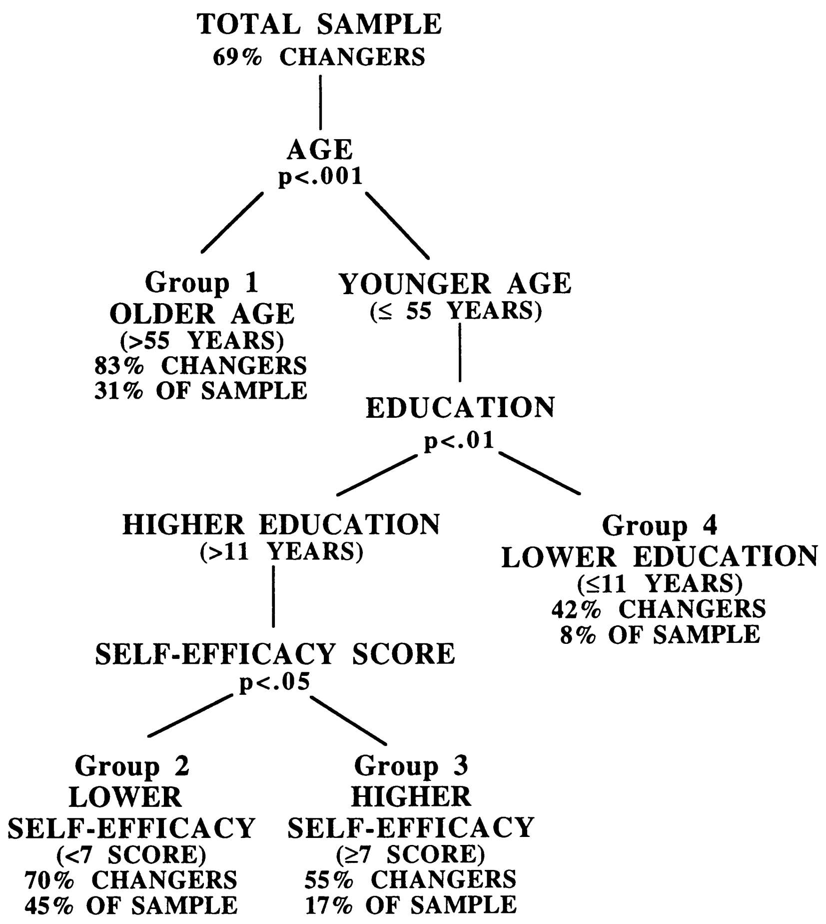

FIGURE 1—Signal detection analysis: development of the optimally efficient algorithm for identifying distinct groups on the basis of positive change in cardiovascular disease risk factor score.

Figure 1 shows the development of the optimally efficient algorithm for identifying distinct groups on the basis of positive change in cardiovascular disease risk factor score. The first optimally efficient variable ($P < .001$) that distinguished positive changers from negative changers was age ($\leq$55 years vs $>$55 years). In the older age group (group 1), 83% of the participants showed positive change. No other variable provided significant discrimination within this group.

Among younger participants ($\leq$55 years of age), educational attainment further discriminated respondents. For those with higher educational attainment ($>$11 years), the next significant split was found for self-efficacy. This variable subdivided the younger subgroup with higher educational attainment into two smaller groups. In the group with lower self-efficacy scores (group 2), 70% showed positive change; in the group with higher scores (group 3), 55% showed positive change. The last subgroup of younger participants was discriminated on the basis of lower educational attainment ($\leq$11 years). This group (group 4) had the lowest proportion of positive changers (42%). After the identification of these four subgroups, no further significant predictors were found and the signal detection test development stopped.

As in all correlational analyses, the factors selected identify respondents at different risk levels but are not necessarily themselves causal factors. Thus, to gain further understanding of the nature of the four subgroups, we examined the profile of each (Table 1). Group 1, the oldest age group and the most likely to show a positive overall risk function change, was distinguished from the other subgroups by higher cholesterol and blood pressure levels and higher prevalence of hypertension at baseline. Group 1 also had the highest perceived risk and highest health media use scores. Group 2, which had lower self-efficacy scores, had a higher proportion of Hispanics, a higher proportion of smokers and heavy smokers, higher rates of hypertension, and higher levels of cholesterol than did group 3. Members of group 3, which had the highest self-efficacy scores, were the youngest participants, the most highly educated, the most likely to be single, and the most likely to be male. They also had the lowest perceived risk and the most positive risk factor profile. Group 4, the group with the lowest proportion of positive changers, had the highest proportion of women, the highest proportion of Hispanics, and the lowest levels of health knowledge.

Discussion

In this paper we provide a prospective examination of factors associated with changes in overall cardiovascular disease risk factor scores in individuals living in

TABLE 1—Baseline Characteristics of Four Change Groups: Men and Women Aged 25 through 74 Years, Stanford Five-City Project, 1979 through 1985

	Group 1: Older Adults	Group 2: Younger, More Educated, Lower Self-Efficacy	Group 3: Younger, More Educated, Higher Self-Efficacy	Group 4: Younger, Less Educated	P[a]
No. in group	127	184	69	31	
Positive changers, %	83	70	55	42	
Sociodemographic variables					
Mean age, y (SD)	63.3 (5.0)[b]	39.4 (9.3)[b]	36.0 (8.1)[b]	40.4 (10.0)[b]	.001
Mean education, y (SD)	13.1 (3.6)	14.3 (2.3)[b]	15.1 (2.4)[b]	8.1 (2.6)[b]	.001
Married, %	70.1	75.5	53.6	80.6	.004
Hispanic, %	4.7	7.6	1.5	38.7	.001
Women, %	55.1	55.4	40.6	67.7	.06
Physiologic variables					
Smokers, %	22.2	32.1	26.1	32.3	.27
Mean no. cigarettes/d (smokers) (SD)	16.5 (10.2)	22.2 (12.9)	12.2 (8.5)	17.7 (9.8)	.02
Mean diastolic blood pressure, mm Hg (SD)	81.9 (11.1)	77.6 (10.0)	76.8 (10.7)	77.5 (10.8)	.01
Hypertensive, %	57.6	23.9	15.9	23.3	.001
Mean plasma cholesterol, mg/dL (SD)	224.5 (37.8)	200.3 (38.7)	192.9 (38.3)	199.7 (41.7)	.001
Mean pulse, beats/min (SD)	69.9 (12.3)	69.7 (9.6)	69.0 (8.7)	70.2 (8.8)	.94
Psychosocial variables					
Mean cardiovascular disease knowledge score (SD)	6.9 (3.0)	6.9 (2.7)	6.9 (2.9)	4.6 (2.3)	.001
Mean health attitudes score (SD)	4.2 (0.7)	3.8 (0.6)	4.3 (0.7)	3.7 (0.7)	.001
Mean self-efficacy score (SD)	6.0 (1.5)	5.4 (1.1)[b]	7.8 (0.6)[b]	4.8 (1.5)	.001
Mean perceived risk score (SD)	4.2 (1.6)	3.7 (1.3)	3.3 (1.4)	3.9 (1.4)	.001
Mean health media use score (SD)[c]	0.2 (0.7)	−0.2 (0.7)	−0.1 (0.8)	−0.1 (0.8)	.001

[a]Based on analysis of variance for continuous variables and chi-square tests for categorical variables.
[b]Numbers that segmented the sample into subgroups in the signal detection model.
[c]Standardized to a mean of 0 and a standard deviation of 1.

the two Stanford Five-City Project treatment cities that received the 6-year education program. Our objective is to provide researchers who are planning cardiovascular disease community interventions with information about subgroups that are the most likely (or unlikely) to make positive changes in response to intervention programs, especially those involving media interventions. Although other studies have examined the effectiveness of demographic and psychosocial variables in segmenting populations,[29,30] few have examined the relationship between segmentation variables and risk factor changes over time.

Four distinct subgroups of individuals were identified on the basis of changes in their cardiovascular disease risk factor scores. Group 1 (31% of the sample) consisted of older adults who initially had the highest mean blood pressure levels, double the rate of hypertensives of other groups, and the highest mean cholesterol levels. This group had the most positive motivation and information-seeking habits, as indicated by its high perceived risk and health media use scores. Given their psychosocial and physiologic profiles, it is not surprising that members of this group were the most likely to change; therefore, some portion of the change may reflect a regression to the mean phenomenon. Their perception of risk was accurately high, their cardiovascular disease knowledge was adequate, and their health media use was high (providing a relatively information-rich environment via print materials). Moreover, their self-efficacy scores show a confidence about making behavioral changes needed to lower risk. The demographic and psychosocial profile of members of this subgroup, combined with their health media use, make them receptive to public health campaigns that disseminate risk reduction information.

Members of groups 2 and 3, who constituted 62% of the sample, were identified by younger age and higher educational attainment. Group 2 (with 70% changers) was distinguished from group 3 (with 55% changers) by self-efficacy score (5.4 and 7.8, respectively). Group 2 also had a higher smoking rate (32%, vs 26% in group 3), a higher percentage of hypertensives (24%, vs 16% in group 3), and a higher mean cholesterol level (200.3 mg/dL in group 2 and 192.9 mg/dL in group 3). The higher percentage of positive changers in group 2 than in group 3 is most likely explained by group 2's greater cardiovascular disease risk at baseline, which gives a greater possibility for change.

At first glance, the fact that group 3 had a higher level of self-efficacy and a lower proportion of positive changers seems counter to the large empirical literature on self-efficacy and behavior change.[9,14] On closer examination, however, we see that group 3 was the youngest of all groups, the most educated, and the most likely to be single, non-Hispanic, and male. This group was also the healthiest in terms of blood pressure and cholesterol. Thus, while its members' self-efficacy and health attitudes were highest, their low levels of perceived risk may indicate that they believe they could change but do not see a need to do so. It is also possible that members of this group have already made changes and do not see the need for further change. The effort to reach those who are younger, more educated, and healthier, but less likely to seek health information via the media, may be most successful if prevention is stressed via mainstream formats such as newspaper articles rather than specialized health media such as doctors' columns. Furthermore, strategies that incorporate short-term outcomes and use a social influences framework may be most appealing to this audience.

Like group 1, group 4 is one that could be labeled "high risk," but unlike group 1, group 4 had a low rate of change (42%). Its members were the least educated of all groups (mean of 8.1 years of schooling). Although predominantly White, almost 40% were Hispanic. Over 65% were women. Members of this group had the highest smoking rates, the lowest levels of cardiovascular disease knowledge, the lowest health attitude scores, and the lowest self-efficacy scores. Although it constitutes only 8% of the sample, this group is at high risk for health problems because of its lower socioeconomic status[27,31] and poorer health knowledge and attitudes. Although persons of all educational levels are beginning to show substantial declines in cardiovascular disease risk factors,[32] those with low educational attainment may be unlikely to respond to health education campaigns that are based on a high level of cardiovascular disease knowledge and the initiation of complex actions. It is possible that members of this subgroup were not provided with the requisite skills to perform many of the behaviors promoted by the campaign and that they lived in environments where resources were scarce and where norms did not support positive changes in health. It is clear that more research is needed on how to provide effective health education to those who fit the profile of this subgroup. For example, community interventionists need to gain a better understanding of how poverty and literacy levels, normative beliefs, and communication styles affect behavior change. Furthermore, interventionists need to increase their understanding of the social environments in which adults from lower educational levels reside.[33–37]

Strengths and Limitations

A major strength of the Five-City Project is the opportunity it offers to conduct cohort analyses on large numbers of men and women for whom multiple sociodemographic, psychosocial, and physiologic measurements are available. In addition, participants in the Project are more likely to represent the community than are clinical or volunteer samples, thus enhancing the study's generalizability. Because of the study's location and the type of intervention, the results are most relevant to California communities with campaigns similar to the Five-City Project.

As noted, only 54.0% of those who participated in the baseline survey (1979/80) also participated in the final cohort survey (1984/85). Although the majority of dropouts were out-migrants rather than refusers, dropouts were significantly different from nondropouts on a number of sociodemographic variables. For example, dropouts were significantly younger (mean age 42.2 vs 46.6 years) and less educated (mean years of education 12.5 vs 13.4) than nondropouts.

Another potential limitation of the study is the possible bias that could arise if those with more motivation to change their cardiovascular disease risk factors were more likely to continue participating in the study. We assessed this potential source of error by comparing respondents who participated in at least the baseline and final cohort surveys with those who dropped out after the baseline survey. We found no significant differences between dropouts and nondropouts on a summary index of nine items assessing confidence in changing dietary habits ($P = .15$) or on a single item assessing intention to quit smoking ($P = .71$, smokers only).

Public Health Implications

This study has three important public health intervention implications. First, this research reinforces the work of others in pointing out the need for campaign designers to segment audiences into more homogeneous and identifiable subgroups to enhance the likelihood that each subgroup will be reached effectively. Second, it points out the need to use sociodemographic, psychosocial, and physiologic variables when segmenting audiences. Third, the distinct makeup of the four population subgroups illustrates that communitywide health education campaigns need to develop specific interventions that target different age, socioeconomic, and cultural subgroups to enhance the likelihood that all will be reached. □

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References

1. Farquhar JW, Fortmann SP, Maccoby N, et al. The Stanford Five-City Project: design and methods. *Am J Epidemiol.* 1985;122:323–334.
2. Farquhar JW, Fortmann SP, Flora JA, et al. Effects of communitywide education on cardiovascular disease risk factors: the Stanford Five-City Project. *JAMA.* 1990; 264:359–365.
3. Fortmann SP, Winkleby MA, Flora JA, Haskell WL, Taylor CB. Effect of long-term community health education on blood pressure and hypertension control: the Stanford Five-City Project. *Am J Epidemiol.* 1990;132:629–646.
4. Fortmann SP, Taylor CB, Flora JA, Jatulis DE. Changes in adult cigarette smoking prevalence after 5 years of community health education: the Stanford Five-City Project. *Am J Epidemiol.* 1993;137:82–96.
5. Blackburn H, Luepker RV, Kline FG, et al. The Minnesota Heart Health Program: a research and demonstration project in cardiovascular disease prevention. In: Matarazzo JD, Miller NE, Weiss SM, eds. *Behavioral Health: A Handbook of Health Enhancement and Disease Prevention.* New York, NY: John Wiley & Sons; 1984:1171–1178.
6. Carleton RA, Lasater TM, Assaf AR, Lefebvre RC, McKinlay SM. The Pawtucket Heart Health Program: an experiment in population-based disease prevention. *R I Med J.* 1987;70:533–538.
7. Kraemer HC. *Evaluating Medical Tests: Objective and Quantitative Guidelines.* Newbury Park, Calif: Sage Publications; 1992.
8. Bandura A. Self-efficacy mechanisms in human agency. *Am Psychol.* 1982;37:122–147.
9. Bandura A. *Social Foundations of Thought and Action.* Englewood Cliffs, NJ: Prentice-Hall; 1986.
10. McGuire W. Attitudes and attitude change. In: Lindzey G, Aronson E, eds. *The Handbook of Social Psychology.* 3rd ed. Hillsdale, NJ: Lawrence Erlbaum; 1985.
11. Lefebvre RC, Flora JA. Social marketing and public health intervention. *Health Educ Q.* 1988;15:299–315.
12. Fishbein M, Ajzen I. *Belief, Attitude, Intention and Behavior.* Menlo Park, Calif: Addison Wesley; 1975.

13. Roser C, Flora JA, Chaffee SH, Farquhar JW. Using research to predict learning from a PR campaign. *Public Relations Rev.* 1990;Summer:61–77.
14. Maibach E, Flora JA, Nass C. Changes in self-efficacy and health behavior in response to a minimal contact community health campaign. *Health Commun.* 1991;3:1–15.
15. Chaffee SH, Roser C. Involvement and the consistency of knowledge, attitudes and behaviors. *Commun Res.* 1986;13:373–399.
16. Jatulis D, Flora JA, Winkleby MA, Fortmann SP. Who remembers heart disease programs? Presented at the 119th Annual Meeting of the American Public Health Association; November 12, 1991; Atlanta, Ga.
17. Fortmann SP, Marcuson R, Bitter PH, Haskell WI. A comparison of the Sphygmetrics SR-2 automatic blood pressure recorder to the mercury sphygmomanometer in population studies. *Am J Epidemiol.* 1981;114:836–844.
18. Fortmann SP, Rogers T, Haskell WL, Solomon DS, Vranizan K, Farquhar JW. Indirect measures of cigarette use: expired air carbon monoxide vs. plasma thiocyanate. *Prev Med.* 1984:13;127–135.
19. Flora JA, Maccoby N, Farquhar JW. Communication campaigns to prevent cardiovascular disease: the Stanford community studies. In: Rice RE, Atkin CK, eds. *Public Communication Campaigns.* Newbury Park, Calif: Sage Publications; 1989: 233–252.
20. Chaffee SH, Roser C, Flora JA, Farquhar JW. A functional interpretation of a health campaign's effects. *Health Commun.* In press.
21. Truett J, Cornfield J, Kannel W. A multivariate analysis of the risk of coronary heart disease in Framingham. *J Chron Dis.* 1967:20;511–524.
22. Winkleby MA, Fortmann SP, Rockhill B. Cigarette smoking trends in adolescents and young adults: the Stanford Five-City Project. *Prev Med.* 1993;22:325–334.
23. *Lipid Research Clinics Manual of Laboratory Operations. Vol 1. Lipid and Lipoprotein Analysis.* Washington, DC: US Dept of Health, Education, and Welfare; 1974.
24. Gibbons RD, Hedeker D, Waternaux C, et al. Some conceptual and statistical issues in analysis of longitudinal psychiatric data. *Arch Gen Psychiatry.* 1993;50:739–750.
25. Mueller CW, Parcel TL. Measures of socioeconomic status: alternatives and recommendations. *Child Dev.* 1981;52:13–30.
26. Liberatos P, Link BG, Kelsey JL. The measurement of social class in epidemiology. *Epidemiol Rev.* 1988;10:87–121.
27. Winkleby MA, Fortmann SP, Barrett DC. Social class disparities in risk factors for disease: eight-year prevalence patterns by level of education. *Prev Med.* 1990;19:1–12.
28. Winkleby MA, Jatulis DE, Frank E, Fortmann SP. Socioeconomic status and health: how education, income, and occupation contribute to cardiovascular disease. *Am J Public Health.* 1992;82:816–820.
29. Slater MD, Flora JA. Health lifestyles: audience segmentation analysis for public health interventions. *Health Educ Q.* 1991; Summer:221–233.
30. Snyder LB, Rouse RA. Target the audience for AIDS messages by actual and perceived risk. *AIDS Educ Prev.* 1992;4: 160–172.
31. Marmot MG, McDowall ME. Mortality decline and widening social inequalities. *Lancet.* 1986;ii:274–276.
32. Winkleby MA, Fortmann SP, Rockhill B. Trends in cardiovascular disease risk factors by educational level: the Stanford Five-City Project. *Prev Med.* 1992;21:592–601.
33. Rogers EM, Shoemaker FF. *Communication of Innovations: A Cross-Cultural Approach.* 2nd ed. New York, NY: MacMillan; 1971.
34. Wallack L, Winkleby MA. Primary prevention: a new look at basic concepts. *Soc Sci Med.* 1987;25:923–930.
35. Bunker JP, Gomby DS. Preface. In: Bunker JP, Gomby DS, Kehrer BH, eds. *Pathways to Health: The Role of Social Factors.* Menlo Park, Calif: Henry J. Kaiser Foundation; 1989:15.
36. Dervin B. Audience as listener and learner, teacher and confidante: the sense-making approach. In: Rice RE, Atkin CK, eds. *Public Communication Campaigns.* Newbury Park, Calif: Sage Publications; 1989: 67–86.
37. Freimuth VS, Mettger W. Is there a hard-to-reach audience? *Public Health Rep.* 1990;105:232–238.