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Farming: Primary Prevention for Hypertension Effects of
Employment Type on Blood Pressure

Farming: Primary Prevention for Hypertension? Effects of Employment Type on Blood Pressure*

Marthe R. Gold and Peter Franks

ABSTRACT: We report findings from the first stage of a community-oriented primary care approach initiated in a financially depressed agricultural area of upstate New York that sought to characterize the causes of relatively increased cardiovascular and cerebrovascular mortality in the region. This report focuses on 633 people aged 16 years and older employed in two adjacent towns. They were surveyed for standard sociodemographic data, information about utilization of and barriers to health care and preventive services, cardiovascular risk factors, and blood pressure measurements. Compared to other workers, those in farming had significantly more low income households, less education, less preventive care, more out-of-pocket expenses, and ate more eggs. After adjustment for other independent variables, farmers had significantly lower mean blood pressure (3.24 mm Hg, 95 percent confidence interval [CI] = 1, 5.5) than the other occupational groups. Age was a significant predictor of mean blood pressure for nonfarmers (.25 mm Hg/yr., CI = 0.18, 0.32), but not for farmers (.09 mm Hg/yr., CI = -0.03, 0.21). These results are congruent with previous studies that have shown decreased cardiovascular morbidity and mortality among farmers. Investigations into the culture of "farm-life" may provide approaches to the primary prevention of hypertension, beyond those suggested by a focus on individual risk factors.

Hypertension is a common chronic illness in industrial countries. In the United States nearly 30 percent of the adult population aged 18 to 74 years have blood pressures over 140/90 or report taking antihypertensive medication (Hypertension Prevalence, 1985). Sequelae of uncontrolled hypertension include coronary artery disease and cerebrovascular disease which together account for 40 percent of all deaths in this country. The precipitous decline in stroke deaths over the past 30 years (over 200%, [National Center for Health Statistics, 1983]) is widely attributed to the improved control of hypertension. Deaths from coronary artery disease have decreased by more than 60 percent over the same time frame. Recent studies (Pell & Fayerweather, 1985; Friedman, 1979) have noted a decrease in the incidence of myocardial infarctions, and Pell and Fayerweather (1985) suggest that a major contributor to that decline has been a diminution in uncontrolled hypertension. However, the mortality attributable to hypertension remains high, and other approaches, particularly prevention, need to be explored.

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The strategies for primary prevention of this chronic illness will necessarily differ according to its etiologies. Although hypertension has been linked with socioenvironmental factors, such as poverty (Harris, 1973; Roberts, 1974) low education (Hypertension Detection and Follow-up Cooperative Group, 1977), lack of access to medical care (Lurie, Ward, Shapiro & Brook, 1984), stressful work (Cobb & Rose, 1973; Karasek, Baker, Marxer & Theorell, 1981), acculturation to western society (Joseph, Prior, Salmund & Stanley, 1983; Scotch, 1963; Sever, Peart, Gordon, & Beighton, 1980; Stamler, Berkson, Lindberg, Miller, Stamler & Collette, 1967), as well as with traditional physiologic causes, no consensus has been achieved as to the primary determinants of this illness.

We report here on our findings of correlates of elevated blood pressure in a rural, white, working population where 20 percent of workers are farm owners or farm hands. Farmers are of special interest in the context of primary prevention because of their relatively low rates of cardiovascular mortality compared with other groups (Breslow & Buell, 1960; Cassel et al., 1971; Dobson, Gibbered, Leeder & O'Connell, 1985; Pomrehn, Wallace & Burmeister, 1982). Previous work has been equivocal, however, as to whether cardiovascular protection is mediated through lower blood pressure in farmers (Cassel, 1971; Pomrehn, 1982). Findings of lower blood pressure in distinct population groups would be useful in further developing models of the primary prevention of hypertension.

Methods

Delaware County, located in central New York, has a population density of 32.5 persons per square mile and a total population of 44,000 people. More than 20 percent of the residents lived at less than 125 percent of the poverty level, and 40 percent at below 200 percent at the time of the 1980 census. Review of health care indicators obtained from the New York State Health Department showed an elevated age adjusted death rate for stroke and cardiac deaths in Delaware County compared to state and national levels. Thus, a program was begun in 1984 that would characterize and assess the health status of the residents of two contiguous, demographically similar towns in the county, with particular emphasis on cardiovascular disease.

The towns of Meredith and Kortright were surveyed using house-to-house screening of all residents over the age of 16 years. The survey and screening of the two towns took place over an 18-month period, from the summer of 1984 through the winter of 1986, and was designed so that the entire interview and screening could be completed within one half of an hour. Community health workers (medical students and nurses) were trained in questionnaire administration, blood pressure measurement (two readings, five minutes apart, right arm, seated), and blood glucose monitoring (using Chemstrip bG). A pilot survey and screening was conducted in

an adjacent town to familiarize them and to provide field supervision.

Only houses occupied through the survey were included. Households where no one was living were excluded. Households explained the program and gave a written consent. Households were visited up to a maximum of three times for measurement of blood pressure and collection of demographic information (e.g., age, sex, education, occupation, employment status, household size, health care utilization (including hospitalizations, physician visits, health care, and the source of usual care), insurance (type of coinsurance, Medicaid or Medicare, and the source of usual care (e.g., time, transportation, and cost of care, and affordability). Questions about education, occupation, and knowledge of cardiovascular disease were also included, and knowledge of cardiovascular disease was measured.

For the purpose of this report, participants were categorized into one of four occupational categories: farmer/manager/professionals, and all other occupations. The relationship between job category and other variables was examined using chi-square tests. Mean blood pressure (diastolic pressure, systolic and diastolic) and other variables were examined in regression analyses.

Because the purpose of this paper was to examine the relationship between farming and blood pressure, and because there were no significant differences between the blood pressure of farmers and nonfarmers ($t = 1.2, p = 0.22$), the variable of farming was entered into the regression analyses into farming variables.

Results

A total of 541 households were surveyed. Of these, 86 percent of the occupied households were included in the study. Of these 633 were currently employed. Of these, 76 were farmers (76 farm owners, 55 farm hands), 55 were professionals/managers and 402 were in other occupational categories.

The relationship between occupational category and cardiovascular risk factors is shown in Table 1. Farm owners and farm hands were high school graduates (80 percent) compared to the two other groups (70 percent). Farm owners and farm hands lived in lower income households (year) compared to the two other groups (year). Farm owners and farm hands paid out of pocket

of this chronic illness will necessitate. Although hypertension has been associated with poverty (Harris, 1973; Hypertension Detection and Follow-up Program, 1976; Lurie, Ward, Cobb & Rose, 1973; Karasek, Baker, & Johnson, 1975), there is no consensus as to why. In contrast to western society (Joseph, Prior, & Sever, 1976; Peart, Gordon, & Beighton, 1977; Stamler & Collette, 1967), as well as in other cultures, no consensus has been achieved as to why.

There is a positive correlation between elevated blood pressure and poverty. In a study where 20 percent of workers are farm hands, there is special interest in the context of the study because of the relatively low rates of cardiovascular disease (Breslow & Buell, 1960; Cassel et al., 1976; Connell, 1985; Pomrehn, Wallace & Johnson, 1975). It has been equivocal, however, as to whether the relationship is mediated through lower blood pressure (Johnson, 1982). Findings of lower blood pressure would be useful in further development of hypertension.

In New York, there is a population density of 44,000 people per square mile, less than 125 percent of the poverty rate at the time of the 1980 census. The study was funded from the New York State Health Department and adjusted death rate for stroke and heart disease compared to state and national levels. The study was designed to characterize and assess the health status of a contiguous, demographically similar population with an emphasis on cardiovascular disease. The study was designed to survey the population aged 16 years and over using house-to-house visits. The survey and screening were over an 18-month period, from the fall of 1986, and was designed so that the study would be completed within one half of an academic year. Medical students and nurses were trained in blood pressure measurement (two readings, seated), and blood glucose monitoring. The survey and screening was conducted in

an adjacent town to familiarize the workers with the technique and to provide field supervision.

Only houses occupied throughout the year were included in the survey. Households where no one was home on a first visit were left leaflets that explained the program and gave an approximate time for a follow-up visit. Households were visited up to a maximum of three times. In addition to the measurement of blood pressure and blood glucose, the survey included demographic information (e.g., age, sex, marital status, family size, occupation, employment status, household income, and education), health care utilization (including hospitalization, the use of preventive and other health care, and the source of usual care), insurance (including availability of coinsurance, Medicaid or Medicare), and perceived barriers to health care (e.g., time, transportation, availability of health care provider, and affordability). Questions about egg consumption and smoking habits were included, and knowledge of cardiovascular risk factors was assessed.

For the purpose of this report, persons employed outside the home were categorized into one of four occupational groups: farm owners, farm hands, manager/professionals, and all other employed persons. The relationship between job category and other traditional risk factors for elevated blood pressure was examined using chi-square tests. The relationship between mean blood pressure (diastolic plus one third of the difference between systolic and diastolic) and other risk factors were examined in a series of regression analyses.

Because the purpose of this paper is to focus on the association between farming and blood pressure, and because there were no statistically significant differences between the blood pressure of farm owners and farm hands ($t = 1.2$, $p = 0.22$), the variable of job category was dichotomized for the regression analyses into farming versus other occupations.

Results

A total of 541 households were screened and surveyed. This represented 86 percent of the occupied houses in the two towns. Of 1,134 persons identified as being 16 years of age and older, 1,066 (94%) were screened. Of these 633 were currently employed outside their home, of whom 131 (21%) were farmers (76 farm owners, 55 farm hands). One hundred and forty-five were professionals/managers and 357 were employed in other occupational categories.

The relationship between occupation and traditional or significant cardiovascular risk factors is shown in Table 1. Fewer farm owners and farm hands were high school graduates than in the other groups. More farm owners and farm hands lived in low income households (less than \$10,000/year) compared to the two other groups. Higher numbers of farm owners and farm hands paid out of pocket for their outpatient care, and preventive

Table 1. Percent of Those with Risk Factor Present By Occupation.

Risk Factor (High Risk)	Farm Owner	Farm Hand	Manager/ Professional	Other	p*
N	76	55	145	357	
Sex (Male)	86	87	50	54	.0001
Education (<12 yrs.)	16	36	5	19	.0001
Income (<\$10,000)	52	59	9	24	.0001
Insurance (None)	76	68	48	60	.0001
Smoker	17	26	32	43	.01
Eggs/Week (>2/wk.)	78	72	56	54	.05
Preventive Care (None)	63	80	57	57	.05
Barriers to Care (>2)	38	47	31	35	.1

* p = p value for a chi-square test, df = 3.

Table 2. Multiple Regression Analysis: Incremental Effect of Significant (p < 0.05) Risk Factors on Mean Blood Pressure (N = 633).

Risk Factor (High Risk)	Parameter Estimate* (mm Hg)	95% Confidence Interval	p
Sex (Male)	6.6	4.7, 8.5	.0001
Age (Each Decade)	2.2	1.6, 2.8	.0001
Work (Nonfarmer)	3.2	1.0, 5.5	.005

*Parameter Estimate indicates the effect of each risk factor on blood pressure after adjusting for the other risk factors

Table 3. Analysis of Variance of Blood Pressure and Occupation (N = 633).

Variable	Parameter Estimate* (mm Hg)
Sex (Male)	7.08
Age (per year)	0.26
Farming	4.30
Interaction of Age and Farming	-0.16

*Parameter Estimate indicates the effect of each risk factor on blood pressure after adjusting for the other risk factors. The negative sign indicates the effect of "farming" on age.

care was used at a lower rate among farmers than in non-farmers. Fewer farmers than non-farmers smoked, and manager/professionals smoked more than farmers overall, fewer farmers (farm owners) than non-farmers.

Table 2 presents the results of a multiple regression analysis of mean blood pressure. Increasing age, sex (male), and occupation (farmer) were predictors of higher blood pressure. Being a farmer had a significantly lower blood pressure. Occupation (farmer), geographic, use of preventive care, and smoking made any significant difference in mean blood pressure. The three risk factors accounted for 19 percent of the variance.

The difference in the effect of occupation on blood pressure and other occupations was confirmed in a multiple regression analysis of workers not involved in farming. Blood pressure (parameter estimate = 6.6 mm Hg, confidence interval [CI] = 0.18, 0.32). Age was not a significant predictor (parameter estimate = 0.09 mm Hg/yr., CI = 0.09, 0.09). Analysis of variance that confirmed the effect of occupation (farming or not) and age. Being a farmer no longer provided a protective effect (parameter estimate = -1.46 mm Hg, CI = -1.46, 10.06). Thus, farm

Factor Present By Occupation.

Manager/ Professional	Other	p*
145	357	
50	54	.0001
5	19	.0001
9	24	.0001
48	60	.0001
32	43	.01
56	54	.05
57	57	.05
31	35	.1

Incremental Effect of Risk Factors on Mean Blood Pressure

95% Confidence Interval	p
4.7, 8.5	.0001
1.6, 2.8	.0001
1.0, 5.5	.005

Risk factor on blood pressure after

Table 3. Analysis of Variance of the Dependent Variable Mean Blood Pressure and the Independent Variables—Age, Sex and Occupation (N = 633).

Variable	Parameter Estimate* (mm Hg)	Standard Error	F	P
Sex (Male)	7.08	0.84	70.7	.0001
Age (per year)	0.26	0.03	59.0	.0001
Farming	4.30	2.94	2.1	.54
Interaction of Age and Farming	-0.16	0.07	5.9	.0174

*Parameter Estimate indicates the effect of each risk factor on blood pressure after adjusting for the other risk factors. The negative sign of the interaction factor indicates the mitigating effect of "farming" on age.

care was used at a lower rate than in the other occupational groups. Consumption of two or more eggs per week was found more commonly in farmers than in non-farmers. Fewer farm owners smoked than farm hands, and manager/professionals smoked less than other employed persons, but overall, fewer farmers (farm owners and farm hands) were smokers.

Table 2 presents the results of the regression analysis of risk factors on mean blood pressure. Increasing age and male sex were highly significant predictors of higher blood pressure. Conversely, those involved in farming had a significantly lower blood pressure. No other risk factors (i.e., demographic, use of preventive care, insurance, barriers, egg consumption, or smoking) made any significant (p < 0.05) contribution to the prediction of mean blood pressure. The three variables—sex, age and job category—accounted for 19 percent of the observed variance of mean blood pressure.

The difference in the effect of age on blood pressure between farming and other occupations was confirmed in further regression analyses. For the workers not involved in farming, age was a significant predictor of mean blood pressure (parameter estimate = 0.25 mm Hg/yr., 95 percent confidence Interval [CI] = 0.18, 0.32). In contrast, for those working in farming, age was not a significant predictor of mean blood pressure (parameter estimate = 0.09 mm Hg/yr., CI = -0.03, 0.21). Table 3 shows the results of an analysis of variance that confirmed a significant interaction between occupation (farming or not) and age. After adjusting for the interaction, being a farmer no longer provided a protective effect (parameter estimate = 4.3 mm Hg, CI = -1.46, 10.06). Thus, farming per se does not reduce blood pressure.

Rather, these results suggest that farming mitigates the effects of aging on blood pressure.

Analyses that excluded those with a prior diagnosis of hypertension revealed essentially the same results and are not reported here.

Discussion

The occupation of farming, in this study, was associated with lower blood pressure in spite of the fact that farmers more frequently fell into traditional high risk groups for hypertension than did nonfarmers. The 2.4 mm Hg per decade difference in blood pressure observed between farmers and other employed persons translates into differences of at least 5 percent in the probability of dying in the next year (Shurtleff, 1974).

Many studies have shown the increased prevalence of hypertension among poor people, those with low educational achievement, and in persons with decreased access to care. The farmers that we studied had lower socioeconomic status than the nonfarmers, increased rates of out-of-pocket expenditures for outpatient care and, predictably, fewer group members who used preventive services. Increased dietary cholesterol (as inferred from a higher quantity of egg consumption), a possible risk factor for hypertension, was more prevalent in the farming population. The sole gauntlet that farmers wore was their lesser predilection for cigarettes. And while cigarettes carry a known association with blood pressure elevation, in our study they did not increase risk.

Because this study was cross-sectional it is possible that the results simply represent the effect of selective survival of farmers with lower blood pressure. However, it is unclear why such selective survival advantage would be present only among persons employed in farming. Reports by other investigators of an overall decreased incidence of coronary artery disease among farmers (Breslow & Buell, 1960; Cassel et al., 1971; Dobson, Gibberd, Leeder & O'Connell, 1985; Pomrehn, Wallace & Burmeister, 1982; Zukel et al., 1959) would certainly be better understood in the context of lower blood pressures in farming populations. Other explanations for lower cardiovascular mortality among farmers such as diet, exercise, and smoking also bear examination.

Physical activity is known to provide protection against cardiovascular disease. While historically farmers have had more physically demanding days than other types of workers, the increasing mechanization of farming has diminished the physical nature of farm work. In this study population, other physical laborers were not found to enjoy the same lowering of blood pressure seen in farmers. The study by Breslow and Buell (1960) of California workers found that farming conferred a stronger protection than other comparably physically demanding jobs.

Farmers were less likely to be smokers in studies by Pomrehn (1982) and

Cassel (1971). However, Cassel (1971) found no difference in coronary artery disease whether or not farmers had a higher consumption of cholesterol. In the present study, serum cholesterol levels, which were similar to non-farmers. Cassel (1971) found a difference in cholesterol levels a

In these two studies, (Pomrehn 1982 and Cassel 1971) measured and no statistically significant difference between nonfarmers was found, although lower blood pressures in farmers were found. When other confounding variables were controlled for, the reduction of lower blood pressures in farmers was maintained. This is adjusting for other variables in the model. This is a primary risk factor for coronary artery disease. The lower blood pressures among farmers are a component of the diminution of risk.

It is tempting to invoke the reduced risk for hypertension and coronary artery disease, level of cholesterol, and smoking as a model that such a model incompletely explains the mortality associated with stress to hypertension (Kasl, 1982). The present study has an increased prevalence of hypertension. The present study suggested possible occupational stressors over work site, the repetitive nature of the work, and working under close supervision in the occupation of farming.

The relative stability of blood pressure among the farmers described here is representative of nonindustrialized cultures, with advancing age in developed countries (Kasl & Roberts, 1963; Prior, Stanhope & Sallis, 1982). The present study suggested that a "coherent value system" is maintained during the lifetime of the farmer, which is responsible for buffering the farmer from the stressors and arousals. It is possible that farmers are buffered from the stresses of industrial society.

Our study was conducted over a period of time when there were being felt by the farmers a sense of loss. The present study percent of the farms in Delaware were being lost. The present study farming on blood pressure seen in farmers. The present study backdrop. Further work is currently being done to evaluate the relationship of farmers and to further delineate physiological responses to stressors (i.e., salt and alcohol utilization).

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Cassel (1971). However, Cassel (1971) found that farmers had lower rates of coronary artery disease whether or not they smoked. Pomrehn (1982) noted higher consumption of cholesterol among farmers and significantly higher serum cholesterol levels, which when adjusted for age and exercise levels were similar to non-farmers. Cassel (1971) found no statistically significant difference in cholesterol levels among study subjects.

In these two studies, (Pomrehn, 1982; Cassel, 1971) blood pressure was measured and no statistically significant difference between farmers and nonfarmers was found, although Cassel's (1971) work revealed consistently lower blood pressures in farmers of all ages. No multivariate adjustment for other confounding variables was carried out in these studies. Our observation of lower blood pressures in farmers emerged as significant only after adjusting for other variables in the regression analyses. Since hypertension is a primary risk factor for coronary artery disease it seems credible that the lower blood pressures among farming population may represent a large component of the diminution of cardiovascular deaths seen in these groups.

It is tempting to invoke the readily quantifiable and individually focused risks for hypertension and coronary artery disease such as number of cigarettes, level of cholesterol, and amount of activity. However, it may be that such a model incompletely explains the lower cardiovascular morbidity and mortality associated with farming. Much literature exists that links stress to hypertension (Kasl, 1981). Certain occupations have been noted to have an increased prevalence of hypertension. Kern and Schnall (1986) have suggested possible occupational stressors including lack of worker control over work site, the repetitive nature of certain tasks, time pressured work, and working under close supervision. Many of these may be less common in the occupation of farming.

The relative stability of blood pressure levels across age groups noted in the farmers described here is reminiscent of the patterns seen in members of nonindustrialized cultures, where the sharp rise in blood pressure seen with advancing age in developed countries is absent (Cassel, 1975; Fulmer & Roberts, 1963; Prior, Stanhope, Evans & Salmond, 1974). Cassel (1975) suggested that a "coherent value system which remains relatively unchallenged during the lifetime of the oldest inhabitants" (p. 205) may be responsible for buffering the autonomic nervous system from repeated arousals. It is possible that farm life provides a similar insulation from some of the stresses of industrial society.

Our study was conducted over a time when significant economic stresses were being felt by the farmers in these towns. Between 1984 and 1986, 20 percent of the farms in Delaware County closed. The protective effect of farming on blood pressure seems more surprising set against such a backdrop. Further work is currently underway to more precisely characterize the relationship of farmers to their work and social networks, and to further delineate physiological risk factors present in the study population (i.e., salt and alcohol utilization, obesity, cholesterol levels, and physical

activity).

It will be useful to more carefully define the relation of farmers to their work and socialization in comparison to other community residents. If the nature of the work is in some way less stressful, further definition of the qualities responsible may provide important insights into structuring the work environments in order to minimize the risk of cardiovascular disease. If the structure of the farm family provides a type of protective social structure that moderates autonomic system responses with the attendant mitigation of hypertension, the protective role of social supports deserves further study.

While the screening and treatment of elevated blood pressure represent important tools of secondary preventive strategies, more work needs to be done on the primary prevention of hypertension. Characterization of groups of persons with lower levels of blood pressure for socio-occupational traits may yield valuable information towards this end.

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