

Geographic Variation in Exercise Testing by Family Physicians

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Background. The purposes of this study were to determine the extent to which exercise stress testing is performed by family physicians; whether rural physicians are more likely to utilize exercise stress testing than their urban counterparts; and what factors influence their decisions.

Methods. A random sample of 211 practicing members of the Nebraska Academy of Family Physicians was surveyed. Responses were received from 163 (77%). To ensure independence, if two or more subjects were members of the same group practice, one was randomly assigned to the study, for a total of 125 respondents available for analysis. Questionnaire items included performance of exercise stress tests, population base, and distance to the nearest specialist who performed the test. Respondents were classified as urban, rural, or frontier, based on population per square mile in their county.

Results. Seventy-three of the 125 respondents (58%) reported that they perform exercise stress testing. Phy-

sicians in rural or frontier counties were twice as likely to perform the test as urban physicians ($P < .001$). Similar results were found for distance to the closest specialist who performs exercise stress tests ($P < .001$) and reported population base ($P < .01$). Of those performing the procedure, 42 (58%) indicated they had learned it during residency, whereas 15 (21%) were self-taught or had learned from a colleague.

Conclusions. Family physicians in rural Nebraska are significantly more likely to perform exercise stress testing than those in urban areas and much more likely to do stress testing than previous national studies indicate. National guidelines should acknowledge the need for family physicians to perform exercise tests and promote training in this procedure.

Key words. Exercise test; family practice; rural health; coronary disease; risk factors.

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Heart disease is currently the leading cause of death in the United States. In 1985, nearly 5 million people living in the United States had symptomatic coronary artery disease.¹ Recognition of risk factors and early intervention are necessary to affect overall morbidity and mortality. Documentation of ischemia-induced electrocardiographic ST segment changes, which form the basis of exercise stress testing, dates to the beginning of this century, when Einthoven produced an electrocardiogram

that revealed postexercise ST depressions.¹ Since Feil and Siegel performed what is generally considered the earliest exercise stress test in 1928 by reproducing ST-T wave changes consistent with ischemia,¹ the exercise stress test has become an essential procedure for diagnosing coronary artery disease.

Family physicians, who manage 26% of all patients with known coronary artery disease,^{2,3} are a logical group to counsel patients about coronary risk factors and to diagnose coronary artery disease using the standard exercise stress test. There is considerable debate, however, regarding whether family physicians should do exercise stress testing themselves or refer patients to specialists for the procedure.

According to the American Academy of Family Phy-

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sicians (AAFP), only 7% of family physicians surveyed in July 1988 performed exercise tests in their offices.⁴ A 1989 study by Hartz and colleagues⁵ suggests that some family physicians may not be using the exercise stress test according to established indications^{6,7} in patients with classic angina pectoris.

Mead and Hindman³ present opposing views on whether family physicians should be performing the test. Eberly⁸ and Harmon⁹ have documented their experience as family physicians in performing treadmill testing and concluded it is a procedure family physicians can perform. Zoller¹⁰ and Mead¹¹ have demonstrated that physicians who are properly trained in the procedure can safely and effectively perform the test and interpret the results.

Training of family physicians is a central issue in the debate. Studies by Jurica¹² and Zoller¹⁰ indicate that 30.6% to 42% of graduates from residency programs that offered training in stress testing continue to perform the procedure in practice. There are also differing opinions among program directors of family medicine and internal medicine training programs. While 92% of family practice program directors surveyed believed family physicians should be taught this skill, only 24% of directors of internal medicine programs agreed.¹² A study by Neighbor and colleagues¹³ concluded that "there is continued need for enhancing coronary risk factor assessment and counseling by resident physicians."

This debate assumes that family physicians uniformly need to perform the procedure, overlooking the possible impact of geography and lack of access to specialists. Many patients with coronary artery disease live in rural areas underserved by specialists. In these regions, family physicians must play a role in diagnosing and managing this disease. Our study sought to determine the extent to which Nebraska family physicians are performing exercise testing without referring patients to specialists, whether rural family physicians are more likely to perform the procedure than those in urban areas, and what factors influence that decision.

Methods

Study Design

A cross-sectional study design was used. Questionnaires on utilization of exercise stress testing were mailed to a random sample of private practice family physicians working in Nebraska and belonging to the Nebraska Academy of Family Practice (NAFP). The study includes a full range of practice situations from solo to large group practices and from urban settings to extremely rural

"frontier" sites. Although Nebraska is unique in many ways, the results should be relevant to other states with similar disparate practice situations. According to figures provided by the NAFP and State of Nebraska Department of Health, 69% of all family physicians in the state belong to the Nebraska Academy of Family Practice, making academy membership a suitable sampling frame.

A six-page questionnaire was developed and piloted on faculty members and third-year residents in the Department of Family Practice to evaluate clarity, question construction, format, and content. The final questionnaire was revised based on feedback from these individuals.

Sample

The questionnaire was mailed to a 50% random sample (N = 244) of the Nebraska Academy of Family Practice members working in the state in November 1990. A reminder postcard was sent 2 weeks later, and at 4 weeks a second questionnaire was sent to nonrespondents. Finally, nonrespondents were contacted by telephone to determine whether they were in private practice and thus eligible to participate in the study.

Of the 244 physicians in the sample, 204 were in private practice. Researchers were unable to contact 7 nonrespondents. Others were retired or in emergency department work. The number of eligible private practice physicians, therefore, was a maximum of 211. Usable questionnaires were received from 163 (77.3%) of those. To ensure independence, if two or more subjects were members of the same group practice, one was randomly assigned to the study, for a total of 125 respondents available for analysis.

Measures

The use of exercise stress testing was the primary dependent variable. Physician responses to whether they performed exercise stress testing were coded as a dichotomous yes/no variable. They also were asked if they ever referred patients for the procedure.

Independent variables were related to geography, availability of specialists, and training. Physician office addresses were used to determine counties, which are classified by the State of Nebraska as urban, rural, or frontier based on population per square mile using 1990 census data. All subjects were asked to estimate the population of the area from which their patients were drawn (choosing one of six categories ranging from 0-5000 to over 100,000) and the distance in miles to the nearest specialist who performed exercise stress testing.

They were asked their age, number of years in practice, number of years' postdoctoral training received, whether they had completed a certified 3-year family practice residency, whether they were currently certified in Advanced Cardiac Life Support (ACLS), and whether they would be interested in taking a course in exercise testing.

Those who routinely performed exercise stress tests were asked how many they had done in the past year and whether they performed the test in the office, hospital, or elsewhere. They were asked to rate on a 4-point Likert scale the importance of several reasons for choosing to perform exercise stress tests themselves, rather than referring patients to a specialist. These included need for the service, interest in the subject matter, patient convenience, and income generated. They were asked to indicate how they learned to do the procedure by circling applicable sources from a list including residency, continuing education course, self-instruction, and colleagues.

Those who reported not doing the test were asked to rate on a 4-point Likert scale the importance of several reasons for not performing it. The reasons listed included lack of interest in the procedure, training, or time, unavailability or prohibitive cost of equipment, lack of hospital privileges, and inadequate reimbursement. Respondents were invited to write in and rate other reasons.

Data Analysis

Since there were very few physicians in frontier counties, frontier and rural counties were combined for analysis purposes. Bivariate analyses were done using cross-tabulation and simple logistic regression. Multiple logistic regression was used to examine the effect of the rural/urban differential when statistically adjusted for physician training or years in practice and to examine possible interactions. Three independent variables were found to be highly correlated: the number of years the physician had been in practice, whether the physician had residency training, and physician age (minimum Pearson $r = .82$, maximum $P < .001$). To avoid ambiguity and computational problems, no more than one of these variables was included in any one logistic regression model.

Odds ratios calculated from logistic regression models are based on a particular difference in the independent variable (just as the change in Y depends on the change in X in conventional regression). If the independent variable is dichotomous, that difference is simply "yes" vs "no," but when the independent variable is continuous, the difference must be specified. Table 1 specifies differences used in this study for population, miles to the nearest specialist, age, and years in practice.

Results

The original sample of 204 private practice physicians included 6.9% frontier, 57.4% rural, and 35.8% urban physicians. The final sample of 125 available and eligible respondents included 10 (8%) from frontier, 77 (61.6%) from rural, and 38 (30.4%) from urban counties. The chi-square goodness-of-fit test indicates that these proportions are not significantly different ($\chi^2 = 1.62$, 2 *df*, $P = .50$). Similarly, the original 163 private practice respondents did not differ significantly from the final 125 eligible respondents in age ($P = .598$), years in practice ($P = .746$), residency training ($P = .716$), or in the percentage who reported performing exercise tests ($P = .910$).

The results that follow apply only to the final sample of 125 eligible respondents. The mean age of eligible respondents was 44 years ($SD = 11$), with a mean of 14 ($SD = 12$) years in practice. A third-year family practice residency had been completed by 73 (58.4%) respondents, and 75 (62.5%) were currently ACLS certified.

The importance attributed to the test is reflected by the responses of 73 (58.4%) of the 125 eligible respondents, who reported that they performed exercise treadmill tests. Of those who did not perform the test themselves, all but one (who had just started practicing) reported that they referred patients to specialists for exercise tests.

The odds that rural physicians would perform exercise tests themselves were more than four times that for urban physicians (odds ratio [OR] = 4.27, $P < .001$, Table 1). Analysis of the other isolation factors confirm this result: the more distant the nearest specialist and the smaller the population base, the more likely the family physician was to perform treadmill testing (Table 1). Ninety percent of the 29 respondents with specialists more than 55 miles away performed the test themselves, compared with only 35% of the 28 respondents with a specialist less than 1 mile away. Similarly, 74% of the 61 physicians in areas with a population under 15,000 performed exercise stress tests, compared with 37% of the physicians in areas with a population over 50,000.

The effects of isolation and training factors on the decision to perform exercise tests was examined by means of multiple logistic regression, which statistically adjusts for other independent variables. All three geographic variables were significant after adjusting for physician age, years in practice, and completion of a third-year family practice residency (maximum $P = .008$). Distance to the nearest specialist was significant after adjusting for reported population ($P < .001$). The greater the population and the nearer the specialist, the less likely physicians were to perform the tests themselves.

Table 1. Simple Logistic Regression Results of Key Independent Variables on Use of Exercise Stress Tests by Family Physicians

Variables	Do Perform Tests (n = 73)	Do Not Perform Tests (n = 52)	Odds Ratio	95% CI	Likelihood Ratio χ^2	P Value
Location						
Rural or frontier	60	27	4.27	1.9-9.6	13.1	.003
Urban	13	25				
Distance to specialist (miles)	46.3*	14.6*	6.08†	2.6-14.3	26.1	<.001
Population (1000s)	40.1*	89.5*	.674‡	.53-86	11.3	<.001
Age (years)	41.9*	45.9*	.654§	.46-.94	16.5	<.001
Years in practice	12.6*	16.9*	.742§	.55-1.0	3.81	.051
Third-year Family Practice residency						
Completed	47	26	1.74	.84-3.6	2.23	.136
Not completed	26	25				

*Mean.

†Odds ratio for a 50-mile difference in distance to nearest specialist.

‡Odds ratio for a population difference of 50,000 persons.

§Odds ratio for a 10-year difference in age or time in practice.

CI denotes confidence interval.

Physician years in practice was a significant factor in the decision to perform exercise tests after adjusting for any of the three isolation factors (odds ratio for 10 years in practice ranged from .63 to .66, maximum $P = .007$). Physicians in practice 20 years or more were less likely to perform the tests in either urban or rural areas. Completion of a third-year residency, not significant in bivariate analysis, became significant after adjusting for the county's status (OR = 2.363, 95% confidence interval = 1.6 to 3.7, $P = .04$). Among urban physicians, one third do exercise testing regardless of their residency training, whereas among rural physicians, 56% of those without a third-year residency perform the test, compared with 81% of those who are residency trained (Pearson $\chi^2 = 6.04$, 1 *df*, $P = .014$, $n = 86$).

Of the 73 who reported performing exercise tests, 62 (84.9%) reported that they performed the procedures only in the hospital. Forty-one (56%) indicated that they had learned the procedure during residency, and of those who had not, 15 had learned the procedure in continuing medical education courses. Fifteen (20%) of those who perform exercise tests had no formal training, but rather had learned by "self-instruction" or had been "taught by a colleague in practice." Two did not indicate where they had received training. Sixty-four percent indicated that

they would be interested in taking a course in exercise testing. Of these physicians, 73% held current ACLS certification. According to their estimates, the average number of exercise stress tests done by these physicians in the past year was 21.2 (SD=17.1).

Of the 52 physicians who indicated they did not perform exercise stress tests, lack of training was the most important reason given for not doing them (Table 2). Other reasons receiving high-importance scores were the cost of the treadmill unit and insufficient time in practice to do the procedures. The most common other reason written in by physicians was that they had easy access to a partner or specialist who performs the test. Forty-seven percent of these physicians held current ACLS certification, and 54% indicated they would be interested in taking a course in exercise stress testing.

Discussion

This study indicates that there may be large regional differences in the performance of exercise stress testing among private practice family physicians. Over one half of the Nebraska family physicians who responded to the questionnaire routinely performed exercise stress testing.

Table 2. Reasons Cited by Physicians (n = 52) for Not Performing Exercise Stress Tests, by Order of Importance (1 = not important to 4 = very important)

Reason	Mean	Standard Deviation	No. of Respondents
Never had training	3.19	1.08	42
No time in the practice to perform the procedure	2.53	1.07	39
Cannot afford to purchase a unit	2.36	1.21	41
No access to treadmill unit	2.15	1.21	40
Lack of hospital privileges	1.97	1.15	39
No interest in the procedure	1.85	0.89	40
Inadequate reimbursement by 3rd-party payer	1.76	0.80	39

This is much higher than the figures reported by Jurica¹², Zoller¹⁰ and the 1988 AAFP study.⁴ Another possible explanation for the difference in this study is that our participants were asked only whether they did exercise stress testing, rather than whether they performed the tests *in the office*, as the AAFP study asked. The majority of our respondents performed the tests in the hospital.

Practice location (county status) is strongly associated with the decision to do exercise stress tests. Physicians in counties defined by the State of Nebraska as rural or frontier are twice as likely to do the test as are their urban counterparts, even with adjustments for physician age and training. Distance to the nearest specialist who performs exercise stress testing and the population of the area from which the practice draws patients are different measures of the isolation factor, and their results parallel those for county status. In many cases, small communities cannot financially support specialists, and without local specialist consultation, physicians must choose between performing the procedures themselves or referring their patients.

The 1988 American Academy of Family Physicians survey⁴ found that residency training was not a statistically significant factor in the decision to perform exercise stress testing. In the present study, those among rural physicians who had completed a third-year residency were more likely to perform the test themselves. Physicians who had been in practice longer were less likely to be performing the test, even after statistically adjusting for isolation factors. Years in practice may correlate with training in two ways: (1) family practice residencies did not exist until less than 20 years before this survey was taken, and (2) physicians who have been out of training longer may be less likely to consider themselves competent to perform the exercise stress tests (if they have not been doing the procedure). The number of tests performed by these physicians per year averaged 21.2, slightly under the 25 recommended by the American College of Physicians, American College of Cardiology, and American Heart Association (ACP/ACC/AHA) Task Force on Clinical Privileges in Cardiology⁶ to maintain clinical competence.

This study has some limitations and leaves certain questions unanswered. A number of physicians (23%) chose not to participate in the survey or did not return the questionnaire. Even if we assume that none of the nonrespondents are doing the procedure, the rate of private practice physicians in our sample who have been performing exercise tests themselves seems unusually high (47% of 204 Nebraska physicians; 58% in rural counties). These rates are much higher than previous studies have indicated.

Details of training experiences were not explored,

and method and interpretation of treadmill results were not examined. Board certification, as a variable, was not examined. This study does not answer the question of whether all family physicians who perform exercise stress testing are competent to do so, although it calls competence into question by indicating that 20% of those performing the test had no formal training. The practice patterns of family physicians in Nebraska, a heavily rural state, may apply to other rural states but cannot be generalized nationally.

The majority of respondents indicated interest in a course in exercise testing, and physicians who did not perform exercise tests themselves cited lack of training as the most important reason. Residency programs are the primary source of training for physicians who perform exercise stress tests, but a large percentage of respondents in this study learned the procedure on the job or in continuing education courses.

If family physicians are going to perform exercise stress testing, they must be knowledgeable about indications, methods, and interpretation of results. They also must demonstrate acceptably low complication rates, which can be accomplished through adequate training during and after residency.

Residency programs can do a number of things to ensure adequate training. The first is to offer, by qualified physicians, adequate training that meets ACP/ACC/AHA Task Force guidelines⁶. One option is to identify residents with a preference for small or isolated communities such as those in our study, in which the majority of physicians are performing exercise stress testing. These residents should be offered a curriculum that meets those specific needs. Alternatively, a family practice department could develop and emphasize a program for the prevention and early detection of cardiovascular diseases.¹³ A strong departmental emphasis would develop resident competence as well as encourage residents to continue these activities in practice. To address the needs of practicing physicians, departments of family medicine, in conjunction with departments of cardiology, could develop training and review courses for continuing education.

Conclusions

Whether family physicians should be doing exercise stress testing is academic. Family physicians will continue to perform the test because demographics and public and physician awareness and expectations will require it.² We need to recognize this reality and focus our efforts toward providing competent and well-trained physicians to serve the needs of the public.

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