US Medical Schools and the Rural Family Physician Gender Gap

Kathleen E. Ellsbury, MD, MSPH; Mark P. Doescher, MD, MSPH; L. Gary Hart, PhD

Background: Women comprise increasing proportions of medical school graduates. They tend to choose primary care but are less likely than men to choose rural practice. Methods: This study used American Medical Association masterfile data on 1988–1996 medical school graduates to identify the US medical schools most successful at producing rural family physicians and general practitioners of both genders. Results: The number of listed rural female family physician or general practitioner graduates among schools ranged from 0–27 (0% to 4.4% of each school's 1988–1996 graduates). There were approximately twice as many male as female rural family physicians and general practitioners. Publicly funded schools produced more rural female family physicians and general practitioners than their privately funded counterparts. Conclusions: Our findings suggest that a few schools, most of them public, may serve as models for schools that aim to train women who later enter rural practice.

(Fam Med 2000;32(5):331-7.)

The shortage of rural physicians continues to be one of the most challenging problems that confronts health policy makers in the United States. The steady increase in the proportion of graduating physicians who are female seems likely to aggravate this shortage. The proportion of US medical students who were female in 1997–1998 was 42.5%, compared with 5.7% in 1959–1960,[1] and women are relatively less likely than men, regardless of specialty, to practice in rural areas. Recent American Medical Association (AMA) data[2] show that clinically active female physicians comprised only 13% of all rural physicians, whereas they comprised 19% of urban physicians.

It is difficult in an environment of marketplace shifts to predict the future from past trends. However, as the proportion of female physicians in the United States continues to increase, the disproportionately lower number of females who practice in rural areas, even among the most recent graduates, may further exacerbate the shortage of rural physicians.[3] Family physicians and general practitioners comprise the greatest proportion of physicians in rural areas.[2] These observed gender imbalances by location argue for further investigation of gender and its correlation to patterns of recruitment and retention of family physicians and general practitioners in rural areas.

For several reasons, it is also important to examine how well individual medical schools perform in producing physicians for rural areas, with specific examination of rural family physician and general practitioner production by gender. First, past studies have reported a positive correlation between female physicians and quality of health maintenance services among female patients[4] and between female providers and female patients' satisfaction with health care services and the choices afforded by the availability of female providers.[5] In addition, portions of both federal and state funds are intended to increase the production of generalist physicians for areas of need, such as rural areas of the United States. It is important, therefore, to examine how well medical schools do at producing family physicians and general practitioners of both genders who practice in rural areas.

A first step in understanding the relationship between gender and workforce maldistribution is to identify medical schools with relatively greater success in producing rural female generalists. Many have called for reform in medical education as a means of addressing the shortage of physicians in rural areas and have proposed changes in medical school admissions, curriculum, and training location.[6-10] If the schools with the greatest success at producing female rural generalists

From the Department of Family Medicine, University of Washington.

can be identified, it should follow that some of the administrative policies and structures of those schools could serve as models for schools with similar goals.

We hypothesized that, while publicly funded medical schools in rural states produce the largest total numbers and proportions of rural generalists, there would be great variation even among those schools in the total numbers of rural female family physicians and general practitioners produced. We also hypothesized that only a few medical schools would contribute much of the nation's stock of rural female family physicians and general practitioners.

Methods

Data from the October 1996 AMA masterfile[11] were analyzed. Given the large number of physicians in this database, we considered it the best available representation of US physician distribution patterns. The contents of the database were used to describe the geographic location and gender distribution of all clinically active, allopathic physicians who had graduated from US medical schools, were listed by the AMA in the years 1988–1996, and were practicing in the United States. We chose this cohort as representative of the most recent medical school graduate practice patterns and demographics. This group would be more likely than an older cohort to allow projections of future physician distribution. We excluded residents in training. Thus, although the cohort examined was the group graduating in 1988–1996, it would not include residents in training and would represent, for the most part, graduates of 1988–1993. We also excluded physicians who were retired or located outside of the 50 states or the District of Columbia. Although osteopaths often practice in rural locations, they were excluded because the AMA database does not include many osteopathic physicians. We defined clinically active physicians as those in office- or hospital-based practice and excluded physicians engaged primarily in research, teaching, or administration, since they contribute relatively little to the physician workforce.

The study population included 53,960 physicians, among them 19,085 women, 20,881 generalists, and 5,817 rural practitioners. The MD graduates listed by the AMA represent 66% of the 82,324 US medical school graduates participating in the residency Match process in the years 1988–1993.[12]

Variables

The AMA database contains several physician variables examined in this study, including gender, listed address (office or home, including county and state), self-reported specialty, practice type, year of graduation from medical school, and medical school location (US medical school name). We classified every physician's listed address as either rural or urban, based on county of self-reported address. Rural or urban county designation was based on the US Office of Management and Budget's Metropolitan Statistical Area classification as enumerated by the 1997 version of the US Department of Agriculture's Urban Influence Codes.[13] Physician specialty was self designated according to a protocol designed by the AMA.[14] A physician's primary specialty was that area of medicine in which he or she spent the plurality of work hours during a typical week. For several of the analyses, we defined generalists as physicians in the primary care specialties of family or general practice, general internal medicine, and general pediatrics.

Schools Included

The AMA masterfile includes 126 US medical schools. We included 122 of these schools, excluding the three medical schools in Puerto Rico. The Association of American Medical Colleges (AAMC) categorizes the Duluth campus of the University of Minnesota as a separate medical school. However, because the AMA masterfile does not separately code the Duluth graduates, they were included with the University of Minnesota (Minneapolis) main campus graduates. Two schools listed as state-funded (Temple University and University of Pittsburgh) in AAMC data were considered to be publicly funded institutions. SAS version 6.12® (Cary, NC, 1997) was used for all analyses.

Results

Practice Locations

Among AMA-listed medical school graduates in 1988–1996, 545 of 19,085 (2.8%) female graduates were rural family physicians or general practitioners (82 of whom practiced in remote areas). This compares with 1,349 of 34,875 (3.9%) male graduates who were rural family physicians or general practitioners (207 of whom practiced in remote areas). The AMA database does not distinguish between family physicians and general practitioners but classifies them under one category. Women comprised 35.4% of listed graduates, 32.1% of rural practitioners, 33.3% of rural family physicians/general practitioners, and 28.4% of rural family physicians/general practitioners in remote areas (isolated counties with no town of 10,000 or more). Among this recent cohort of graduates, rural male family physicians and general practitioners outnumbered their female counterparts by a ratio of 2.5 to 1, compared with an overall male-to-female physician graduate ratio of 1.8 to 1.

The total number of listed rural female family physicians and general practitioners who graduated in 1988–1996 varied substantially by US medical school (Table 1). Overall, the numbers and percentages of these schools' recent graduates who were rural female family physicians and general practitioners were low.

Table 1

1988–1996 US Allopathic Medical School Rural Generalist Graduates by Gender, as Listed in 1996 AMA Masterfile*

State	Medical School	Ownership	Total # of Listed Graduates	Graduates: AMA-listed Male Rural FPs and GPs		Graduates: AMA-listed Female Rural FPs and GPs	
				#	%	#	%
Alabama	University of Alabama	Public	573	15	2.6	4	.7
	University of South Alabama	Public	233	8	3.4	1	.4
Arizona	University of Arizona	Public	330	8	2.4	**7**	**2.1**
Arkansas	University of Arkansas	Public	469	46	9.8	6	1.3
California	Loma Linda University	Private	505	24	4.8	4	.8
	Stanford University	Private	219	4	1.8	1	.5
	University of California, Davis	Public	337	7	2.1	6	1.8
	University of California, Irvine	Public	347	4	1.2	0	.0
	University of California, Los Angeles	Public	650	2	3	1	.2
	University of California, San Diego	Public	410	7	1.7	0	.0
	University of California, San Francisco	Public	477	3	.6	3	.6
	University of Southern California	Private	568	6	1.1	2	.4
Colorado	University of Colorado	Public	475	12	.25	**15**	**3.2**
Connecticut	University of Connecticut	Public	280	2	.7	0	.0
	Yale University	Private	278	0	.0	2	.7
DC	George Washington University	Private	482	7	1.5	3	.6
	Georgetown University	Private	625	4	.6	4	.6
	Howard University	Private	279	5	1.8	1	.4
Florida	University of Florida	Public	413	2	.5	5	1.2
	University of Miami	Private	566	0	.0	1	.2
	University of South Florida	Public	342	5	1.5	3	.9
Georgia	Emory University	Private	372	3	.8	1	.3
	Medical College of Georgia	Public	664	33	5.0	**11**	**1.7**
	Mercer University	Private	115	18	15.7	5	**4.3**
	Morehouse University	Private	90	1	1.1	1	1.1
Hawaii	University of Hawaii	Public	205	1	.5	1	.5
Illinois	Chicago Medical School/Finch University	Private	532	5	.9	3	.6
	Loyola University	Private	424	4	.9	3	.7
	Northwestern University	Private	490	3	.6	0	.0
	Rush Medical College	Private	393	10	2.5	3	.8
	Southern Illinois University	Public	259	18	6.9	6	**2.3**
	University of Chicago, Pritzker	Private	309	1	.3	1	.3
	University of Illinois	Public	1,040	21	2.0	**11**	1.1
Indiana	Indiana University	Public	970	37	3.8	**9**	.9
Iowa	University of Iowa	Public	621	51	8.2	**21**	**3.4**
Kansas	University of Kansas	Public	669	38	5.7	**14**	**2.1**
Kentucky	University of Kentucky	Public	343	26	7.6	**9**	**2.6**
	University of Louisville	Public	473	16	3.4	4	.8
Louisiana	Louisiana State University, New Orleans	Public	625	10	1.6	5	.8
	Louisiana State University, Shreveport	Public	345	12	3.5	1	.3
	Tulane University	Private	482	3	.6	2	.4
Maryland	Johns Hopkins University	Private	316	0	0.0	3	0.9
	University of Maryland	Public	494	7	1.4	1	0.2
	Uniformed Services University	Public	458	18	3.9	2	0.4
Massachusetts	Boston University	Private	437	6	1.4	2	0.5
	Harvard Medical School	Private	409	1	0.2	4	1.0
	Tufts University	Private	439	1	0.2	2	0.5
	University of Massachusetts	Public	351	3	0.9	1	0.3
Michigan	Michigan State University	Public	387	13	3.4	5	1.3
	University of Michigan	Public	601	5	0.8	**7**	1.2
	Wayne State University	Public	949	15	1.6	5	0.5
Minnesota	Mayo Medical School	Private	103	7	6.8	2	**1.9**
	University of Minnesota	Public	911	65	7.1	**27**	**3.0**
Mississippi	University of Mississippi	Public	423	32	7.6	6	1.4
Missouri	St Louis University	Private	511	12	2.3	0	0.0
	University of Missouri, Columbia	Public	396	17	4.3	**12**	**3.0**
	University of Missouri, Kansas City	Public	290	6	2.1	2	0.7
	Washington University	Private	352	5	1.4	3	0.9

(continued on next page)

Table 1

(continued)

State	Medical School	Ownership	Total # of Listed Graduates	Graduates: AMA-listed Male Rural FPs and GPs		Graduates: AMA-listed Female Rural FPs and GPs	
				#	%	#	%
Nebraska	Creighton University	Private	379	12	3.2	2	.5
	University of Nebraska	Public	466	49	10.5	15	3.2
Nevada	University of Nevada	Public	172	9	5.2	6	**3.5**
New Hampshire	Dartmouth Medical School	Private	191	0	.0	5	**2.6**
New Jersey	UMDNJ-New Jersey, Newark	Public	536	3	.6	2	.4
	UMDNJ-Robert Wood Johnson	Public	472	4	.8	0	.0
New Mexico	University of New Mexico	Public	242	11	4.5	6	**2.5**
New York	Albany Medical College	Private	404	4	1.0	3	.7
	Albert Einstein	Private	534	0	.0	0	.0
	Columbia University	Private	391	1	.3	0	.0
	Cornell University	Private	287	1	.3	0	.0
	Mount Sinai	Private	406	0	.0	2	.5
	New York Medical College	Private	639	6	.9	1	.2
	New York University	Private	434	0	.0	1	.2
	SUNY at Brooklyn	Public	677	1	.1	3	.4
	SUNY at Buffalo	Public	476	4	.8	3	.6
	SUNY at Stonybrook	Public	354	4	1.1	1	.3
	SUNY at Syracuse	Public	534	6	1.1	3	.6
	University of Rochester	Private	332	0	.0	1	.3
North Carolina	Bowman Gray SOM/Wake Forest University	Private	373	7	1.9	2	.5
	Duke University	Private	373	2	.5	1	.3
	East Carolina University	Public	267	16	6.0	6	2.2
	University of North Carolina	Public	517	15	2.9	**9**	**1.7**
North Dakota	University of North Dakota	Public	193	21	10.9	**8**	**4.2**
Ohio	Case Western Reserve University	Private	486	2	.4	3	.6
	Medical College of Ohio	Public	521	16	3.1	5	1.0
	Northeastern Ohio Universities College of Medicine	Public	325	4	1.2	1	.3
	Ohio State University	Public	808	18	2.2	**9**	1.1
	University of Cincinnati	Public	650	17	2.6	**12**	**1.8**
	Wright State University	Public	376	19	5.1	5	1.3
Oklahoma	University of Oklahoma	Public	552	24	4.3	3	.5
Oregon	Oregon Health Sciences University	Public	334	17	5.1	**8**	**2.4**
Pennsylvania	Hahnemann University**	Private	559	3	.5	2	.4
	Jefferson Medical College	Private	770	18	2.3	4	.5
	Medical College of Pennsylvania**	Public	382	3	.8	**7**	**1.8**
	Pennsylvania State University	Private	301	3	1.0	5	**1.7**
	Temple University***	State	577	9	1.6	6	1.0
	University of Pennsylvania	Private	468	0	.0	4	.9
	University of Pittsburgh***	State	419	5	1.2	2	.5
Rhode Island	Brown University	Private	248	2	.8	1	.4
South Carolina	Medical University of South Carolina	Public	516	12	2.3	4	.8
	University of South Carolina	Public	223	8	3.6	0	.0
South Dakota	University of South Dakota	Public	206	23	11.2	**9**	**4.4**
Tennessee	East Tennessee State University	Public	210	13	6.2	3	1.4
	Meharry Medical College	Private	196	3	1.5	1	.5
	University of Tennessee	Public	575	22	3.8	**8**	1.4
	Vanderbilt University	Private	310	2	.6	0	.0
Texas	Baylor College of Medicine	Private	555	9	1.6	4	.7
	Texas A&M University	Public	167	7	4.2	4	2.4
	Texas Tech University	Public	381	21	5.5	4	1.0
	University of Texas, Galveston	Public	674	14	2.1	4	.6
	University of Texas, Houston	Public	685	11	1.6	4	.6
	University of Texas, San Antonio	Public	720	17	2.4	**12**	**1.7**
	University of Texas Southwestern, Dallas	Public	691	9	1.3	3	.4
Utah	University of Utah	Public	367	21	5.7	3	.8
Vermont	University of Vermont	Public	309	11	3.6	**9**	**2.9**
Virginia	Eastern Virginia Medical School	Private	319	6	1.9	4	1.3
	University of Virginia	Public	455	12	2.6	2	.4
	Virginia Commonwealth University	Public	615	15	2.4	**10**	**1.6**
Washington	University of Washington	Public	603	35	5.8	**18**	**2.7**

(continued on next page)

Among individual medical schools, the total numbers of listed rural female generalists ranged from 0 to 27 (mean=8 rural family physicians and general practitioners for all schools), while the percentage of each school's graduates who were rural female generalists ranged from 0% to 4.4%. Publicly funded medical schools produced 64% (34,659) of all graduates but 82% (445) of the 545 listed rural female family physicians and general practitioners. The 25 schools in the top quartile for numbers of rural female family physicians and general practitioners (shown in bold in Table 1) produced 26% (13,915) of all graduates but 76% (414) of the rural female family physicians and general practitioners. The schools in the top quartile for numbers of graduates who were rural female family physicians and general practitioners (shown in bold on Table 1) were all publicly funded, with the exception of the Medical College of Pennsylvania. Similarly, all but 4 of the 30 schools in the top quartile for percentage of graduates who were rural female family physicians and general practitioners (shown in bold on Table 1) were publicly funded.

There was great variation in the overall production of rural graduates (both genders, all specialties) among medical schools in 1988–1996 (data not shown). Among schools, the percentage of 1988–1996 graduates practicing in rural areas in 1996 ranged from 1.6% at New York University to 36.5% at Mercer School of Medicine, with a mean among schools of 11.3% (not shown on Table 1). The 31 medical schools in the top quartile for numbers of rural physicians produced 50% (2,905) of the 5,817 listed rural physician graduates. Most (27 of 31) of the top-quartile schools with the highest numbers of rural graduates were publicly funded and among the bottom quartile of schools. Few (7 of 27) were publicly funded. The 27 schools of the bottom quartile produced 17% of all study graduates but only 7% of those located in rural areas.

Discussion

The large variation in medical schools' production of generalists has been described in the past.[15] In that earlier study, 12 schools produced more than one quarter of rural generalists. Similarly, we found that 17 schools produced more than 25% of the 5,814 rural generalists. We also found that of 545 rural female family physicians and general practitioners, more than 25% graduated from the 25 schools at the top of the list that ranked schools by production of such graduates. The few high producers of rural female family physicians and general practitioners were almost all publicly funded. A few privately funded schools, especially those in relatively rural states, appear to recruit many female students who later enter rural practice. Admittedly, the distinction between public and private medical schools is somewhat arbitrary, with public institutions relying

Table 1

(continued)

State	Medical School	Ownership	Total # of Listed Graduates	Graduates: AMA-listed Male Rural FPs and GPs		Graduates: AMA-listed Female Rural FPs and GPs	
				#	%	#	%
West Virginia	Marshall University	Public	173	6	3.5	2	1.2
	West Virginia University	Public	294	14	4.8	4	1.4
Wisconsin	Medical College of Wisconsin	Private	668	8	1.2	3	0.4
	University of Wisconsin	Public	517	19	3.7	**11**	2.1
Mean			442	11	2.7	4	1.1
Minimum			90	0	0.0	0	0.0
Median			421	7	1.7	3	0.7
75th percentile			548	16	3.7	6	1.4
Maximum			1,040	65	15.7	27	4.4
Totals			53,960	1,349		545	

"Graduates" means individuals who ***ever*** graduated from the listed medical school and met criteria for inclusion in the study.

FP—family physician
GP—general practitioner

* Numbers in top quartile for production of female generalists are shown in bold.
** Medical College of Pennsylvania and Hahnemann School of Medicine have since merged to form Allegheny University Health Sciences Center
*** For analysis purposes, these schools were considered publicly funded, since they receive state funds.

heavily on private funds and vice versa. Urban medical schools, private medical schools, and many publicly funded schools produced few rural female family physicians and general practitioners. Many schools have missions focused on producing physicians for the underserved. If that mission has an urban rather than a rural emphasis, the school would likely have a lower rank in this study.

The largest producers of rural family physicians and general practitioners tended to be schools in the midsection of the United States. Schools in the most southern states and some midwestem states produced rural family physician and general practitioner graduate populations that were predominantly male, while schools on the coastal regions tended to produce more gender-balanced groups of rural generalist graduates. This pattern mirrors data reported elsewhere[2] and cited in the *Council on Graduate Medical Education 10th Report,*[3] showing wide regional variations in rural male-to-female generalist ratios in 1997. These ratios were highest in southern states, midwestern states, Idaho, and Utah.

Limitations

There are several limitations in this study. Although based on a large number of physicians, this study does not include data on allopathic physicians not listed in the AMA masterfile. Osteopathic physicians were also excluded. Thus, the data are not complete. However, the database contains the majority of allopathic physicians, and the distribution of physicians within this database likely provides a representative reflection of the US geographic distribution of recently graduated family physicians and general practitioners, not in training, by gender and medical school. The ranks of medical schools could be quite different with the inclusion of even a few additional graduates, though we assume that if the AMA database were more complete, the rankings among schools would likely remain similar.

Graduates who were practicing in the District of Columbia (DC) in October of 1996 were excluded from the analyses. Those practicing in DC are all urban, so the bias is to show the medical schools as slightly more rural than they would be if DC were included.

Because the most recent cohort of graduates was analyzed to make the study relevant to the most recent changes in medical school production, many of the study period graduates were still in their residency training in 1996. It seems that the net influence of this on the study results is to bias the findings toward showing that the medical schools are producing higher percentages of generalists than will be true at a later point in time. This is because medical school graduates who specialize spend more time in residencies and therefore are more likely not to be included in this study's analyses. The resident exclusion probably has little influence on the relative generalist female and male results.

This paper also does not address retention or migration of physicians. (Few studies have; see West et al[16] for an example.) We also did not explore the entire spectrum of rural female generalists because we excluded osteopath physicians, physician assistants, and nurse practitioners, the majority of whom are generalists.

The database does not include information about whether physicians work full-time or part-time. Because female physicians are relatively more likely than their male counterparts to work part-time,[17] the statistics in this study may overestimate the availability of female physicians in rural areas.

The database does not distinguish between general practitioners (with less residency-based training or training obtained prior to the creation of family practice as a board-certified specialty) and family physicians. Thus, the family physician/general practitioner classification, though heterogeneous, represents the most general of medical specialties and the one most likely to serve rural populations.

Finally, we used the listed address to infer a rural practice location. It is likely that some, if not many, physicians list a rural address that may represent their place of residence, while they work in an urban practice. However, the converse could also be true. Thus, the meaning of the address variable is somewhat ambiguous.

Conclusions

The issues of correlation of gender and geography in career pathways should not be overlooked. As the percentage of women in medical training increases, the relative underrepresentation of women practicing in rural areas may exacerbate physician shortages, especially in remote rural areas. In addition, local shortages of female physicians in rural areas may compromise some female patients' willingness to seek medical care, especially for such services as prevention,[4,5] and will, at the very least, limit the choices available to both male and female rural patients.

Most of the schools producing high numbers and percentages of rural physicians are publicly funded, yet some private schools produced significant numbers of rural female generalist physicians. One explanation may be that such schools attract women whose career inclinations differ somewhat from those of men or who follow different career pathways than typical of most women in medicine. A few private medical schools are located in relatively rural states like New Hampshire and Minnesota. Such schools, despite having nonpublic funding, may offer female students more exposure to attractive models of rural practice, thereby influencing career choices. It is unclear whether patterns of recent

years will continue. Medical students' career preferences may shift rapidly in response to such influences as training program curricula and economic forces. It is also possible that as the physician-to-population ratio increases, rural areas will find it easier to recruit physicians.

Recruiting and retaining adequate numbers of physicians for rural areas is likely to remain difficult. The maldistribution cannot be corrected in a few years. But, taking observed patterns and career influence factors into account, medical schools can do more to adapt their programs and to produce female physicians who choose to practice in rural areas.

Policies are needed to effectively remedy the shortage of rural physicians overall and rural female generalists in particular. Future studies should explore issues beyond the scope of this study, such as 1) the specific components of schools' admission policies, curricula, and career advising efforts that contribute to the production of rural generalists of both genders and 2) the factors motivating female generalists to enter and remain in rural practice.

Acknowledgment: This WWAMI Rural Health Research Center study was funded by the Federal Office of Rural Health Policy of the Health Resources and Services Administration.

Corresponding Author: Address correspondence to Dr Ellsbury, University of Washington, Department of Family Medicine, Box 356390, Seattle, WA 98195-6390. 206-543-9425. Fax: 206-543-3821. E-mail: ellsbury@u.washington.edu.

REFERENCES

1. Bickel J, Croft K, Johnson D, Marshall R. Women in US academic medicine statistics. Washington, DC: Association of American Medical Colleges, 1997.
2. Doescher M, Ellsbury KE, Hart LG. The distribution of rural female generalist physicians in the United States. J Rural Health 2000;in press.
3. Council on Graduate Medical Education. Tenth report: physician distribution and health care challenges in rural and inner-city areas. Washington, DC: Government Printing Office, 1998.
4. Lurie N, Slater J, McGovern P, Ekstrum J, Quam L, Margolis K. Preventive care for women: does the sex of the physician matter? N Engl J Med 1993;329:478-82.
5. Delgado A, Lopez-Fernandez LA, Luna JD. Influence of the doctor's gender in the satisfaction of the user. Med Care 1993;9:795-800.
6. American College of Physicians. Rural primary care. Ann Intern Med 1995;122(5):380-90.
7. Kassebaum DG, Szenas PL, Ruffin AL. The declining interest of medical school graduates in generalist specialties: students' abandonment of earlier inclinations. Acad Med 1993;68(4):278-80.
8. Saver BG, Bowman R, Crittenden RA, Maudlin RK, Hart LG. Barriers to residency training of physicians in rural areas. Rural health working paper #46. Seattle: WWAMI Rural Health Research Center, University of Washington, 1998.
9. Verby JE, Newell JP, Andresen SA, Swentko WM. Changing the medical school curriculum to improve patient access to primary care. JAMA 1991;266(1):110-3.
10. Rabinowitz HK, Diamond JJ, Markham FW, Hazelwood CE. A program to increase the number of family physicians in rural and underserved areas: impact after 22 years. JAMA 1999;281(3):255-60.
11. American Medical Association directory of physicians in the United States. Geographical register of physicians. Chicago: American Medical Association, 1996.
12. Association of American Medical Colleges. AAMC data book. Washington, DC: Association of American Medical Colleges, 1994.
13. Ghelfi LM, Parker TS. A county-level measure of urban influences. Staff paper no. 9702. Washington, DC: Rural Economy Division, Economic Research Service, US Department of Agriculture, 1997.
14. Roback G, Randolph M, Seidman B. Physician characteristics and distribution in the United States. Chicago: Division of Survey and Data Resources, American Medical Association, 1990.
15. Rosenblatt RA, Whitcomb ME, Cullen TJ, Lishner DM, Hart LG. Which medical schools produce rural physicians? JAMA 1992;268:1559-65.
16. West PA, Norris TE, Gore J, Baldwin L-M, Hart LG. The geographic and temporal patterns of residency-trained family physicians: University of Washington Family Practice Residency Network. J Am Board Fam Pract 1996;9(2):100-8.
17. Hojat M, Gonnella JS, Veloski JJ, Moses S. Differences in professional activities, perceptions of professional problems, and practice patterns between men and women graduates of Jefferson Medical College. Acad Med 1990;65(12):755-61.