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Comparison of Dermatologist Density Between Urban and Rural Counties in the United States

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IMPORTANCE As the US population continues to increase and age, there is an unmet need for dermatologic care; therefore, it is important to identify and understand the characteristics and patterns of the dermatologist workforce.

OBJECTIVE To analyze the longitudinal dermatologist density and urban-rural disparities using a standardized classification scheme.

DESIGN, SETTING, AND PARTICIPANTS This study analyzed county-level data for 1995 to 2013 from the Area Health Resources File to evaluate the longitudinal trends and demographic and environmental factors associated with the geographic distribution of dermatologists.

MAIN OUTCOMES AND MEASURES Active US dermatologist and physician density.

RESULTS In this study of nationwide data on dermatologists, dermatologist density increased by 21% from 3.02 per 100 000 people to 3.65 per 100 000 people from 1995 to 2013; the gap between the density of dermatologists in urban and other areas increased from 2.63 to 3.06 in nonmetropolitan areas and from 3.41 to 4.03 in rural areas. The ratio of dermatologists older than 55 years to younger than 55 years increased 75% in nonmetropolitan and rural areas (from 0.32 to 0.56) and 170% in metropolitan areas (from 0.34 to 0.93). Dermatologists tended to be located in well-resourced, urban communities.

CONCLUSIONS AND RELEVANCE Our findings suggest that substantial disparities in the geographic distribution of dermatologists exist and have been increasing with time. Correcting the workforce disparity is important for patient care.

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Supplemental content

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An adequate and appropriately trained physician workforce is necessary to meet the nation's current and future health care demands. As the US population continues to increase and age, there is an unmet need for dermatologic care.[1] The increasing incidence of skin cancer, high prevalence of complex inflammatory skin disorders, advanced therapeutics, and widening market for surgical and noninvasive procedures have also contributed to an increased demand for dermatologists that is expected to continue to increase.[1-7]

The undersupply of dermatologists has been described during the past 2 decades,[5,8-10] and previous work has identified the maldistribution of physicians and dermatologists.[11-14] Rural areas face significant physician workforce shortages, with rural residents experiencing long wait times and traveling long distances to receive care.[5] This pattern is especially important given previous studies[15-17] that found that dermatologist density is associated with patient outcomes for diseases, such as melanoma and Merkel cell carcinoma.

To develop strategies and effective policies to offset a shortage, we must better understand the characteristics and patterns observed in the dermatologist workforce. We hypothesize that despite an expanding dermatologist workforce, there is a widening gap between dermatologists in urban and rural settings given the greater professional opportunities in urban areas, desire for proximity to family and support, and insufficient financial incentives to practice in resource-poor areas.[13,18-22] The goal of this study was to build on existing work by evaluating the up-to-date longitudinal trends and demographic and environmental factors associated with the geographic distribution of dermatologists, using a classification scheme that measures the degree of urbanization in each US county.

Methods

Demographic and physician data from 1995 to 2013 were obtained from the Area Health Resources File (AHRF).[23] The New

York University School of Medicine's Institutional Review Board waived the need for review and informed consent. All data were deidentified.

Primary outcome measures included the densities of dermatologists, general practitioners, physicians of other specialties, and total physicians in each US county, which are derived from the number of these physicians in each county per 100 000 people. We specifically used data on active physicians who reported involvement with patient care. The AHRF assigns each county a 9-point Rural-Urban Continuum Code (RUCC), a formal classification scheme that distinguishes counties by size, degree of urbanization, and proximity to metropolitan areas.[24] Counties with RUCCs of 1 to 3 were classified as metropolitan, 4 to 7 as nonmetropolitan, and 8 to 9 as rural using the most recent 2013 RUCCs (eAppendix in the Supplement). For comparison, we conducted a longitudinal analysis of the density and distribution of physicians in otolaryngology, urology, and plastic surgery, which are medical specialties similar to dermatology in size and practice pattern of being referral-based subspecialties that provide a combination of medical and surgical clinical care.

We also conducted a longitudinal analysis of the age distribution of dermatologists using the ratio of number of dermatologists older than 55 years to the number of dermatologists younger than 55 years. Because a number of rural counties had no dermatologists younger than 55 years, we combined dermatologists into metropolitan (RUCCs 1-3) and nonmetropolitan or rural (RUCCs 4-9) categories.

To better delineate the demographic and environmental differences between counties with no dermatologists and those with at least 1, we performed a logistic regression analysis. Dermatologist density was dichotomized (0 and >0). Univariate associations between indicators and dermatologist density were tested, and correlations between indicator variables were analyzed to identify potential associations. A 2-sided $P < .05$ was considered to be significant. Because so many counties had no dermatologists, a multivariate linear regression was used for counties that had 1 dermatologist or more. The same covariates were used but excluded number of hospitals and referral centers because their presence, but not necessarily their magnitude, is informative for modeling.

Data management and analysis were performed with Microsoft Excel for Mac 2011, version 14.2.3 (Microsoft Corp) and R Statistical Software, version 2.14.0 (R Foundation for Statistical Computing).

Key Points

Questions What are the longitudinal dermatologist density trends, and are there urban and rural disparities?

Findings In this study county-level data from the Area Health Resources File, from 1995 to 2013, dermatologist density increased the most in rural followed by nonmetropolitan and metropolitan counties; however, the gap between metropolitan and other areas also widened. Dermatologists were heterogeneously distributed and consistently located in well-resourced communities.

Meaning The findings suggest that substantial disparities in the geographic distribution of dermatologists exist and have been increasing with time; correcting workforce disparities is important for patient care.

Results

The longitudinal analysis of the density and distribution of dermatologists and general practitioners revealed a geographic heterogeneity in the distribution and density among both physician types across the United States (eFigures 1 and 2 in the Supplement).

Dermatology

The density of dermatologists nationally and by urbanization is given in **Table 1**. Although the percentage changes in dermatologist density in nonmetropolitan counties (25.1%) and rural counties (30.3%) were higher than in metropolitan counties (18.4%), the differences in the dermatologist density in metropolitan vs nonmetropolitan and rural areas increased from 1995 to 2013. The difference in dermatologist density between metropolitan and nonmetropolitan counties increased from 2.63 per 100 000 people (3.47 vs 0.84 per 100 000 people) in 1995 to 3.06 per 100 000 people (4.11 vs 1.05 per 100 000 people) in 2013 ($P = .048$). In addition, the difference in dermatologist density between metropolitan and rural counties increased from 3.41 per 100 000 people (3.47 vs 0.065 per 100 000 people) in 1995 to 4.03 per 100 000 people (4.11 vs 0.085 per 100 000 people) in 2013 ($P = .053$).

The number of dermatologists younger than 55 years increased by 21.3% from 1995 to 2013 in metropolitan areas and by 6.5% in nonmetropolitan and rural areas. The number of dermatologists older than 55 years increased by 112.4% in metropolitan counties and by 153.0% in nonmetropolitan and rural areas. The ratio of all dermatologists in the United States who were older than 55 years to younger than 55 years increased by 78.1% from 0.32 in 1995 to 0.57 in 2013. In metropolitan counties, the age ratio in 1995 was 0.32 and increased to 0.56 by 2013 (increase of 75.0%). From 2010 to 2013, the ratio decreased from 0.57 to 0.56. In nonmetropolitan and rural areas, the ratio was 0.34 in 1995 and increased to 0.93 by 2013 (increase of 170.5%).

Total Physicians and General Practitioners

The density of total physicians and general practitioners nationally and by urbanization is given in Table 1. From 1995 to 2013, the national mean density increased by 15.6% for total physicians and 9.58% for general practitioners. The difference between total physician density in metropolitan and nonmetropolitan counties increased from 164 per 100 000 people in 1995 to 188 per 100 000 people in 2013 ($P = .04$). The difference between total physician density in metropolitan and rural counties increased from 220 per 100 000 people in 1995 to 257 per 100 000 people in 2013 ($P = .049$).

Otolaryngology, Urology, and Plastic Surgery

The density of otolaryngology, urology, and plastic surgery physicians nationally and by urbanization is given in Table 1.

Table 1. Active Physician Density by Specialty and Year[a]

Area	Density, per 100 000 People		Change From 1995 to 2013, %
	1995	2013	
Dermatology			
National	3.02	3.65	+20.6
Metropolitan	3.47	4.11	+18.4
Nonmetropolitan	0.84	1.05	+25.1
Rural	0.065	0.085	+30.3
Total Physicians			
National	243	280	+15.6
Metropolitan	270	309	+14.2
Nonmetropolitan	106	121	+13.2
Rural	50.4	52.0	+3.22
General Practitioners			
National	26.6	29.1	+9.58
Metropolitan	26.2	29.0	+10.5
Nonmetropolitan	28.6	30.4	+6.58
Rural	26.8	25.5	−4.93
Otolaryngology			
National	3.24	3.25	+0.27
Metropolitan	3.63	3.58	−1.38
Nonmetropolitan	1.38	1.42	+3.57
Rural	0.065	0.169	+161
Urology			
National	3.53	3.31	−6.16
Metropolitan	3.86	3.60	−6.62
Nonmetropolitan	2.01	1.74	−13.5
Rural	0.32	0.25	−21.8
Plastic Surgery			
National	2.01	2.44	+21.4
Metropolitan	2.37	2.80	+18.1
Nonmetropolitan	0.24	0.44	+81.5
Rural	0.022	0.021	−2.24

[a] All data were calculated to 3 significant digits.

Table 2. Logistic Regression Results for Determining the Presence of at Least 1 Dermatologist in a County Based on Demographic and Environmental Variables

Variable	Estimate	*P* Value
APRN density	0.012899	$<2 \times 10^{-16}$
Primary care density	0.025601	$<2 \times 10^{-16}$
Median household income	6.57×10^{-5}	$<2 \times 10^{-16}$
Percentage without insurance	−0.085327	$<2 \times 10^{-16}$
Percentage unemployed	0.02093	.32
Percentage >65 y of age	−0.17107	$<2 \times 10^{-16}$
Percentage white	-1.41×10^{-5}	$<2 \times 10^{-16}$
Percentage urban	0.064243	$<2 \times 10^{-16}$
Population per square mile	0.0070475	$<2 \times 10^{-16}$
Hospitals	1.22265	$<2 \times 10^{-16}$
Rural referral center	−0.04936	.02

Abbreviation: APRN, advanced practice registered nurse.

The differences in otolaryngologist density decreased from 2.25 per 100 000 people to 2.16 per 100 000 people between metropolitan and nonmetropolitan counties and decreased from 3.57 per 100 000 people to 3.41 per 100 000 people between metropolitan and rural counties from 1995 to 2013. The differences in urologist density increased from 1.85 per 100 000 people to 1.86 per 100 000 between metropolitan and nonmetropolitan counties and decreased from 3.54 per 100 000 people to 3.35 per 100 000 people between metropolitan and rural counties from 1995 to 2013. The differences in plastic surgeon density increased from 2.13 per 100 000 people to 2.35 per 100 000 people between metropolitan and nonmetropolitan counties and increased from 2.35 per 100 000 people to 2.77 per 100 000 people between metropolitan and rural counties from 1995 to 2013.

Dermatologist Regression Analyses

From 1995 to 2013, the number of counties with no dermatologists decreased from 2285 of 3200 (71.4%) to 2196 of 3200 (68.6%). For our logistic univariate regression, counties with a higher advanced practice registered nurse (APRN) density, primary care physician density, median household income, percentage of urban population, population per square mile, and number of hospitals were more likely to have at least 1 dermatologist (**Table 2**). Counties with a higher percentage of population without insurance, percentage of population older than 65 years, percentage of white people, and number of rural referral centers were less likely to have at least 1 dermatologist.

For our multivariate linear regression in counties with at least 1 dermatologist, variables that had a significantly positive association with dermatologist density were APRN density, primary care physician density, median household income, percentage without insurance, percentage older than 65 years, and population per square mile (**Table 3**). Variables significantly inversely associated with dermatologist density were percentage of unemployed people and percentage of white people.

Discussion

This study evaluated the geographic distribution of active dermatologists over time using a formal rural-urban county classification scheme. Our analysis revealed there was a 21% increase in dermatologist workforce during the study period, which was higher than otolaryngology, urology, plastic surgery, general practitioners, and total physicians. This finding may be partially associated with the quantity of residency positions for dermatology having increased faster than other specialties and the overall number of graduate medical education positions.[25,26] In addition, the 30% increase in dermatologist density in rural areas exceeded that of most other compared physician groups, some of which experienced a decrease in rural physician density.

However, our analysis revealed that although the density of dermatologists has been increasing, there have been substantial disparities in the geographic distribution and density of dermatologists across the United States and these disparities have been increasing with time. Although from 1995 to

Table 3. Multivariate Linear Regression Results for the Association of Demographic and Environmental Variables and Dermatologist Density in Counties With at Least 1 Dermatologist

Variable	Estimate	*P* Value
APRN density	6.35×10^{-4}	.002
Primary care density	4.80×10^{-3}	$<2 \times 10^{-16}$
Median household income	1.85×10^{-6}	.03
Percentage without insurance	7.26×10^{-3}	1.04 × 10−4
Percentage unemployed	-5.75×10^{-2}	2.84×10^{-8}
Percentage >65 y of age	9.19×10^{-3}	4.44×10^{-5}
Percentage white	-2.02×10^{-6}	.002
Percentage urban	-3.63×10^{-4}	.41
Population per square mile	8.39×10^{-6}	.002

Abbreviation: APRN, advanced practice registered nurse.

2013, the percentage of increase of dermatologist density was higher in rural and nonmetropolitan areas than in urban areas, the difference in density between metropolitan and nonmetropolitan, as well as metropolitan and rural regions, widened. This increase in disparity for the dermatology workforce parallels that of total physicians, but there were variations among specialties, with a decrease in the otolaryngology workforce density gap between metropolitan and other areas during the study period. Although the exact reasons for the differences between specialties are unclear, concerns regarding the increasing geographic maldistribution of physicians span across specialties, and innovative approaches in health care delivery and proactive advocacy will be needed to reduce the widening gap.[27-32]

Trends in dermatologist age groups likely play a role in the observed urban-rural workforce disparities. In 2013, dermatologists in nonmetropolitan areas were older than their counterparts in metropolitan locations. We found that the ratio of dermatologists older than 55 years to younger than 55 years increased more substantially between 1995 and 2013 in nonmetropolitan and rural areas compared with metropolitan areas. Thus, older dermatologists retiring in the next 1 to 2 decades will likely affect nonurban areas more heavily. In addition, our data indicate that the number of young dermatologists is increasing in metropolitan counties but decreasing in nonmetropolitan and rural counties. This finding may be because recent graduates are more likely to practice in a dermatology group or multispecialty group or be academics, which are more common in urban communities. Solo practices are much more common in rural areas.[33] Physicians tend to settle in urban areas because of the combination of professional and personal considerations.[12,30,32] Given increasing interest in surgical and cosmetic dermatology among younger dermatologists, market forces in urban areas with higher procedural and elective cosmetic demands, proper patient demographics, and economic prosperity may be driving dermatologists to metropolitan communities.[25,32] More than half of married physicians have highly educated spouses, which makes greater job opportunities in metropolitan areas an important consideration.[22] A desirable location with lifestyle flexibility has consistently ranked as one of the highest priorities for recent graduates.[18,28,34-36] In addition, dermatology graduates have a geographic preference to settle close to their hometown[37] or training site and are also less likely to move to rural areas after residency.[19,38-40] Support from and proximity to family may be instrumental because female physicians bear more childrearing and household responsibilities and experience greater depressive symptoms from work-family conflict.[21,41,42] The increasing proportion of women in dermatology may be an additional explanation for the observed geographic maldistribution and differences observed compared with other specialties.[43]

Univariate and multivariate regression models supported the clustering trends seen in our density mapping. Areas with higher densities of dermatologists were positively correlated with areas of higher population density. Of interest, numbers of hospitals and APRNs were among the covariates significantly associated with dermatologist presence. This finding demonstrates that few dermatologists are practicing in areas without systems support. Despite the use of nonphysician practitioners, such as nurse practitioners and physician assistants, to compensate for physician shortages,[5,36,44] our study suggests that physicians and APRNs, who can practice independently in many states, seem to be similarly clustered in metropolitan, well-resourced communities. This finding is consistent with results from a recent study[45] analyzing Medicare data showing that most dermatologists and nonphysician practitioners favor practicing in urban environments and are located in similar geographic areas.

Rural and Urban Disparity Trends

Accounting for demographic and medical coverage changes, the projected increase in dermatology visits between 2013 and 2025 is among the highest of all specialties at 16%.[1] In 2014, dermatologists reported a mean appointment wait time of 18 days for established patients and 29 days for new patients, which is largely stable from 2005.[33] Although not observed consistently,[46] wait times for new and established dermatologic patients in rural areas were longer than those for their more urban counterparts on a national level.[5] In addition, rural residents travel longer distances to receive care, especially from specialists, including dermatologists.[5,12,14]

Failure to train sufficient dermatologists may exacerbate already long wait times, reduce access, and impede clinical outcomes and quality of life, especially for patients in rural areas. The supply of dermatologists is unlikely to increase substantially in the immediate future given lack of sufficient federal funding. The number of dermatology residency training slots has not kept up with the pace of demand and has increased only at an annual rate of 0.9% from 2001 to 2010.[47,48]

Many of the small and rural states have limited residency training capacity, which has contributed to the discrepancy because the location of graduate medical education training is often associated with the location where physicians ultimately practice.[38,48] In addition, developing strategies to attract dermatologists to rural and underserved areas will be needed, and such strategies may include financial incentives, such as loan repayment and higher reimbursement, funding rural graduate medical education training spots, increasing physician spouse job opportunities, and recruiting students

of rural origin and diverse backgrounds to enter medical school and the specialty.[19,22,49-55] In fact, rural origin is the strongest indicator of physicians' eventual rural practice, but students from rural backgrounds are consistently underrepresented in medical schools.[49,56] Partnerships between existing residency programs and rural regional medical centers that have difficulty recruiting dermatologists may offer a viable alternative model to expand residency positions while simultaneously addressing rural health care needs.[57] Increasing rural exposure during medical school and residency may influence eventual rural practice while providing trainees with increased medical and surgical dermatology opportunities. Rural outreach and visiting consultants, approaches that have been successful for expanding specialist care in underserved nonurban areas, can be considered for dermatology.[58-60] Data from Kaiser Permanente, Veterans Health Administration, Medicaid managed care plan, and safety-net health system teledermatology programs have demonstrated that telemedicine is a feasible and effective method to deliver dermatologic care in rural and underserved areas.[33,44,61-70] Provision of remote telementoring and dermatology-specific case-based education to primary care physicians in underserved regions serves as an additional avenue to improve access.[71-73]

The maldistribution of dermatologists has also been observed in other countries.[74,75] Our findings are in concordance with a Brazilian study[75] that reported that higher socioeconomic factors, as well as urban areas with better infrastructure and higher income levels, favor the settlement of dermatologists and physicians in general. In a 2006 Canadian survey,[74] 95% of dermatologists had an urban practice component (population >70 000), 16% had a rural component (population between 10 000 and 69 999) to their practice, and 7% had a remote practice component (population <10 000). There was a shift from rural to urban practice locations over time.

Strengths and Limitations

Compared with previous studies on this subject,[13,14] this study has several differences and advantages. The primary data for this study are inclusive of all dermatologists across the country regardless of American Academy of Dermatology membership and include only those who are actively practicing clinical medicine, an important distinction that may not be captured through the membership directory. The geographic analysis based on county is more representative of the type of dermatologist accessibility that patients face. The period studied includes data from as recent as 2013 and spans more than 19 years, the longest, to our knowledge, of any existing study on this topic in dermatology. The long study period allows for more accurate examination of trends and patterns. We were also able to compare and contrast trends for dermatologists with those for other medical specialties, so we can better understand and evaluate unique aspects for our specialty. The use of a formal, standardized classification scheme in the RUCC to distinguish metropolitan, nonmetropolitan, and rural areas, by considering factors such as population sizes and degree of urbanization, is unique to this study. In addition, to our knowledge, no study has used a logistical regression analysis to analyze associations between demographic, socioeconomic, and environmental factors and dermatologist density.

There are limitations to this study, including inability to differentiate among a medical dermatologist, dermatologic surgeon, and cosmetic dermatologist. We were not able to differentiate between full-time and part-time dermatologists, including those who have family obligations, such as childbearing and raising young children, especially in a changing demographic situation.[5,6,21,76] We were unable to account for locum tenens work or care provided at satellite offices. We did not account for dermatology-focused nurse practitioners and physician assistants because these data were not available, but they constitute a significant proportion of the dermatology workforce, and many practice in similar geographic areas as dermatologists.[45,77] Nonphysician dermatology practitioners are becoming increasingly prevalent and used by dermatology practices, with an estimate of more than 2500 dermatology physician assistants in 2016 and more than 600 dermatology nurse practitioners in 2011.[33,36,77,78] Although we can find associations with density of dermatologists, we cannot establish causality. Through this study, we were not able to determine the association of the data with clinical outcomes.

Conclusions

From 1995 to 2013, dermatologist density overall and in rural communities substantially increased at a rate higher than that seen among total physicians and general practitioners. However, the disparity between the urban vs nonurban distribution of dermatologists in the United States continued to worsen, with many counties lacking a dermatologist. Dermatologists, especially young dermatologists, tend to practice in well-resourced, urban communities. The percentage of older dermatologists was 2-fold greater in nonurban than urban communities, and the number of dermatologists younger than 55 years who practice in rural communities was decreasing. Correcting this workforce disparity, which is likely to worsen, is important to minimize disruptions in patient care. Careful workforce planning will be needed to consider alternative health care delivery models, dermatologist recruitment strategies, and the role of nonphysician practitioners and telemedicine, especially in nonmetropolitan or rural areas.

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