

Asthma Hospitalization Trends in Charleston, South Carolina, 1956 to 1997: Twenty-fold Increase Among Black Children During a 30-Year Period

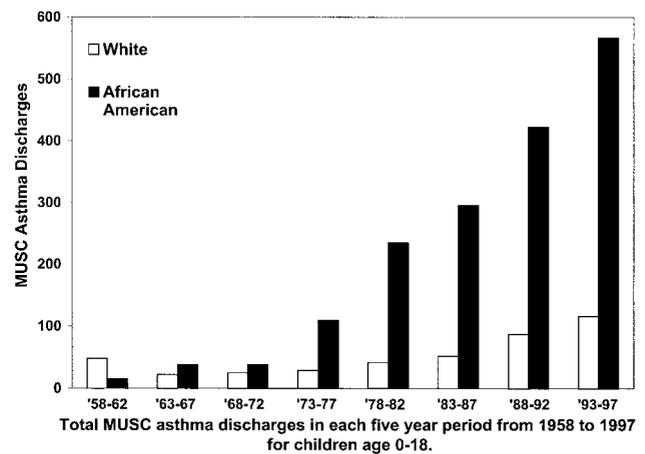
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ABSTRACT. *Objective.* The increase in asthma prevalence has been documented worldwide, affecting many races living in many different climates. Multiple studies have demonstrated that the most striking prevalence and morbidity of asthma in the United States has been in black children, but little research has determined the scale of the increase, or specifically when the disease became severe in this group. This study sought to determine exactly when the rise in asthma hospitalizations among black patients began and what the pattern of asthma hospitalizations has been in different races and age groups over a 40-year period in 1 urban area.

Methods. A retrospective chart review of discharges from the Medical University of South Carolina was conducted from 1956 to 1997. Charts with the primary discharge diagnosis of asthma were examined for discharge date, race, and age group (0- to 4-year-olds, 5- to 18-year-olds, 19- to 50-year-olds, ≥51-year-olds). The diagnostic codes used were based on the *International Classification of Diseases (ICD)-6, 1956-1957; ICD-7, 1958-1967; ICD-8, 1968-1978; and ICD-9, 1979-1997.* Over the period studied, this hospital was the primary inpatient provider for children in this area, and the only provider for uninsured children. Between 1960 and 1990, the racial makeup of the area remained stable, as did the percentage of blacks living at the poverty level. The raw number of asthma discharges, rate per 10 000 discharges of the same race, and rate per 100 000 population in Charleston County were tabulated for each age group and racial category.

Results. Over the time period examined, there has been a progressive increase in asthma hospitalizations in black individuals of all age groups and in whites under 18 years. The most striking increase has been in black children 0 to 18 years old (Figure). The increase either as raw values or as a rate per 100 000 began around 1970, and was linear. This increase in black children discharged with asthma as a rate per 100 000 population was 20-fold: the rate increased from 18 in 1970 to 370 in 1997. Asthma discharges as a rate per 10 000 black children discharged increased by 24-fold from 1960 to 1997. Total discharges

from the hospital increased from 49 000 to 128 000 per year over this period. Blacks made up only 28% of discharges in 1957, but that proportion increased to 56% in 1960 and remained relatively stable over the following 35 years. The increase seen in white children 0 to 18 years of age as a rate per 100 000 population was 5-fold and began around 1980. Both increases seem to be consistent over the time period studied, and continued to 1997.



Conclusions. Among a predominantly poor black population living in a southern US city, there has been a steady increase in childhood asthma hospitalizations over the past 30 years. A significant although less dramatic rise has occurred in white children. Over this time period, although there have been many changes in lifestyle that could have contributed to this rise, there have been no major changes in housing conditions for poor patients. In addition, Medicaid coverage for children in South Carolina did not change significantly until 1999. The time course of these increases parallels increases reported in other Western populations, suggesting that there must be 1 or more common factors contributing to the rise. Many explanations have been offered for the changes in incidence and severity of asthma. The scale of the change, time course, and linearity of the increase in this study represent a challenge to many of the hypotheses proposed to explain this epidemic. *Pediatrics* 2001; 108(6). URL: <http://www.pediatrics.org/cgi/content/full/108/6/e97>; *asthma, hospitalization, children, prevalence, black.*

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ABBREVIATIONS. MUSC, Medical University of South Carolina, ICD, *International Classification of Diseases.*

Increases in asthma prevalence have been reported worldwide, affecting populations of many races that live in very different climates.¹⁻⁵ In addition to the increase in prevalence, there has been an increase in asthma mortality and hospitalization.^{2,6-8} In the United States, the most striking increases in asthma have occurred in black communities and among children.^{5,7-15} A comprehensive review in 1997 reported a significant increase in childhood self-reported asthma between 1980 and 1994. The same review showed a doubling of asthma office visits and a near doubling of childhood asthma hospitalizations between 1979 and 1992, with black individuals having consistently higher rates of hospitalization than white individuals.¹⁶

Analysis of published data from countries worldwide and for the United States suggests that the increase in asthma prevalence began in the 1970s.^{5,9,11,14,17} However, little research has showed specifically when asthma became a problem for black individuals. One study of the Washington, DC, area showed that the number of black asthma admissions surpassed the number of white admissions during the period 1964 to 1976.⁹ Another study suggested that the increase in prevalence of asthma in black children began in the mid-1960s.⁷ The present study presents 1 university hospital's asthma experience during a 40-year period and examines the time course of changes in black and white asthma hospitalizations among different age groups during the same period.

METHODS

Population

The Medical University of South Carolina (MUSC) in Charleston was chosen for a retrospective chart review because it is a hospital that has served a large proportion of the black community in Charleston during the past 40 years. The percentage of different races in the population of Charleston has remained relatively stable during this time, and accurate medical records spanning this 40-year time period were available.

MUSC accepted its first patients in 1955. Before that, a private hospital provided the primary inpatient service for both black and white patients. On opening, MUSC immediately became the primary inpatient service for black patients, and there was a slower but steady shift of white patients to MUSC from the private hospital. During the entire time period studied here, Charleston Memorial Hospital, located nearby, also served the black community, but at no time did Charleston Memorial have an inpatient pediatric service. Thus, from 1955 on, MUSC had a large majority of the black pediatric inpatient admissions.

The population of Charleston County increased from 216 382 in 1960 to 313 478 in 1997. The percentage of black individuals in Charleston County remained between 31% and 36% from 1960 to 1997.¹⁸ Therefore, through the period of time studied, the racial makeup of the Charleston population remained relatively stable. The age distribution of the population of Charleston County has been more dynamic, but generally the population has steadily grown older. In 1960, 42% of the population was <18 years old; by 1997, this percentage had decreased to 24%.

Data Collection

A retrospective chart review was conducted for the years 1956 to 1997, with the exception of 1989 (records for that year were destroyed by a hurricane). A total of 3061 hospitalizations for asthma were in the computer database. Asthma hospitalizations were determined by the first-listed discharge diagnosis recorded using the *International Classification of Diseases (ICD)* codes. During the period studied, 4 different ICD classifications were used:

ICD-6 (code 350-390, 1956-1957), ICD-7 (code 350-390, 1958-1966; code 2419, 1967), ICD-8 (code 2419, 1968; code 493.0-493.9, 1969-1978), and ICD-9 (code 493.0-493.9, 1979-1997). Those charts with the primary discharge diagnosis of asthma were examined for discharge date, race (white and black) and age group (0-4, 5-18, 19-50, and ≥ 51). The unit of sampling was the individual; therefore, data revealing trends by race and age exclude readmissions in a single year.

To look at trends in overall hospitalizations at MUSC, other data examined included total discharges for each year from 1955 to 1997 and total discharges by race for the years 1955 to 1961 and 1978 to 1997. Because of a change in hospital policy on record keeping during the turbulent civil rights years 1962 to 1977, there was no racial data for total discharges recorded during that time period. US Census Bureau records were examined for total, black, and white populations, as well as populations younger than 18 years in Charleston County during the years 1960, 1970, 1980, 1990, and 1997 (1997 data are an estimate from the Census Bureau, as this was not a census year). Asthma discharge data were examined for each year for total white individuals, total black individuals, and both races in the age groups 0 to 4, 5 to 18, 19 to 50, and ≥ 51 years of age.

Statistical Methods

The raw number of asthma discharges, annual rate of asthma discharges per 10 000 total MUSC admissions of the same race, and annual rate per 100 000 population of 0- to 18-year-olds of the same race in Charleston County were tabulated for each age and racial category. Because population data were available only for each decade year, 5-year periods of asthma discharges were averaged to show a rate per population for each 10-year mark. (for example, the asthma hospitalization rate for 1960 was calculated using the average number of asthma discharges in 1958-1962). Because of variations in census reporting, the 1960 rates were calculated using population of 0- to 17-year-olds, and 1997 rates were calculated using 0- to 19-year-olds. The rate for 1997 was calculated using that single year of data; it was not an average. Trends were evaluated with a χ^2 test for trend. χ^2 was used to compare asthma hospitalization rates between specific time periods.

RESULTS

Table 1 shows the number of black and white asthma hospitalizations in each age group, along with the total number of black and white discharges in each 5-year period. During the period for which records were available, there has been a progressive increase in black asthma hospitalizations in all age groups and in white individuals aged 0 to 4 and 5 to 18. It is clear that the most dramatic increases were among black 0- to 4- and 5- to 18-year-olds (Table 1). These increases occurred while the racial makeup of total hospital discharges remained fairly stable (Table 1). The asthma hospitalizations in these age groups were compared with total discharges of each race and with total population of 0- to 18-year-old children of each race in Charleston County during the same time period. The rate of increase seen in the 0- to 4- and 5- to 18-year-old age groups was similar, so these groups were combined.

There was an increase in both white and black asthma hospitalizations for 0- to 18-year-olds. Both increases were consistent and seem to be linear during the time period studied and continued to 1997. The increase for white individuals seems to have started around 1980 (Table 1, Figs 1 and 2). The increase in the rate of white asthma discharges between 1980 and 1997 per 100 000 population was 5-fold ($P < .001$; Fig 2) and per 10 000 white discharges was 3-fold ($P < .01$). The increase for black

TABLE 1. MUSC Asthma Discharges and Total Discharges, 1958 to 1997, by Age and Race

Year	Age 0-4		Age 5-18		Age 19-50		Age 51+		Total Discharges†		
	White	Black	White	Black	White	Black	White	Black	White	Black	Both
1958-1962	11	7	37	8	86	17	45	5	29,245	19,860	49,105
1963-1967	9	18	13	20	58	19	49	9			75,672
1968-1972	12	17	13	21	29	12	25	7		(54%)*	75,580
1973-1977	15	53	14	57	20	20	28	14			89,177
1978-1982	26	109	16	126	13	22	21	15	46,147	53,989	100,136
1983-1987	29	138	23	158	19	28	13	18	47,047	50,171	98,055
1988-1992	55	222	32	201	18	23	8	17	53,776	52,946	106,722
1993-1997	64	227	52	340	47	75	18	39	68,930	56,882	125,812

* Estimate of percentage of black discharges for 1967 to 1968, based on discharges in November 1967, February 1968, and June 1968.

† No race data for total discharges was available for 1963 to 1977.

individuals seems to have started around 1970 (Table 1, Figs 1 and 2). The increase in the rate of black asthma discharges between 1970 and 1997 per 100 000 population was 20-fold ($P < .001$; Fig 1) and per 10 000 black discharges was 24-fold ($P < .001$) compared with 1960. (Because of the missing race data needed for this particular analysis, we cannot calculate the increase since 1970, when the increase probably began.) There was a decline in white asthma discharges in the 1960s and a decline in black asthma discharges between 1966 and 1971. Because the numbers involved in these years were small (<10

patients per year), it is unclear whether these were true trends.

Asthma discharge data in this study was examined for seasonality, including all admissions and readmissions of the same patient. Seasonal increases in the fall and spring were apparent throughout the period studied.

DISCUSSION

Although hospitalizations for asthma are only a portion of total asthma care visits, hospitalization rate can be regarded as an indicator of moderately

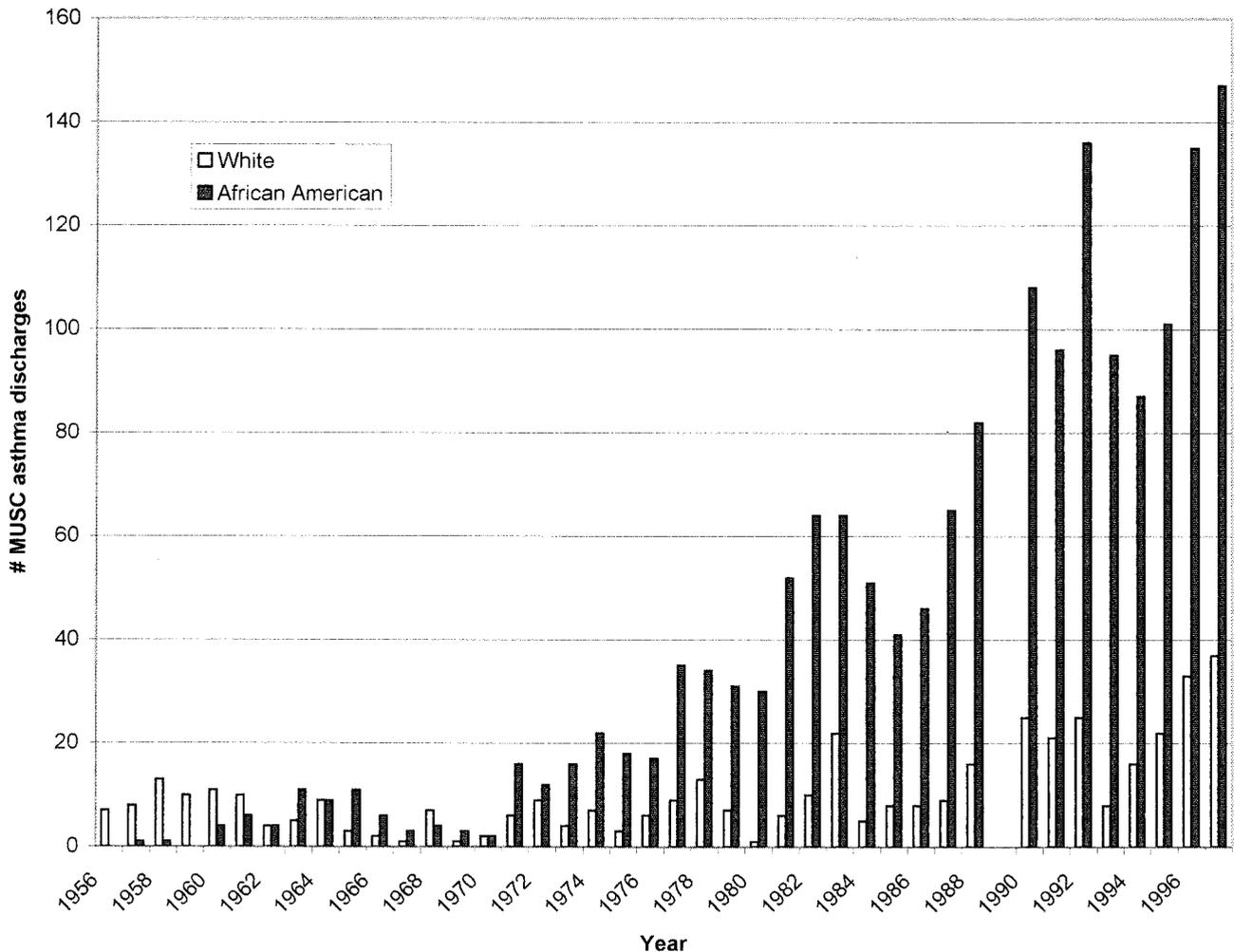


Fig 1. MUSC asthma discharges for children 0 to 18 years old, 1956 to 1997, by ethnicity. Data are missing for 1989.

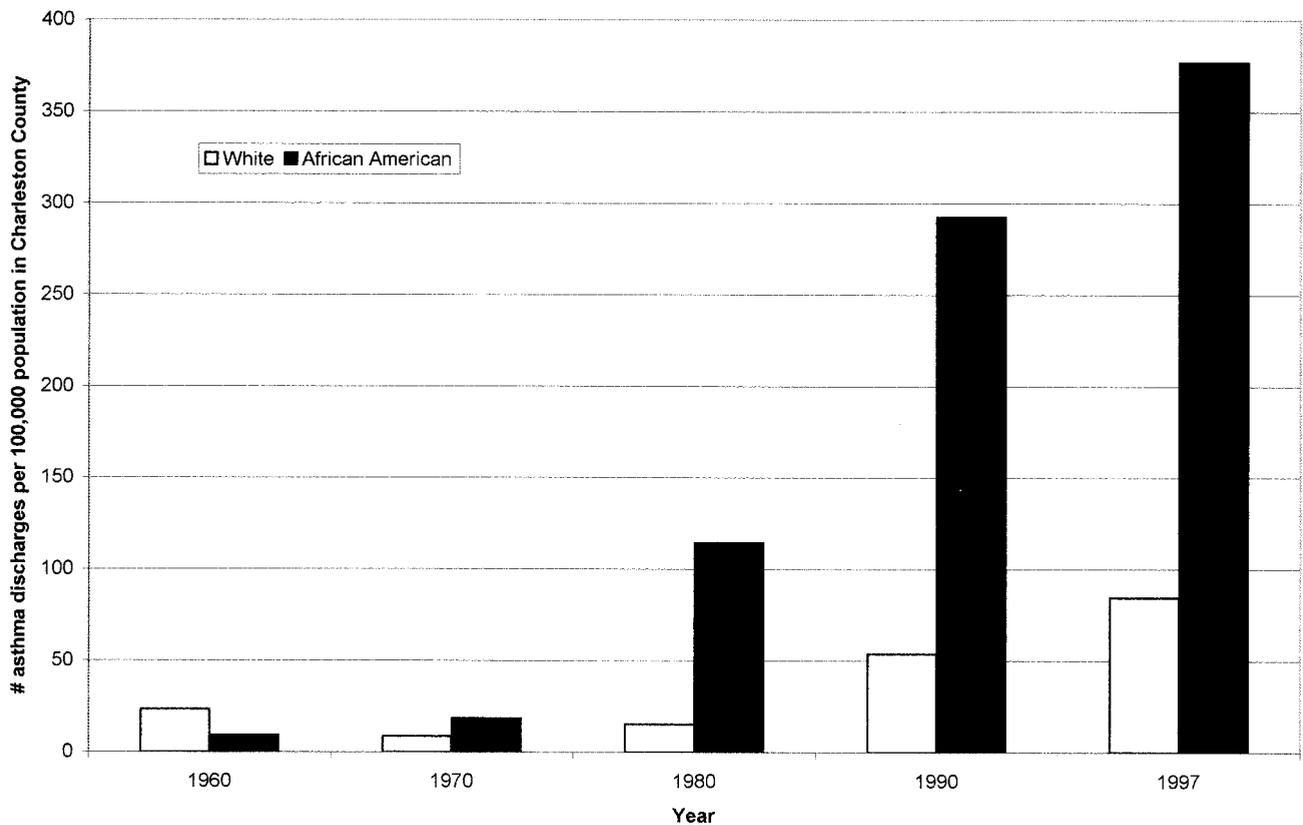


Fig 2. MUSC asthma discharges, age 0 to 18, expressed as annual rate per 100 000 population of 0- 18-year-olds of each race in Charleston County.

severe to severe asthma in the community.¹⁹ The present study demonstrated a steady increase in 1 university hospital's asthma hospitalization rate in both black and white children age 0 to 18 years. The increase in black individuals is far more dramatic than the increase in white individuals. The rise in black pediatric asthma hospitalizations started around 1970 and has occurred in a population with a decreasing percentage of 0- to 18-year-olds and a stable racial makeup during the period studied.

This study shows an increase in the number of children requiring admission for asthma since 1970, which parallels the increase reported among black children age 0 to 14 years in Washington, DC,⁹ in children nationwide age 0 to 17 years based on National Center for Health Statistics results,⁷ in Finnish 19-year-olds,³ and in children age 0 to 14 years in community-based studies in the United States.^{11,17} The increase in asthma hospitalization reported here occurred despite many advances in emergency department treatment of asthma during the same period, most notably the introduction of controlled-release theophylline in the early 1970s, nebulized albuterol in the late 1970s, and intravenous methylprednisolone in the 1980s. Some of this increase may be a reflection of coding changes in certain years, but other studies have concluded that for at least 1 of these coding changes, a diagnostic shift alone could not explain the increase.^{12,20} Other contributing factors could be an increasing awareness of asthma on the part of parents and individuals, increased case-

finding of physicians, or change in criteria for admission.

Many explanations have been offered for the changes in incidence and severity of asthma. Among these are increased indoor allergen load, changes in immune response with increasing antibiotic use and increased rate of vaccinations, changes in air pollution and diet, improved survival of premature infants, increase in smoking rate of mothers, and increase in sedentary lifestyle with associated decreased lung expansion.^{2,5,21,22} Although the cause of the seasonal increases found in this study is not established, the fall and spring asthma peaks correlate with both environmental allergen levels and rhinovirus seasons. Tree pollen levels in the Charleston area are highest in April, weed pollen levels are highest in October, and peak rhinovirus activity is highest in the fall and spring in nearby areas.²³⁻²⁵ These seasonal associations would not, however, account for the long-term trend found in this study.

Before speculating on the reasons for the increases seen in this study, one must consider the confounding factor of poverty in the black population in Charleston County. In 1970, 45% of all black families in Charleston County were at the poverty level; in 1990, 34% of black individuals in Charleston County were at the poverty level. This is in contrast to a poverty level of 8% in the white population in Charleston County in 1980 and 1990.¹⁸ Several studies have found a correlation in the United States between low socioeconomic status and increased

rates of asthma.^{2,7,15} There is conflicting evidence, however, on how much of the increase in asthma in black individuals can be accounted for by low socioeconomic status.^{15,26} Even if the increase in black asthma admissions found here is partially attributed to poverty rather than race, what is still not clear is the exact link between poverty and asthma. This relationship found in the United States has not been observed in other countries. Indeed, in Africa and other developing countries, asthma is consistently a disease associated with affluence.²⁷

Several factors could contribute to a higher rate of asthma in poor urban communities such as Charleston. This population could be receiving less regular medical care, leading to more episodes of asthma requiring hospitalization. They could be living in more crowded conditions, leading to more respiratory illnesses.² Even if this were true, why the dramatic increase since 1970? Poverty and housing in Charleston County has not changed dramatically during that time period. It is known that children with sensitization to the indoor allergens dust mite, cockroach, and domestic animals are at increased risk for developing asthma and that in Charleston's humid climate, dust mite sensitization is the most important. It is unlikely, however, that the Charleston black population has seen a steady increase in indoor allergen load since 1970 to explain the increase in asthma.^{21,22,28}

Another theory deserves consideration. It is known that among urban black populations there is an association between obesity and asthma.²⁹ In this population with rising asthma prevalence, there is also increased obesity, decreased exercise, increased television watching, and a more sedentary lifestyle.^{5,30,31} In contrast, asthma remains uncommon in rural areas of the world where physical exercise such as walking is a part of daily life, and children spend less time watching television.^{27,32-34} We believe that this relationship between sedentary lifestyle and increased wheezing bears additional investigation.

This study has several limitations. It was conducted in an urban population served by a university hospital, with a relatively small local population. Therefore, the results may not be generalizable to all patient populations. The only outcome measured was asthma discharges; we were not able to examine outpatient visits, morbidity, or mortality. Also, MUSC not only serves Charleston County but also draws patients from 2 nearby counties, Berkeley and Dorchester. The rates of asthma hospitalization in the present study were calculated using only the Charleston County population. However, the racial makeup of the other 2 counties served by MUSC has been similar to that of Charleston County in all census years examined, and between 1960 and 1990, the percentage of black individuals in the other 2 counties actually decreased.¹⁸ It is also worth noting that the total populations of Berkeley and Dorchester Counties have been between 10% and 40% that of Charleston County during the years examined.

Because population data were available only for each decade, the asthma discharges were averaged over 5-year periods to calculate a rate of admissions

relative to the population. Because of this averaging, it is difficult to tell exactly in which year the increase in asthma hospitalizations began. Also, because we wanted to show the most recent data available, we did not average the 1997 data.

Another limitation is that in later years of our study, other private hospitals opened in and near Charleston County, and some of the asthma patients that previously would have come to MUSC were going to other hospitals. At least 2 of the 3 primary competing hospitals, however, did not admit Medicaid or indigent patients until the 1989 expansion of Medicaid under Optional Coverage for Women and Infants. This program expanded Medicaid coverage to pregnant women and infants younger than 1 year. However, children older than 1 year were not included in this expansion and were not affected until the 1999 Title XXI State Child Health Insurance Program was introduced. Overall, our rates of asthma hospitalizations in later years may be underestimated, and most affected would be the data for white individuals, as MUSC has always cared for the majority of black inpatients.

The results of this study provide clear evidence of an increase in asthma among black children living in a southern US city during a 30-year period. This increase seems to have started around 1970, and when calculated on a population basis, the rise is 20-fold, linear, and continuing. The increase has occurred during the same time period as that seen for asthma prevalence in many other Western communities. This similarity suggests that there must be 1 or more common factors that have contributed to the increase. The scale of the change, the time course, and the linearity of the increase represent a serious challenge to many of the hypotheses proposed to explain this epidemic.

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REFERENCES

1. Mitchell EA. International trends in hospital admission rates for asthma. *Arch Dis Child*. 1985;60:376-378
2. Weiss KB, Gergen PJ, Wagener DK. Breathing better or breathing worse? The changing epidemiology of asthma morbidity and mortality. *Annu Rev Public Health*. 1993;14:491-513
3. Haahtela T, Lidholm H, Bjorksten F, Koskenvuo K, Laitinen LA. Prevalence of asthma in Finnish young men. *BMJ*. 1990;301:266-268
4. Hyndman SJ, Williams DRR, Merrill SL, Lipscombe JM, Palmer CR. Rates of admission to hospital for asthma. *BMJ*. 1994;308:1596-1600
5. Woolcock AJ, Peat JK. Evidence for the increase in asthma worldwide. In: CIBA Foundation, ed. *The Rising Trends in Asthma*. New York, NY: John Wiley & Sons; 1997:122-139
6. Lang DM, Polansky M. Patterns of asthma mortality in Philadelphia from 1969 to 1991. *N Engl J Med*. 1994;331:1542-1546
7. Evans R III, Mullally DI, Wilson RW, et al. National trends in the morbidity and mortality of asthma in the US: prevalence, hospitalization and death from asthma over two decades: 1976-1984. *Chest*. 1987; 91:655-745
8. Targonski PV, Persky VW, Orris P, Addington W. Trends in asthma mortality among African Americans and Whites in Chicago, 1968 through 1991. *Am J Public Health*. 1994;84:1830-1833
9. Mullally DI, Howard WA, Hubbard TJ, Grauman JS, Cohen SG. Increased hospitalizations for asthma among children in the Washington,

- DC area during 1961–1981. *Ann Allergy*. 1984;53:15–19
10. Weiss KB, Wagener DK. Changing patterns of asthma mortality: identifying target populations at high risk. *JAMA*. 1990;264:1683–1687
 11. Yunginger JW, Reed CE, O'Connell EJ, Melton LJ III, O'Fallon WM, Silverstein MD. A community-based study of the epidemiology of asthma: incidence rates, 1964–1983. *Am Rev Respir Dis*. 1992;146:888–894
 12. Gergen PJ, Weiss KB. Changing patterns of asthma hospitalization among children: 1979 to 1987. *JAMA*. 1990;264:1688–1692
 13. Mullally DI, Grauman JS, Evans R III, Kaslow RA. Hospitalizations of children for asthma in U. S. A. 1965–1982 [abstract] *J Allergy Clin Immunol*. 1985;75:197
 14. Halfon N, Newacheck PW. Trends in the hospitalization for acute childhood asthma, 1970–84. *Am J Public Health*. 1986;76:1308–1311
 15. Wissow LS, Gittelsohn AM, Szklo M, Starfield B, Mussman M. Poverty, race, and hospitalization for childhood asthma. *Am J Public Health*. 1988;78:777–782
 16. Mannino DM, Homa DM, Pertowski CA, et al. Surveillance for asthma—United States, 1960–1995. *Morb Mortal Wkly Rep CDC Surveill Summ*. 1998;47:1–27
 17. Vollmer WM, Osborne ML, Buist AS. 20-Year trends in the prevalence of asthma and chronic airflow obstruction in an HMO. *Am J Respir Crit Care Med*. 1998;157:1079–1084
 18. US Bureau of the Census. 1960, 1970, 1980, 1990 Census of Population and Housing: South Carolina. Washington, DC: US Bureau of the Census; 1999
 19. Jalaludin B, Chey T, Holmwood M. Admission rates as an indicator of the prevalence of severe asthma in the community. *Aust N Z J Public Health*. 1998;22:214–219
 20. Jackson RT, Mitchell EA. Trends in hospital admission rates and drug treatment of asthma in New Zealand. *N Z Med J*. 1983;96:727–729
 21. Woolcock AJ, Peat JK, Trevillion LM. Is the increase in asthma prevalence linked to increase in allergen load? *Allergy*. 1995;50:935–940
 22. Platts-Mills TAE, Sporik RB, Chapman MD, Heymann PW. The role of domestic allergens. In: CIBA Foundation, ed. *The Rising Trends in Asthma*. New York, NY: John Wiley & Sons; 1997:173–185
 23. American Academy of Allergy, Asthma, and Immunology. National Allergy Bureau Pollen and Mold Report. Available: <http://www.aaaai.org/scripts/nab/cityDetail.asp?Location=138>. Accessed July 10, 2001
 24. Gwaltney JM Jr, Hendley JO, Simon G, Jordan WS Jr. Rhinovirus infections in an industrial population: I. The occurrence of illness. *N Engl J Med*. 1966;275:1261–1268
 25. Rakes GP, Arruda E, Ingram JM, et al. Rhinovirus and respiratory syncytial virus in wheezing children requiring emergency care. *Am J Respir Crit Care Med*. 1999;159:785–790
 26. Nelson DA, Johnson CC, Divine GW, Strauchman C, Joseph CLM, Ownby DR. Ethnic differences in the prevalence of asthma in middle class children. *Ann Allergy Asthma Immunol*. 1997;78:21–26
 27. Yemaneberhan H, Bekele Z, Venn A, Lewis S, Parry E, Britton J. Prevalence of wheeze and asthma and relation to atopy in urban and rural Ethiopia. *Lancet*. 1997;350:85–90
 28. Call RS, Smith TF, Morris E, Chapman MD, Platts-Mills TAE. Risk factors for asthma in inner city children. *J Pediatr*. 1992;121:862–866
 29. Luder E, Melnik TA, DiMaio M. Association of being overweight with greater asthma symptoms in inner city black and Hispanic children. *J Pediatr*. 1998;132:699–703
 30. Heath GW, Pratt M, Warren CW, Kann L. Physical activity patterns in American high school students. Results from the 1990 youth risk behavior survey. *Arch Pediatr Adolesc Med*. 1994;148:1131–1136
 31. Gortmaker SL, Must A, Sobol AM, Peterson K, Colditz GA, Dietz WH. Television watching as a cause of increasing obesity among children in the United States, 1986–1990. *Arch Pediatr Adolesc Med*. 1996;150:356–362
 32. Turner KJ, Dowse GK, Stewart GA, Alpers MP. Studies on bronchial hyperreactivity, allergic responsiveness, and asthma in rural and urban children of the highlands of Papua New Guinea. *J Allergy Clin Immunol*. 1986;77:558–566
 33. Hemmelgarn B, Ernst P. Airway function among Inuit primary school children in far Northern Quebec. *Am J Respir Crit Care Med*. 1997;156:1870–1875
 34. Weinberg EG. Urbanization and childhood asthma: an African perspective. *J Allergy Clin Immunol*. 2000;105:224–231

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