

Epidemiology of Asthma

In Genesee County, Michigan

Elizabeth Wasilevich, MPH
Asthma Epidemiologist
Bureau of Epidemiology
Michigan Department of Community Health
517.335.8164

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Table of Contents	page
Section 1: Asthma Prevalence	4
Section 2: Hospitalization for Asthma	6
Total Population, 3-Year Rates	8
Total Population, Annual Rates	9
Sex Stratified, 3-Year Rates	10
Sex Stratified, Annual Rates	11
Race Stratified, 3-Year Rates	12
Race Stratified, Annual Rates	13
Sex and Race Stratified, 3-Year Rates	14
Sex and Race Stratified, Annual Rates	15
Income Stratified, 3-Year Rates	16
Age Stratified (0-4, 5-14, 15-34, 35-64, and ≥65), 3-Year Rates	17
Age Stratified (0-4, 5-14, 15-34, 35-64, and ≥65), Annual Rates	18
Age Stratified (<18 and ≥18), 3-Year Rates	19
Age Stratified (<18 and ≥18), Annual Rates	20
Total Population by Zip Code, 3-Year Rates	21
Section 3: Asthma Mortality	22
Total Population, 3-Year Rates	23
Total Population, Annual Rates	24
Sex Stratified, 3-Year Rates	25
Race Stratified, 3-Year Rates	26
Age Stratified (<18 and ≥18), 3-Year Rates	27
Section 4: <i>Healthy People 2010</i> Objectives for Asthma	28
<u>Hospitalization:</u>	
Children Aged <18 Years, 3-Year Rates	29
Children Aged <18 Years, Annual Rates	30
Age Stratified (0-4, 5-64, and ≥65), 3-Year Rates	31
Age Stratified (0-4, 5-64, and ≥65), Annual Rates	32
<u>Mortality:</u>	
Age Stratified (0-4, 5-14, 15-34, 35-64, and ≥65), 3-Year Rates	33

<i>Table of Contents (continued)</i>	page
Section 5: Appendix	34
<u>Hospitalization:</u>	
Total Population, Annual Rates for County and State	35
Males, Annual Rates for County and State	36
Females, Annual Rates for County and State	37
Whites, Annual Rates for County and State	38
Blacks, Annual Rates for County and State	39
White Males, Annual Rates for County and State	40
White Females, Annual Rates for County and State	41
Black Males, Annual Rates for County and State	42
Black Females, Annual Rates for County and State	43
Children Aged 0-4 Years, Annual Rates for County and State	44
Children Aged 5-14 Years, Annual Rates for County and State	45
Children/Adults Aged 15-34 Years, Annual Rates for County and State	46
Adults Aged 35-64 Years, Annual Rates for County and State	47
Adults Aged ≥65 Years, Annual Rates for County and State	48
Children Aged <18 Years, Annual Rates for County and State	49
Adults Aged ≥18 Years, Annual Rates for County and State	50
Genesee County, 3-Year Rates	51
<u>Mortality:</u>	
Total Population, Annual Rates for County and State	52
<u>HP 2010 Hospitalization:</u>	
Children Aged <18 Years, Annual Rates for County and State	53
Children Aged 0-4 Years, Annual Rates for County and State	54
Children/Adults Aged 5-64 Years, Annual Rates for County and State	55
Adults Aged ≥65 Years, Annual Rates for County and State	56
Section 6: Data Sources	57
Section 7: Methods	59

Section 1: Asthma Prevalence

Prevalence is the proportion of individuals in a population who have the disease at a point in time or during a given time period. It is often used to describe the health burden on a given population. Using prevalence estimates of current asthma from the Michigan Behavioral Risk Factor Survey (BRFS), estimates of the number with asthma living in each county are given in this section.

Current asthma prevalence is the proportion of survey respondents who reported that in their lifetime a health care professional told them they have asthma and reported “yes” to the question: Do you still have asthma?

The Michigan BRFS is the source of most estimates of the prevalence of certain health behaviors, conditions, and practices associated with leading causes of death. Data are collected quarterly by telephone interview; a sample of telephone numbers is selected using a list-assisted, random-digit dialed methodology.

From this survey, the prevalence of asthma can be determined for adults (≥ 18 years) and children (< 18 years). Data for children are based on information provided by an adult respondent about children living in their home. Due to small sample size, descriptive information regarding children is limited, precluding prevalence analysis by age, race, and sex strata.

Data from the BRFS are designed to estimate prevalence statewide. However, using asthma prevalence for the State of Michigan, we can approximate the number of individuals with asthma in specific counties and local coalitions. In this report, the number of adults (≥ 18 years) with asthma was calculated using the asthma prevalence rates from the 2003 Michigan Behavioral Risk Factor Survey. The number of children with asthma was calculated from the prevalence rates reported in the 2002 Michigan Behavioral Risk Factor Survey.

Number of Children (aged less than 18 years) [1] and Adults (aged 18 years and older) [2] with Asthma in Genesee County and the State of Michigan.

	Children (<18 Years)	Adults (≥18 Years)
	2002	2003
Genesee County	10,854	30,156
Michigan	233,894	701,319

1 Number of children with current asthma was calculated by multiplying the population of children in 2002 by the percentage of adults reporting current asthma for children in the home in the 2002 Michigan BRFSS.

2 Number of adults with current asthma was calculated by multiplying the population of adults in 2003 by the percentage reporting current asthma in the 2003 Michigan BRFSS.

Data Source: Behavioral Risk Factor Survey, Michigan, 2002 and 2003

Section 2: Hospitalization for Asthma

Preventable hospitalizations are those where timely and effective ambulatory care can prevent the onset of an illness or condition, control an acute episode of an illness, or manage a chronic disease or condition so that hospitalization is unnecessary. Asthma hospitalizations are considered preventable because patients with asthma should be able to stay out of the hospital if they have and use good asthma management techniques.

Hospitalization data was acquired from the Michigan Inpatient Database for the years 1990 to 2002. All hospital discharges from any of Michigan's reporting acute care hospitals or Michigan residents discharged from reporting acute care hospitals in contiguous states are included in this database. It includes virtually all hospitalizations in Michigan and for Michigan residents during this time period.

There is no confirmed case classification for an asthma hospitalization. In accordance with the case definition for a probable asthma hospitalization recommended by the Council for State and Territorial Epidemiologists (CSTE), all inpatient hospitalizations are selected from the database where asthma was the primary reason for the stay. (Position Statement 1998-EH/CD1) These are hospitalizations with primary discharge diagnosis coded to the International Classification of Disease (ICD) Version-9-CM codes 493.XX.

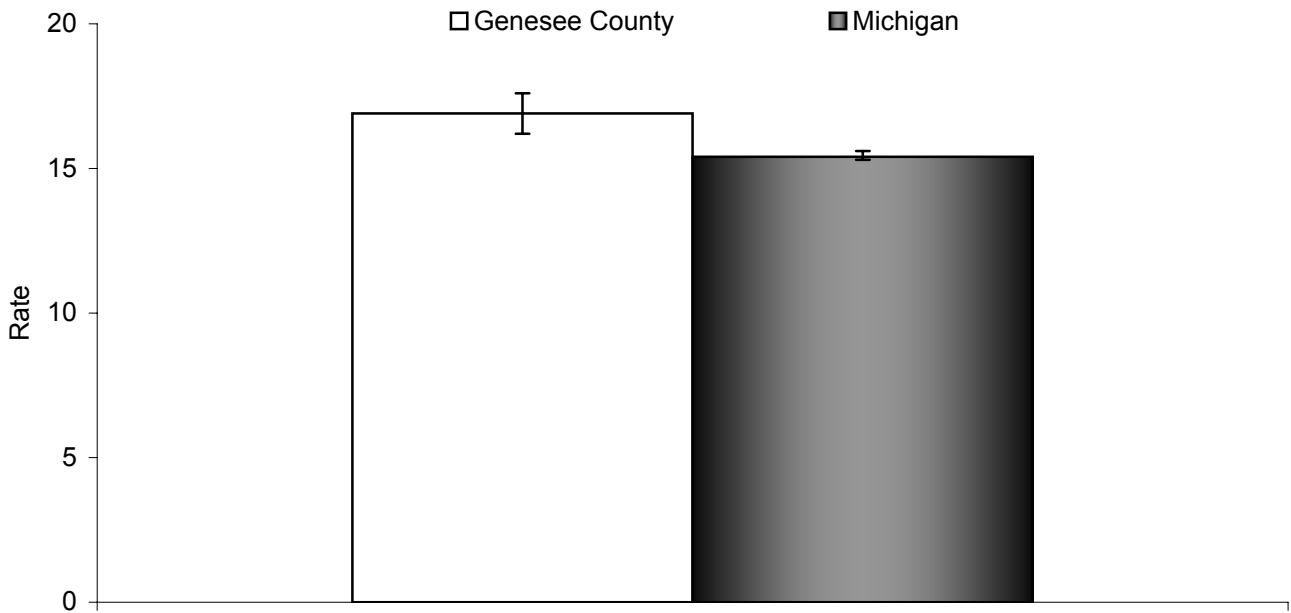
These data are the number of inpatient hospitalizations for asthma. This is not the same as the number of individual people hospitalized for asthma. An individual can be hospitalized more than once for the same condition during the study period and multiple hospitalizations cannot be distinguished from this data source. From these data, age-adjusted asthma hospitalization rates are calculated and presented per 10,000 population. Rates are age adjusted so that valid comparisons can be made between populations of different age distributions.

Hospitalization rates for demographic or geographic units with a small number of events (less than or equal to 20 events) or a small population size (less than 5,000 population) are not calculated because these rates are statistically unstable. In addition, to protect the identity of persons who have been hospitalized, counts less than 5 are not presented in this report.

Ninety five percent confidence intervals are computed for hospitalization rates where more than one year of data are combined. The confidence interval estimates the statistical uncertainty of the asthma hospitalization rate and can be used to test whether a specific measure is statistically different between groups. Average asthma hospitalization rates are considered statistically different between groups if their 95% confidence intervals do not overlap. This technique is used to compare rates for demographic subpopulations, such as male versus female, and geographical subpopulations, such as county versus state.

To determine if annual asthma hospitalization rates follow an increasing or decreasing trend over the 13-year period 1990-2002, the Spearman Correlation Coefficient and its accompanying statistical Rank Correlation Test are utilized. This test assesses whether there is a statistically significant monotonic relationship between 2 variables, in this case year and asthma hospitalization rate, without making any assumption about the underlying distribution of the data. This statistical test does not determine the significance of more complex trend patterns. There is no way to know from these statistics if a specific event or series of events caused a change in asthma hospitalization rates.

Figure 1. Rates (per 10,000) [1,2] of Hospitalization due to Asthma [3] for Genesee County and the State of Michigan, All Ages, 2000-2002.



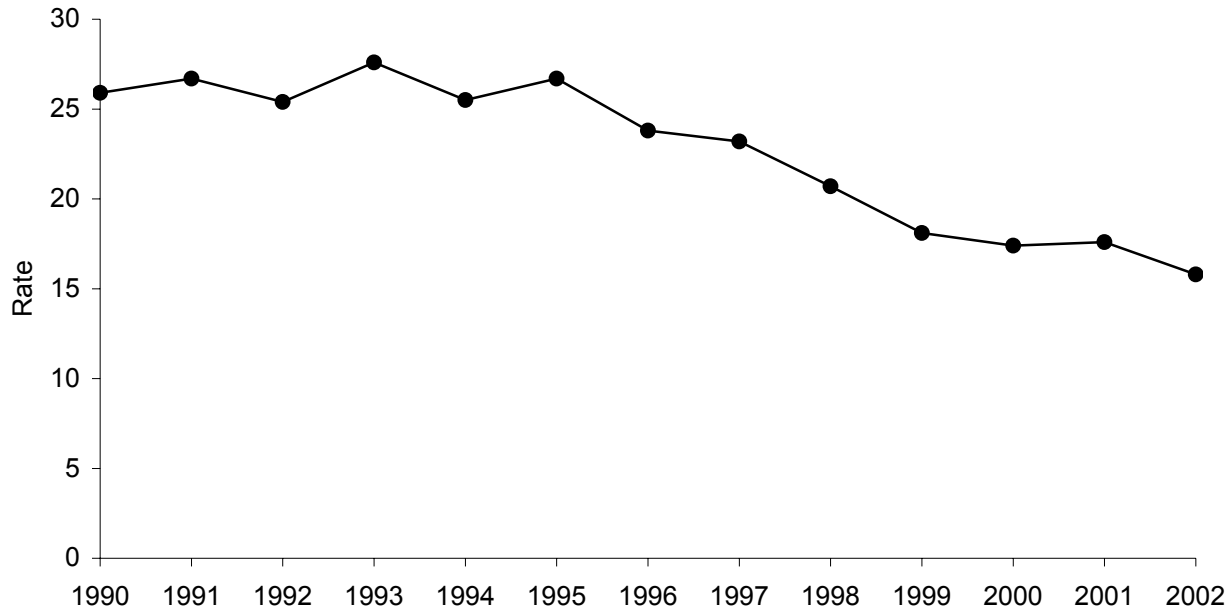
- 1 Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
- 2 Population estimates are taken from the Michigan population estimates for 2001.
- 3 Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

	Total Population
Genesee County Rate	16.9
95% CI	16.2 , 17.6
Count	2,248
Michigan Rate	15.4
95% CI	15.3 , 15.6
Count	45,945

Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

- ✧ The average number of hospitalizations due to asthma per year in Genesee County, 2000-2002, is 749.
- ✧ Genesee County has significantly higher asthma hospitalization rates than the State of Michigan as a whole, 2000-2002.

Figure 2. Annual Rates (per 10,000) [1,2] of Asthma [3] Hospitalization, All Ages, for Genesee County, 1990-2002.



- 1 Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
- 2 Population estimates are taken from the Michigan population estimates for 1990-2002.
- 3 Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

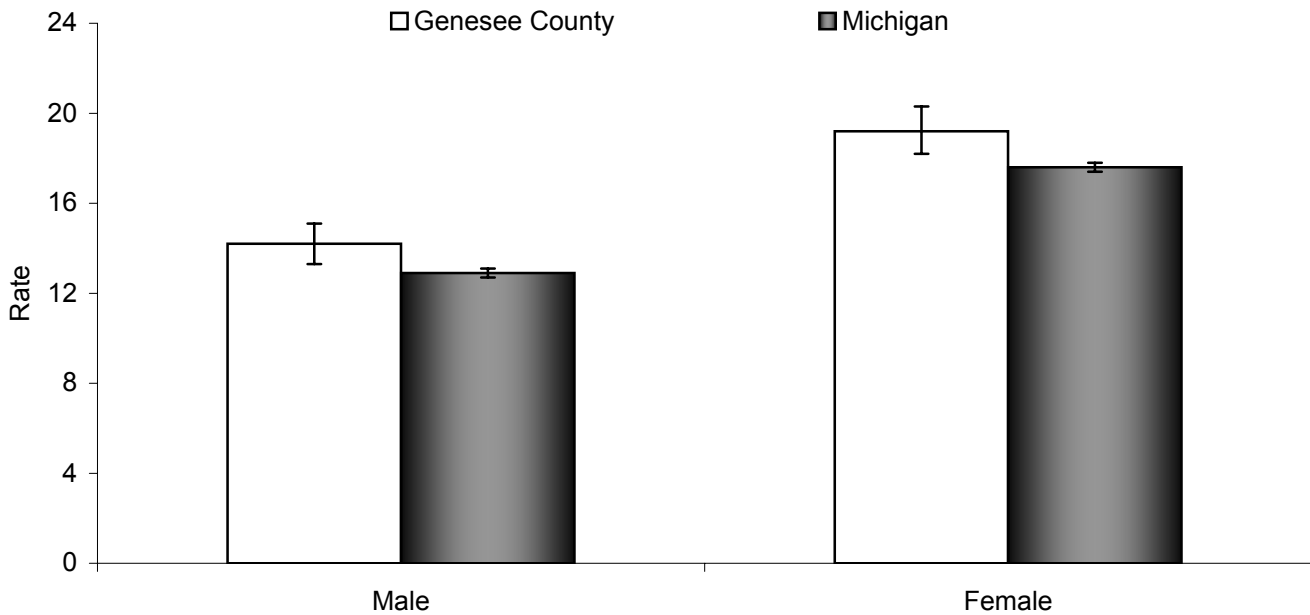
Year	Total Population	
	Rate	Count
1990	25.9	1,121
1991	26.7	1,166
1992	25.4	1,117
1993	27.6	1,208
1994	25.5	1,107
1995	26.7	1,179
1996	23.8	1,054
1997	23.2	1,026
1998	20.7	905
1999	18.1	793
2000	17.4	770
2001	17.6	778
2002	15.8	700

Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

✧ Between 1990 and 2002, there has been a significant overall decrease in asthma hospitalization rates among persons in Genesee County ($\rho = -0.89$, $p < 0.01$).

See appendix page 35 for supporting data.

Figure 3. Rates (per 10,000) [1,2] of Hospitalization due to Asthma [3] by Sex for Genesee County and the State of Michigan, All Ages, 2000-2002.



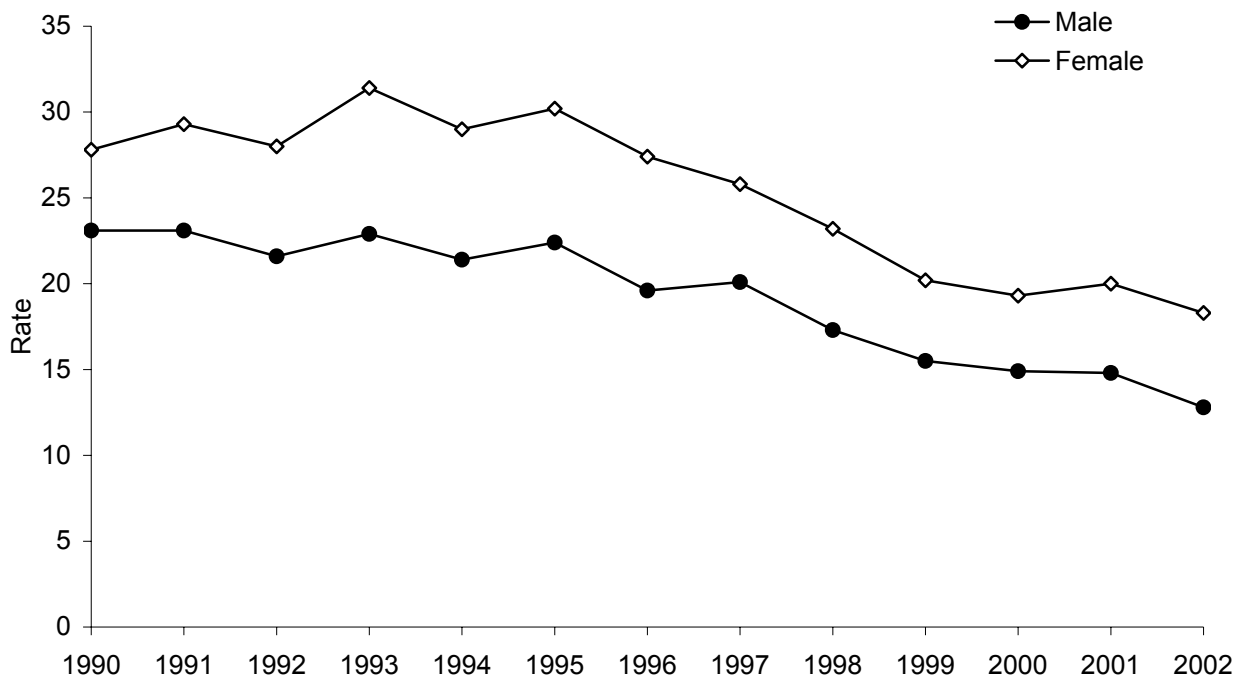
- 1 Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
- 2 Population estimates are taken from the Michigan population estimates for 2001.
- 3 Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

	Male	Female
Genesee County Rate	14.2	19.2
95% CI	13.3 , 15.1	18.2 , 20.3
Count	937	1,311
Michigan Rate	12.9	17.6
95% CI	12.7 , 13.1	17.4 , 17.8
Count	18,987	26,958

Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

- ✧ The asthma hospitalization rates for males and females in Genesee County are significantly higher than the respective rates for the State of Michigan as a whole, 2000-2002.
- ✧ In Genesee County and the State of Michigan, females have significantly higher asthma hospitalization rates than males, 2000-2002.

Figure 4. Annual Rates (per 10,000) [1,2] of Asthma [3] Hospitalization by Sex, All Ages, for Genesee County, 1990-2002.



1 Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.

2 Population estimates are taken from the Michigan population estimates for 1990-2002.

3 Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

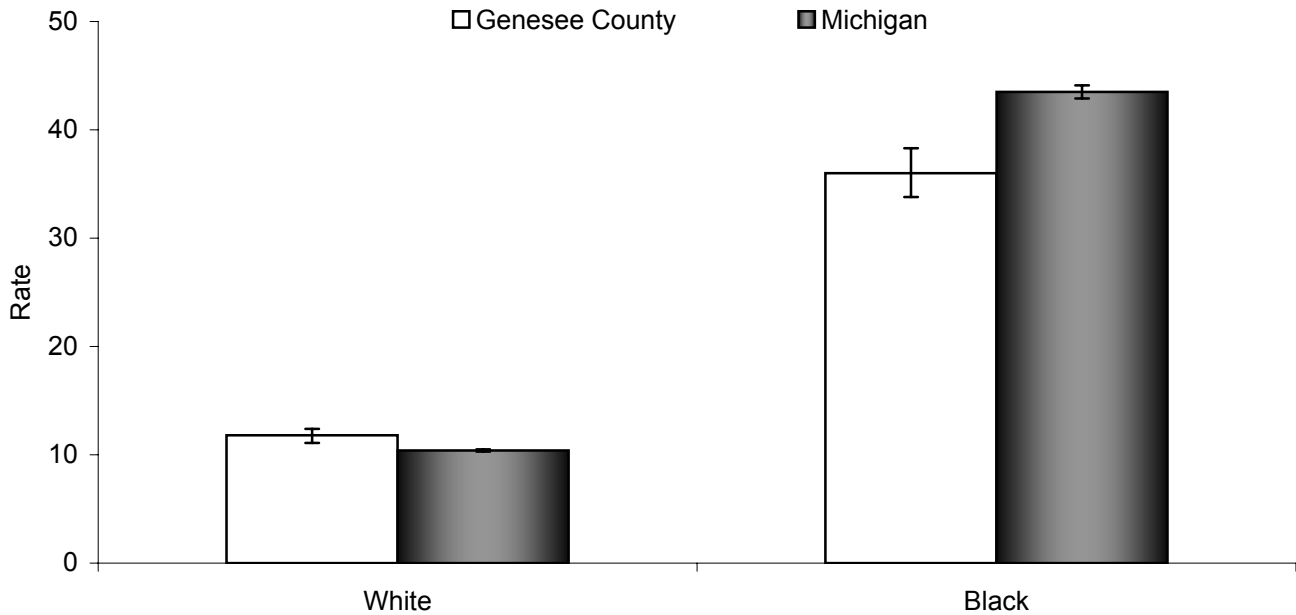
Year	Male		Female	
	Rate	Count	Rate	Count
1990	23.1	500	27.8	621
1991	23.1	507	29.3	659
1992	21.6	485	28.0	632
1993	22.9	503	31.4	705
1994	21.4	460	29.0	647
1995	22.4	497	30.2	680
1996	19.6	435	27.4	619
1997	20.1	444	25.8	582
1998	17.3	384	23.2	521
1999	15.5	336	20.2	457
2000	14.9	332	19.3	438
2001	14.8	324	20.0	454
2002	12.8	281	18.3	419

Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

◇ Between 1990 and 2002, there has been a significant overall decrease in asthma hospitalization rates for both the male and female populations in Genesee County (male, $\rho = -0.97$, $p < 0.01$; female, $\rho = -0.84$, $p < 0.01$).

See appendix pages 36 and 37 for supporting data.

Figure 5. Rates (per 10,000) [1,2] of Hospitalization due to Asthma [3] by Race [4] for Genesee County and the State of Michigan, All Ages, 2000-2002.



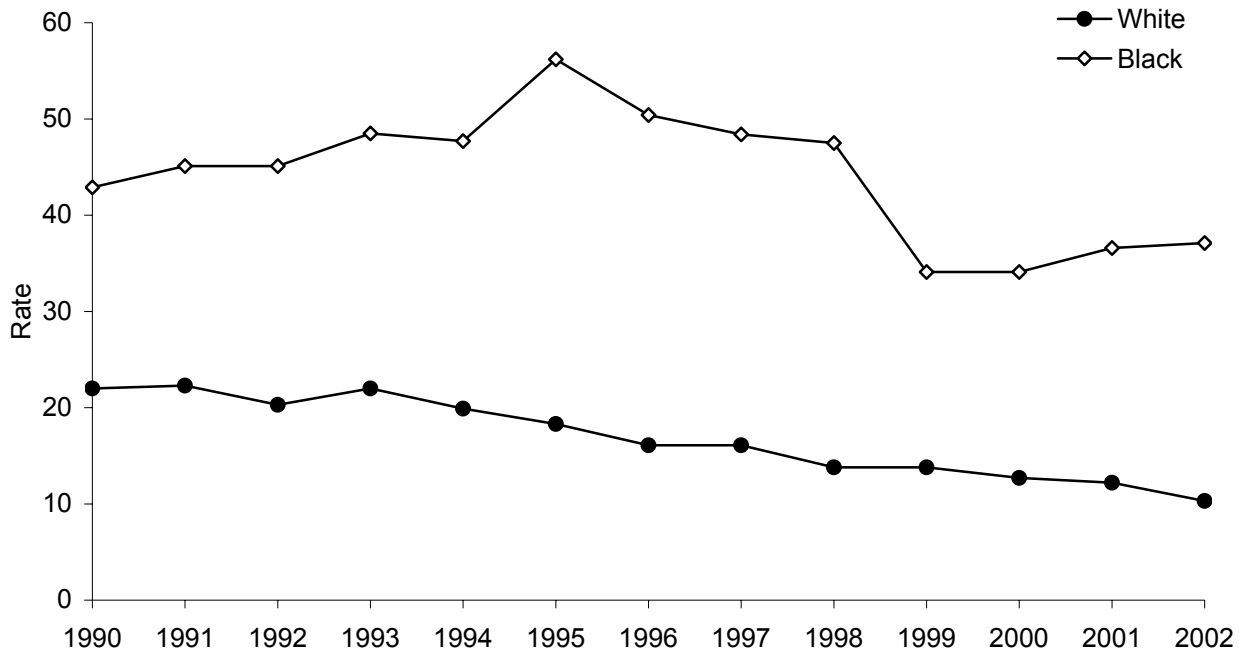
- 1 Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
- 2 Population estimates are taken from the Michigan population estimates for 2001.
- 3 Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.
- 4 For records that are missing data for race, race was assigned based on the 1990 census population for Michigan.

	White	Black
Genesee County Rate	11.8	36.0
95% CI	11.1 , 12.4	33.8 , 38.3
Count	1,190	1,044
Michigan Rate	10.4	43.5
95% CI	10.3 , 10.5	42.9 , 44.1
Count	25,455	19,685

Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

- ✧ The asthma hospitalization rate for white persons in Genesee County is significantly higher than the rate among white persons in the State of Michigan as a whole, 2000-2002.
- ✧ The asthma hospitalization rate for black persons in Genesee County is significantly lower than the rate among black persons in the State of Michigan as a whole, 2000-2002.
- ✧ The asthma hospitalization rates for white persons in Genesee County and the State of Michigan are significantly lower than the respective rates for black persons, 2000-2002.
- ✧ While black persons in Genesee County and the State of Michigan have higher asthma hospitalization rates, white persons experience the greatest absolute burden of asthma hospitalization.

Figure 6. Annual Rates (per 10,000) [1,2] of Asthma [3] Hospitalization by Race [4], All Ages, for Genesee County, 1990-2002.



- 1 Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
- 2 Population estimates are taken from the Michigan population estimates for 1990-2002.
- 3 Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.
- 4 For records that are missing data for race, race was assigned based on the 1990 census population for Michigan.

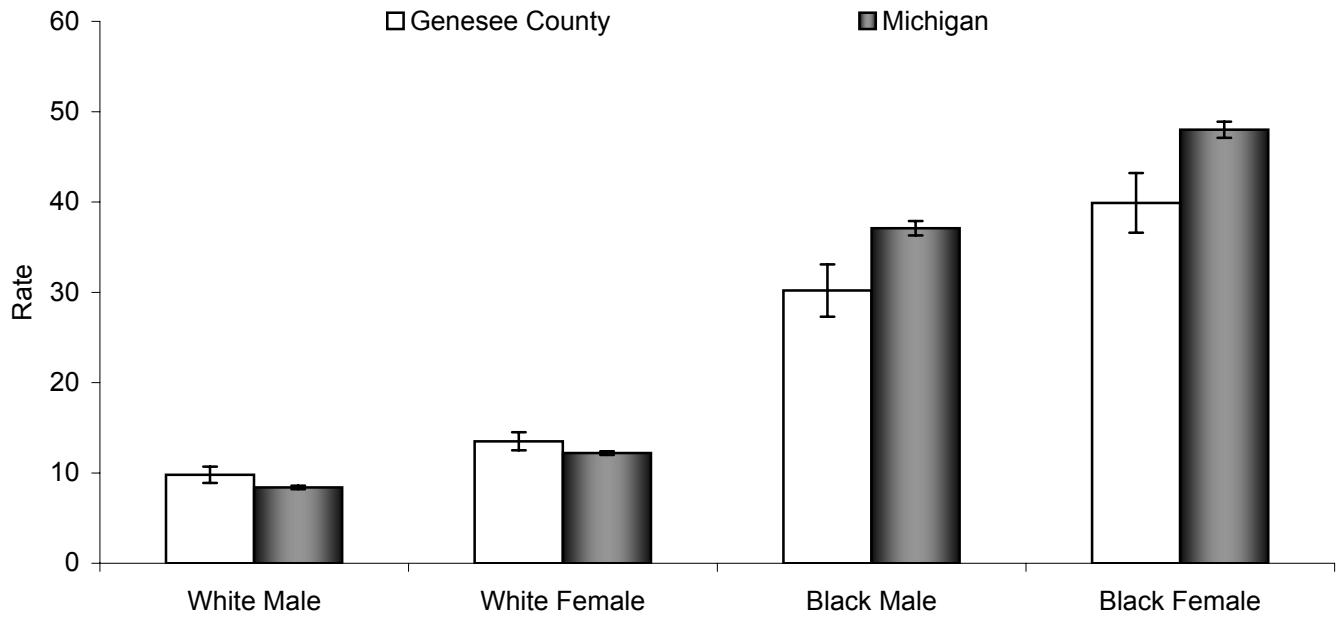
Year	White		Black	
	Rate	Count	Rate	Count
1990	22.0	744	42.9	374
1991	22.3	751	45.1	412
1992	20.3	685	45.1	424
1993	22.0	741	48.5	462
1994	19.9	666	47.7	438
1995	18.3	614	56.2	558
1996	16.1	544	50.4	507
1997	16.1	537	48.4	487
1998	13.8	461	47.5	442
1999	13.8	463	34.1	324
2000	12.7	426	34.1	341
2001	12.2	413	36.6	359
2002	10.3	351	37.1	344

Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

✧ Between 1990 and 2002, there has been a significant overall decrease in asthma hospitalization rates among white persons in Genesee County ($\rho = -0.98$, $p < 0.01$).

See appendix pages 38 and 39 for supporting data.

Figure 7. Rates (per 10,000) [1,2] of Hospitalization due to Asthma [3] by Sex and Race [4] for Genesee County and the State of Michigan, All Ages, 2000-2002.



1 Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.

2 Population estimates are taken from the Michigan population estimates for 2001.

3 Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

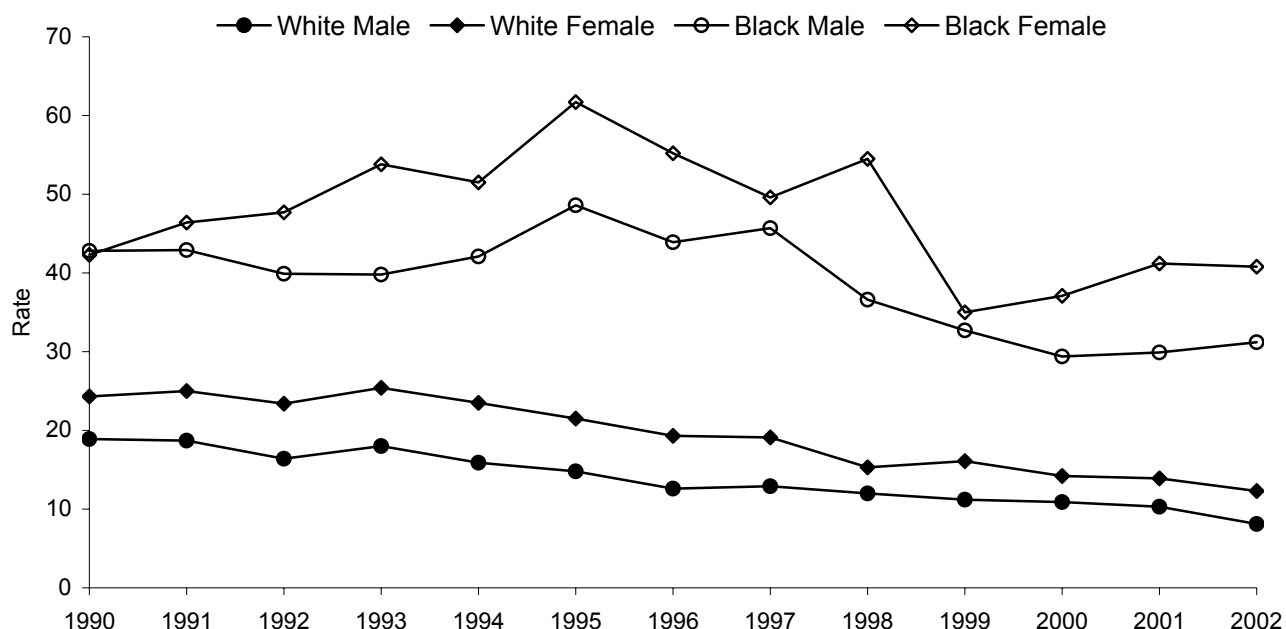
4 For records that are missing data for race, race was assigned based on the 1990 census population for Michigan.

	White Male	White Female	Black Male	Black Female
Genesee County Rate	9.8	13.5	30.2	39.9
95% CI	8.9 , 10.7	12.5 , 14.5	27.3 , 33.1	36.6 , 43.2
Count	478	712	451	593
Michigan Rate	8.4	12.2	37.1	48.0
95% CI	8.2 , 8.6	12.0 , 12.4	36.3 , 37.9	47.1 , 48.9
Count	9,916	15,539	8,702	10,983

Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

- ✧ In Genesee County, the asthma hospitalization rate for black females is significantly higher than the rates among white males, white females, or black males, 2000-2002.
- ✧ In Genesee County, the asthma hospitalization rate for black persons is significantly higher than the rate among white persons, 2000-2002, regardless of sex.

Figure 8. Annual Rates (per 10,000) [1,2] of Asthma [3] Hospitalization by Sex and Race [4], All Ages, for Genesee County, 1990-2002.



1 Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.

2 Population estimates are taken from the Michigan population estimates for 1990-2002.

3 Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

4 For records that are missing data for race, race was assigned based on the 1990 census population for Michigan.

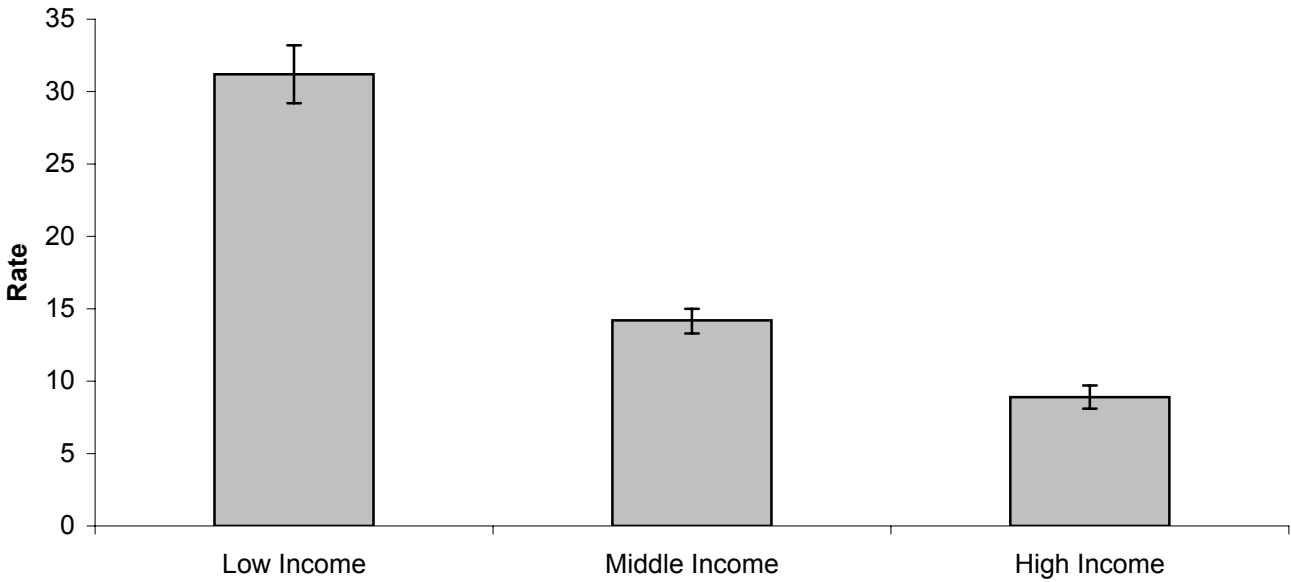
Year	White Male		White Female		Black Male		Black Female	
	Rate	Count	Rate	Count	Rate	Count	Rate	Count
1990	18.9	313	24.3	431	42.8	185	42.3	189
1991	18.7	310	25.0	441	42.9	197	46.4	215
1992	16.4	275	23.4	410	39.9	207	47.7	217
1993	18.0	294	25.4	447	39.8	208	53.8	254
1994	15.9	256	23.5	410	42.1	202	51.5	236
1995	14.8	241	21.5	373	48.6	254	61.7	304
1996	12.6	206	19.3	338	43.9	227	55.2	280
1997	12.9	208	19.1	329	45.7	236	49.6	251
1998	12.0	198	15.3	263	36.6	186	54.5	256
1999	11.2	181	16.1	282	32.7	154	35.0	170
2000	10.9	179	14.2	247	29.4	152	37.1	189
2001	10.3	167	13.9	246	29.9	153	41.2	206
2002	8.1	132	12.3	219	31.2	146	40.8	198

Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

✧ Between 1990 and 2002, there has been a significant overall decrease in asthma hospitalization rates among the white male, white female, and black male populations in Genesee County (white male, $\rho = -0.99$, $p < 0.01$; white female, $\rho = -0.95$, $p < 0.01$; black male, $\rho = -0.62$, $p < 0.05$).

See appendix pages 40 through 43 for supporting data.

Figure 9. Rates (per 10,000) [1,2] of Hospitalization due to Asthma [3] by Income [4] for Genesee County, 2000-2002.



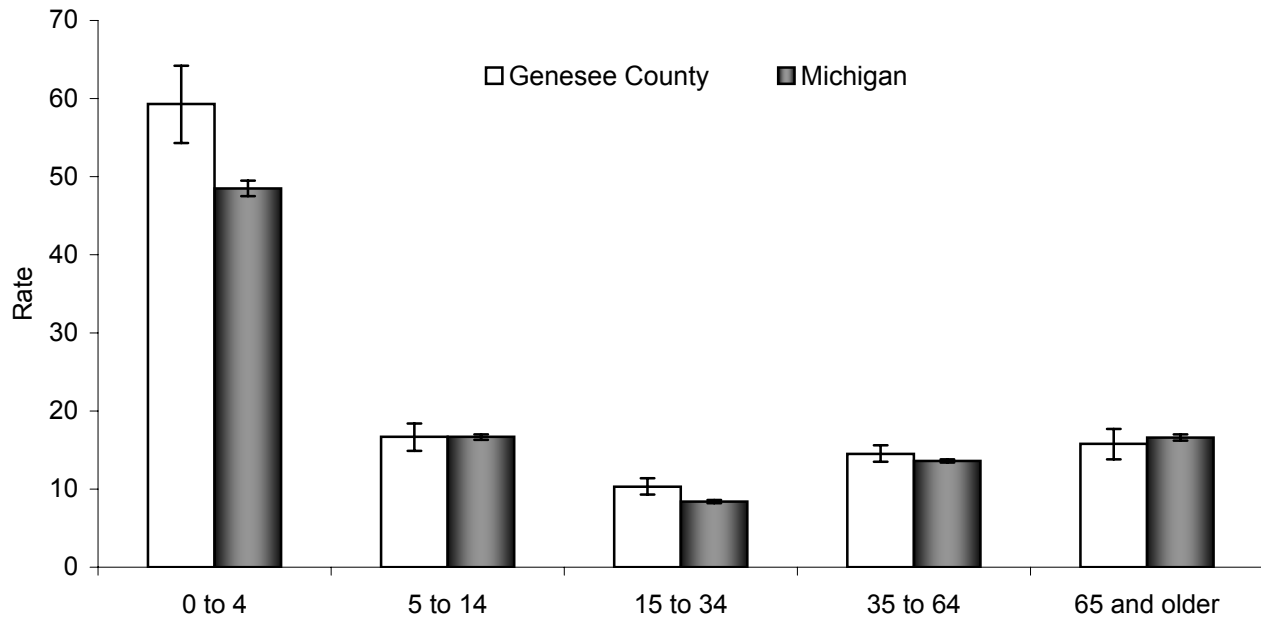
- 1 Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
- 2 Populations are taken from the 2000 US Census.
- 3 Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.
- 4 High income = top 20% of Michigan's zip code areas, as determined by median household income from Census 2000; Low income = bottom 20% of Michigan's zip code areas, as determined by median household income from Census 2000; all others are considered middle income.

	Low Income	Middle Income	High Income
Genesee County Rate	31.2	14.2	8.9
95% CI	29.2 , 33.2	13.3 , 15.0	8.1 , 9.7
Count	1,007	1,053	459

Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

✧ In Genesee County, the asthma hospitalization rate for low income areas is significantly higher than the rate for high or middle income areas, 2000-2002.

Figure 10. Rates (per 10,000) [1] of Hospitalization due to Asthma [2] by Age Group for Genesee County and the State of Michigan, 2000-2002.



1 Population estimates are taken from the Michigan population estimates for 2001.

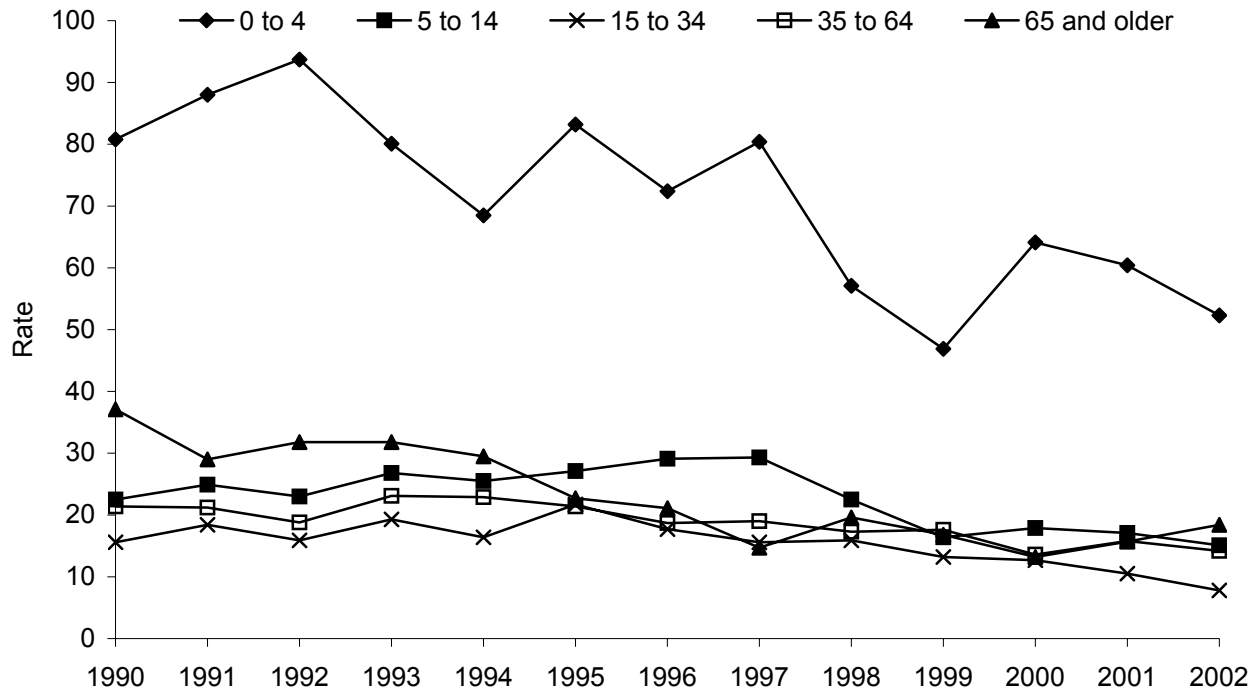
2 Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

	0 to 4	5 to 14	15 to 34	35 to 64	65 and older
Genesee County Rate	59.3	16.7	10.3	14.5	15.8
95% CI	54.3 , 64.2	14.9 , 18.4	9.3 , 11.4	13.5 , 15.6	13.8 , 17.7
Count	556	342	364	742	244
Michigan Rate	48.5	16.7	8.4	13.6	16.6
95% CI	47.5 , 49.5	16.3 , 17.0	8.2 , 8.6	13.4 , 13.8	16.2 , 17.0
Count	9,637	7,375	6,859	15,964	6,110

Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

- ✧ For Genesee County and the State of Michigan, children aged 0 to 4 years have significantly higher rates of asthma hospitalization than all other age groups, 2000-2002.
- ✧ For Genesee County and the State of Michigan, persons aged 15 to 34 years have significantly lower rates of asthma hospitalization than all other age groups, 2000-2002.

Figure 11. Annual Rates (per 10,000) [1] of Asthma [2] Hospitalization by Age Group for Genesee County, 1990-2002.



1 Population estimates are taken from the Michigan population estimates for 1990-2002.

2 Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

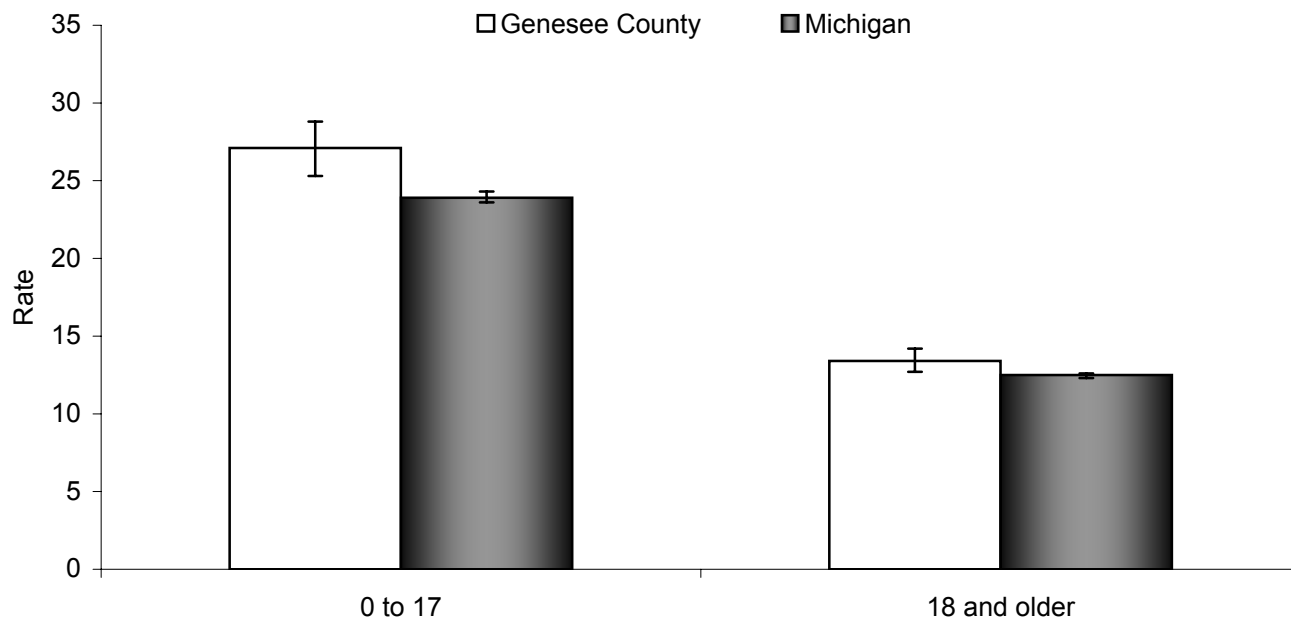
Year	0 to 4		5 to 14		15 to 34		35 to 64		65 and older	
	Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count
1990	80.8	275	22.5	150	15.6	214	21.4	319	37.1	163
1991	88.0	302	24.9	167	18.4	247	21.2	320	29.0	130
1992	93.7	322	23.0	154	15.9	209	18.8	287	31.8	145
1993	80.1	275	26.8	180	19.3	248	23.1	357	31.8	148
1994	68.5	232	25.5	171	16.4	207	22.9	358	29.5	139
1995	83.2	276	27.1	184	21.7	271	21.4	339	22.7	109
1996	72.4	235	29.1	198	17.7	218	18.7	301	21.1	102
1997	80.4	257	29.3	200	15.6	189	19.0	308	14.7	72
1998	57.1	181	22.5	154	15.9	190	17.3	283	19.6	97
1999	46.9	148	16.4	113	13.2	156	17.6	292	16.8	84
2000	64.1	202	17.9	122	12.7	149	13.6	230	13.2	67
2001	60.4	189	17.1	117	10.5	123	15.8	268	15.7	81
2002	52.3	165	15.1	103	7.8	92	14.2	244	18.4	96

Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

✧ Between 1990 and 2002, there has been a significant overall decrease in asthma hospitalization rates among the populations aged 0 to 4 years, 15 to 34 years, 35 to 64 years, and 65 years and older in Genesee County (0 to 4, $\rho = -0.82$, $p < 0.01$; 15 to 34, $\rho = -0.69$, $p < 0.05$; 35 to 64, $\rho = -0.81$, $p < 0.01$; 65 and older, $\rho = -0.86$, $p < 0.01$).

See appendix pages 44 through 48 for supporting data.

Figure 12. Rates (per 10,000) [1,2] of Hospitalization due to Asthma [3] by Age Group for Genesee County and the State of Michigan, 2000-2002.



1 Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.

2 Population estimates are taken from the Michigan population estimates for 2001.

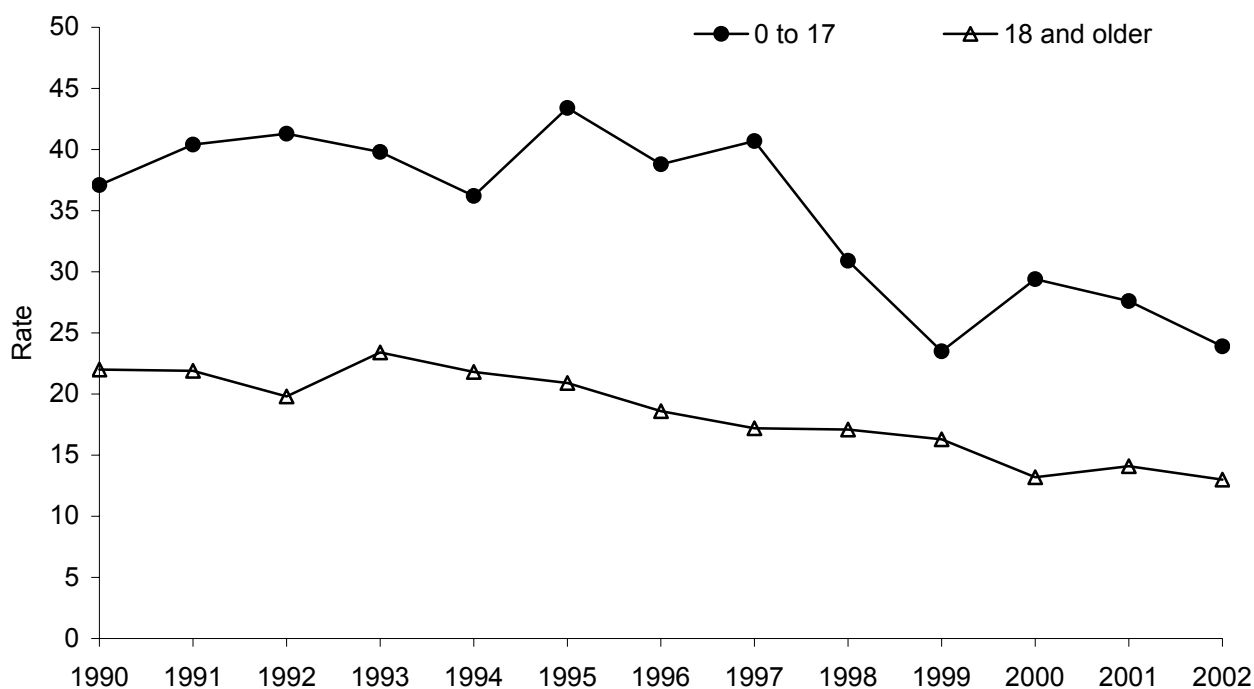
3 Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

	0 to 17	18 and Older
Genesee County Rate	27.1	13.4
95% CI	25.3 , 28.8	12.7 , 14.2
Count	958	1,290
Michigan Rate	23.9	12.5
95% CI	23.6 , 24.3	12.3 , 12.6
Count	18,141	27,804

Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

- ✧ For Genesee County and the State of Michigan, the rates of asthma hospitalization for children less than 18 years of age are significantly higher than the respective rates for adults aged 18 years and older, 2000-2002.
- ✧ The rates of asthma hospitalization for children less than 18 years of age and adults aged 18 years and older in Genesee County are significantly higher than the respective rates for the State of Michigan as a whole, 2000-2002.

Figure 13. Annual Rates (per 10,000) [1,2] of Asthma [3] Hospitalization by Age Group for Genesee County, 1990-2002.



1 Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.

2 Population estimates are taken from the Michigan population estimates for 1990-2002.

3 Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

Year	0 to 17		18 and Older	
	Rate	Count	Rate	Count
1990	37.1	456	22.0	665
1991	40.4	501	21.9	665
1992	41.3	512	19.8	605
1993	39.8	491	23.4	717
1994	36.2	443	21.8	664
1995	43.4	530	20.9	649
1996	38.8	470	18.6	584
1997	40.7	488	17.2	538
1998	30.9	369	17.1	536
1999	23.5	280	16.3	513
2000	29.4	349	13.2	421
2001	27.6	326	14.1	452
2002	23.9	283	13.0	417

Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

✧ Between 1990 and 2002, there has been a significant overall decrease in asthma hospitalization rates among children aged less than 18 years and adults aged 18 years and older in Genesee County (less than 18, $\rho = -0.69$, $p < 0.05$; 18 and older, $\rho = -0.93$, $p < 0.01$).

See appendix pages 49 and 50 for supporting data.

Rates (per 10,000) [1,2] of Hospitalization due to Asthma [3] by Zip Code of Residence, Genesee County, All Ages, 2000-2002.

Zip Code	Count	Rate	95% Confidence Interval	
			Lower Limit	Upper Limit
48415	36	13.2	8.8	17.6
48418	17	‡	‡	‡
48420	50	7.9	5.7	10.1
48421	23	12.5	6.8	18.1
48423	113	12.4	10.1	14.7
48429	30	9.8	6.3	13.3
48430	52	5.6	4.0	7.1
48433	67	9.2	6.9	11.4
48436	10	‡	‡	‡
48437	~	‡	‡	‡
48438	8	‡	‡	‡
48439	104	8.8	7.1	10.4
48442	63	11.8	8.8	14.8
48449	21	18.2	10.3	26.1
48451	28	7.5	4.6	10.3
48457	24	9.3	5.6	13.1
48458	150	19.9	16.7	23.1
48462	49	15.3	10.5	20.0
48463	12	‡	‡	‡
48464	6	‡	‡	‡
48473	61	10.8	8.0	13.5
48502	15	‡	‡	‡
48503	186	20.9	17.9	24.0
48504	363	29.7	26.6	32.9
48505	443	41.6	37.6	45.5
48506	174	16.5	14.1	19.0
48507	194	19.0	16.3	21.7
48509	38	12.3	8.4	16.3
48519	24	11.5	6.9	16.1
48529	38	11.1	7.5	14.7
48532	89	15.2	12.0	18.4
48746	30	11.4	7.2	15.5
Genesee County	2,248	16.9	16.2	17.6

1 Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.

2 Populations are taken from the 2000 US Census.

3 Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

‡ Insufficient data to compute a stable rate (number of events ≤20 or population <5000).

~ Number of hospitalizations <5.

Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

Section 3: Asthma Mortality

Successful asthma management reduces symptoms and improves quality of life. Failure to maintain good control of the disease results in a higher risk of mortality. Death due to asthma is a rare and preventable event, indicative of difficulty in self-management and/or access to care.

Mortality data are acquired from the Michigan Resident Death Files for the years 1990 to 2003. This database includes all deaths in Michigan and deaths of Michigan residents where the death occurred out-of-state. As recommended by the Council for State and Territorial Epidemiologists (Position Statement 1998-EH/CD 1), deaths where asthma is primary cause are selected from these data. From 1990 to 1998, these are deaths with primary cause coded to International Classification of Disease (ICD) Version-9 codes 493.XX. Deaths occurring from 1999 to 2003 are classified according to ICD Version 10; ICD-10 codes for asthma are J45 and J46. The ICD-10 coding scheme is different and more detailed than its predecessor, ICD-9. Deaths coded with ICD-10 are not directly comparable to deaths coded with ICD-9.

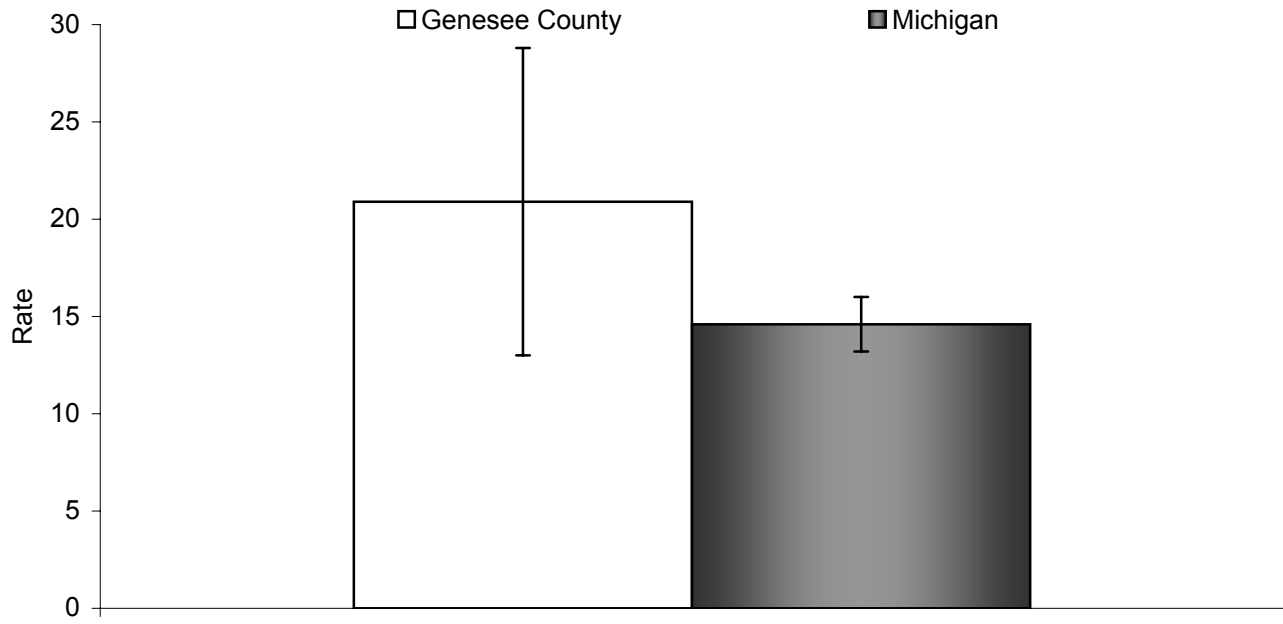
While a comparability ratio between ICD-9 and ICD-10 exists for asthma (0.8938; that is, for every 100 asthma deaths coded with ICD-9, only 89.38 would be coded as asthma using ICD-10), the analysis presented here does not attempt to compare pre-1999 data with asthma death occurring since 1999. (Anderson RN, *et al.* National Vital Statistics Reports; 49(2). 2001)

Age-adjusted asthma mortality rates are calculated and presented per 1,000,000 population. Rates are age adjusted so that valid comparisons can be made between populations of different age distributions. Mortality rates for demographic units with a small number of events (less than 5 events) or a small population size (less than 5,000 population) are not calculated because these rates are statistically unstable. In addition, to protect the identity of the deceased, counts less than 5 are not presented in this report.

Ninety five percent confidence intervals are computed for asthma mortality rates where more than one year of data are combined. The confidence interval estimates the statistical uncertainty of the mortality rate and can be used to test whether rates are statistically different between groups. Average asthma mortality rates are considered statistically different between groups if their 95% confidence intervals do not overlap. This technique is used to compare rates for demographic subpopulations, such as male versus female, and geographical subpopulations, such as county versus state.

Due to the difference in asthma mortality coding between pre-1999 and 1999-present data, trend analyses were not conducted.

Figure 14. Rates (per 1,000,000) [1,2] of Mortality due to Asthma [3] for Genesee County and the State of Michigan, All Ages, 2001-2003.



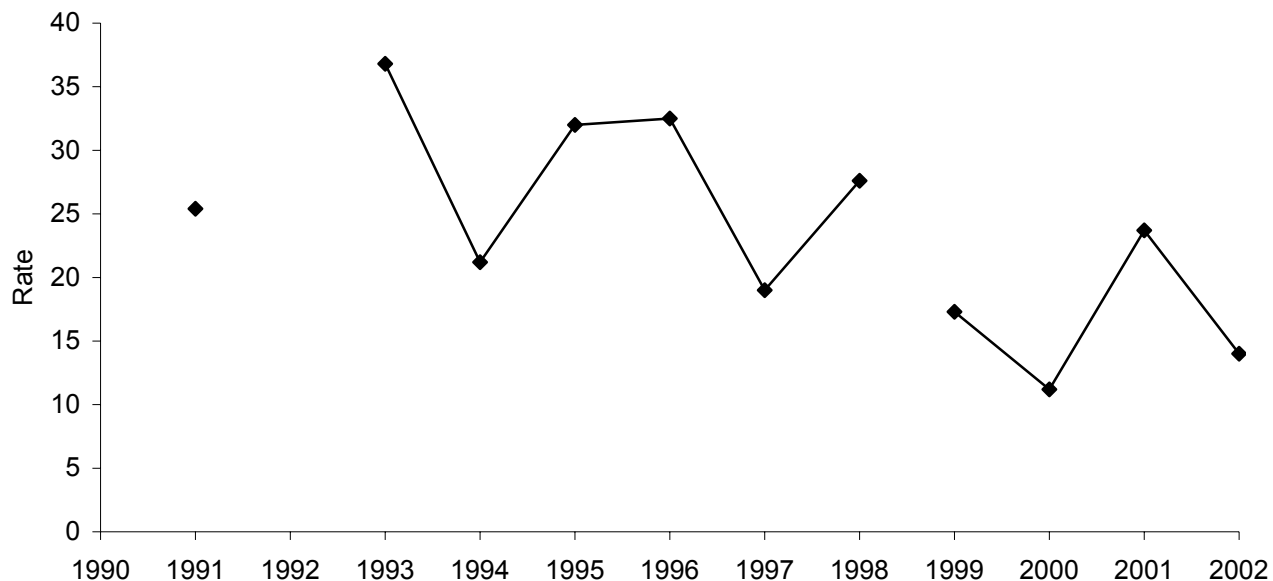
- 1 Rates are age adjusted to the 2000 US standard population by the direct standardization method.
- 2 Population estimates are taken from the Michigan population estimates for 2002.
- 3 Asthma death is defined as a primary cause of death as asthma, ICD-10=J45 or J46.

	Total Population
Genesee County Rate	20.9
95% CI	13.0 , 28.8
Count	27
Michigan Rate	14.6
95% CI	13.2 , 16.0
Count	441

Data Source: Michigan Resident Death Files, Bureau of Epidemiology, MDCH.

- ✧ The average number of deaths due to asthma per year in Genesee County, 2001-2003, is 9.
- ✧ The rate of asthma mortality in Genesee County is higher than the rate for the State of Michigan as a whole, 2001-2003, though not significantly.

Figure 15. Annual Rates (per 1,000,000) [1,2] of Mortality due to Asthma, All Ages, for Genesee County, 1990-2002 [4].



- 1 Rates are age adjusted to the 2000 US standard population by the direct standardization method.
- 2 Population estimates are taken from the Michigan population estimates for 1990-2002.
- 3 Asthma death is defined as a primary cause of death as asthma, ICD-9=493.XX and ICD-10=J45 or J46.
- 4 Due to a change in coding for asthma deaths beginning in 1999, rates calculated for 1999-2002 are not comparable to rates calculated for 1990-1998.

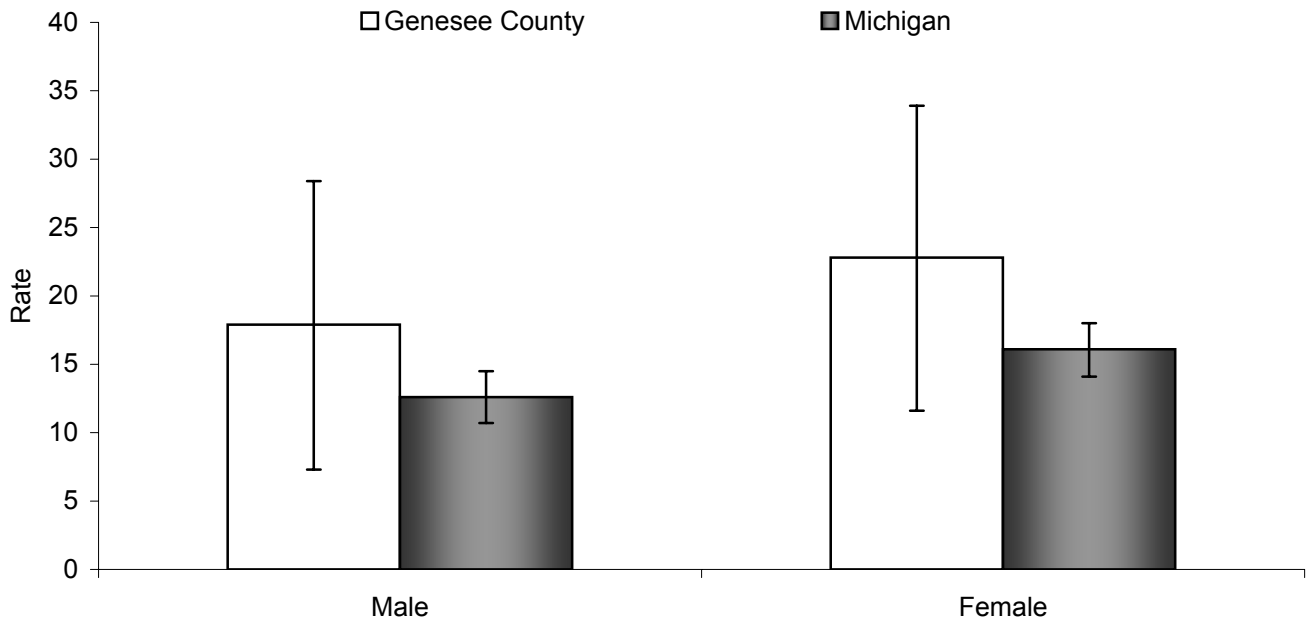
Year	Total Population	
	Rate	Count
1990	‡	~
1991	25.4	10
1992	‡	~
1993	36.8	13
1994	21.2	8
1995	32.0	13
1996	32.5	13
1997	19.0	8
1998	27.6	11
1999	17.3	7
2000	11.2	5
2001	23.7	10
2002	14.0	6

- ‡ Insufficient data to compute a stable rate (number of events <5 or population <5000).
 ~ Due to a low number of events (<5), results are suppressed to protect the identity of the deceased.

Data Source: Michigan Resident Death Files, Bureau of Epidemiology, MDCH.

See appendix page 52 for supporting data.

Figure 16. Rates (per 1,000,000) [1,2] of Mortality due to Asthma [3] by Sex for Genesee County and the State of Michigan, All Ages, 2001-2003.



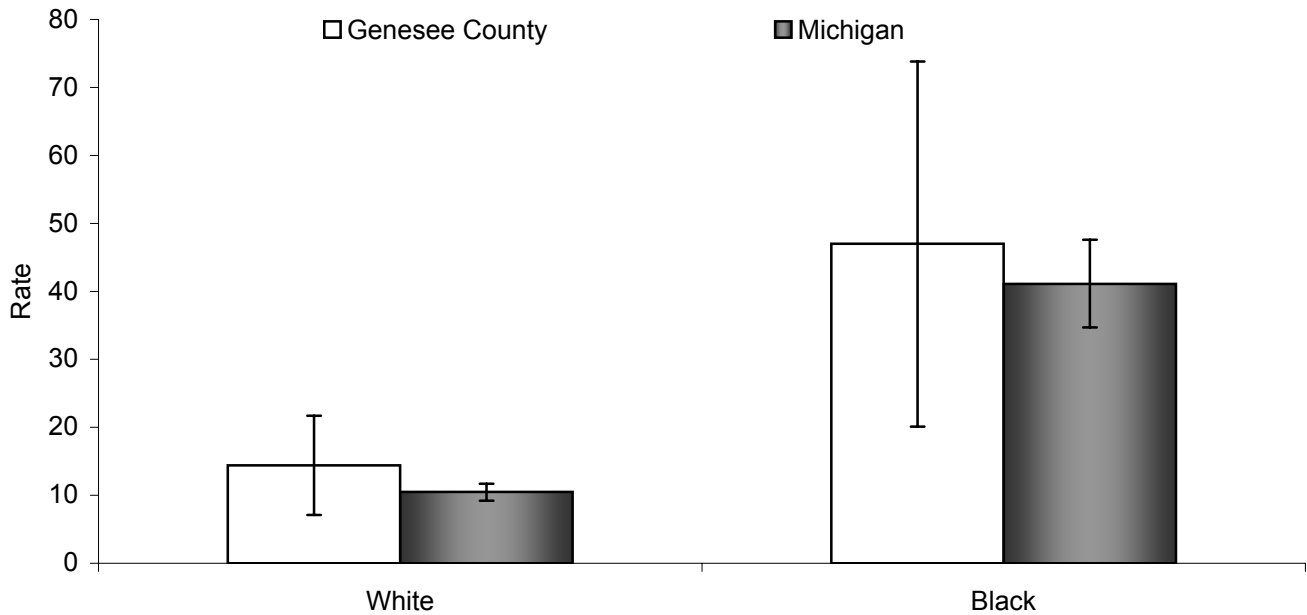
- 1 Rates are age adjusted to the 2000 US standard population by the direct standardization method.
- 2 Population estimates are taken from the Michigan population estimates for 2002.
- 3 Asthma death is defined as a primary cause of death as asthma, ICD-10=J45 or J46.

	Male	Female
Genesee County Rate	17.9	22.8
95% CI	7.3 , 28.4	11.6 , 33.9
Count	11	16
Michigan Rate	12.6	16.1
95% CI	10.7 , 14.5	14.1 , 18.0
Count	171	270

Data Source: Michigan Resident Death Files, Bureau of Epidemiology, MDCH.

- ✧ The rates of asthma mortality for both the male and female populations in Genesee County are higher than the respective rates for the State of Michigan as a whole, 2001-2003, though not significantly.
- ✧ For Genesee County and the State of Michigan, the rates of asthma mortality for females are not significantly different than the respective rates for males, 2001-2003.

Figure 17. Rates (per 1,000,000) [1,2] of Mortality due to Asthma [3] by Race for Genesee County and the State of Michigan, All Ages, 2001-2003.



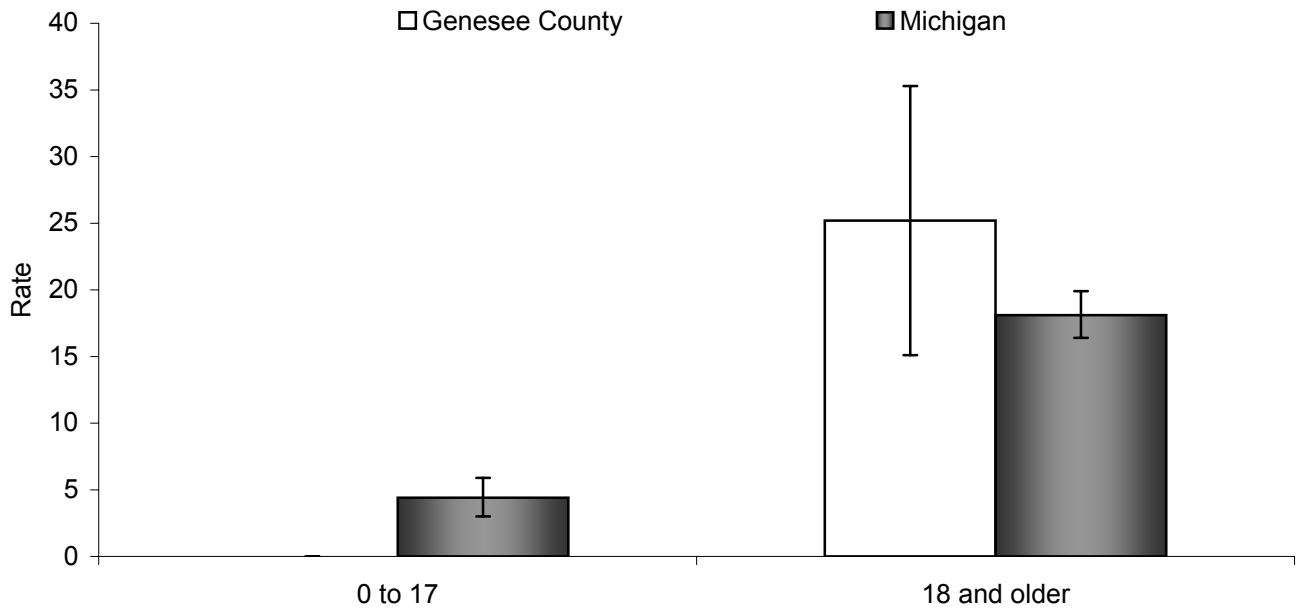
- 1 Rates are age adjusted to the 2000 US standard population by the direct standardization method.
- 2 Population estimates are taken from the Michigan population estimates for 2002.
- 3 Asthma death is defined as a primary cause of death as asthma, ICD-10=J45 or J46.

	White	Black
Genesee County Rate	14.4	47.0
95% CI	7.1 , 21.7	20.1 , 73.8
Count	15	12
Michigan Rate	10.5	41.1
95% CI	9.2 , 11.7	34.7 , 47.6
Count	273	163

Data Source: Michigan Resident Death Files, Bureau of Epidemiology, MDCH.

- ✧ While black persons in the State of Michigan have a significantly higher asthma mortality rate, white persons experience more asthma related deaths, 2001-2003.
- ✧ Black persons in Genesee County have a higher asthma mortality rate than white persons, 2001-2003, though not significantly.

Figure 18. Rates (per 1,000,000) [1,2] of Mortality due to Asthma [3] by Age Group for Genesee County and the State of Michigan, 2001-2003.



1 Rates are age adjusted to the 2000 US standard population by the direct standardization method.

2 Population estimates are taken from the Michigan population estimates for 2002.

3 Asthma death is defined as a primary cause of death as asthma, ICD-10=J45 or J46.

	0 to 17	18 and Older
Genesee County Rate	‡	25.2
95% CI	‡ , ‡	15.1 , 35.3
Count	~	24
Michigan Rate	4.4	18.1
95% CI	3.0 , 5.9	16.4 , 19.9
Count	35	406

‡ Insufficient data to compute a stable rate (number of events <5 or population <5000).

~ Due to a low number of events (<5), results are suppressed to protect the identity of the deceased.

Data Source: Michigan Resident Death Files, Bureau of Epidemiology, MDCH.

✧ The asthma mortality rate in the State of Michigan is significantly higher for individuals aged 18 years and older than for individuals aged less than 18 years, 2001-2003.

Section 4: *Healthy People 2010* Objectives for Asthma

The U.S. Department of Health and Human Services has developed *Healthy People 2010*, a set of disease prevention and health promotion objectives for the nation to achieve over the first decade of the new century. Although neither the United States nor Michigan have met all the *Healthy People 2010* targets for asthma, Michigan has had some success in reaching particular asthma objectives for some populations. For more information about the *Healthy People 2010* initiative, visit their website: <http://www.healthypeople.gov>.

The following asthma hospitalization and mortality figures provide information for Genesee County and the State of Michigan, as compared to the *Healthy People 2010* targets for asthma.

Selected *Healthy People 2010* Objectives Related to Asthma for which Genesee County Data are Available for Comparison.

Objective 1-9a: Reduce hospitalization rates for three ambulatory-care-sensitive conditions: pediatric asthma, uncontrolled diabetes, and immunization preventable pneumonia and influenza.

Target: 17.3 per 10,000 (age 0-17 years)

Objective 24-1: Reduce asthma deaths.

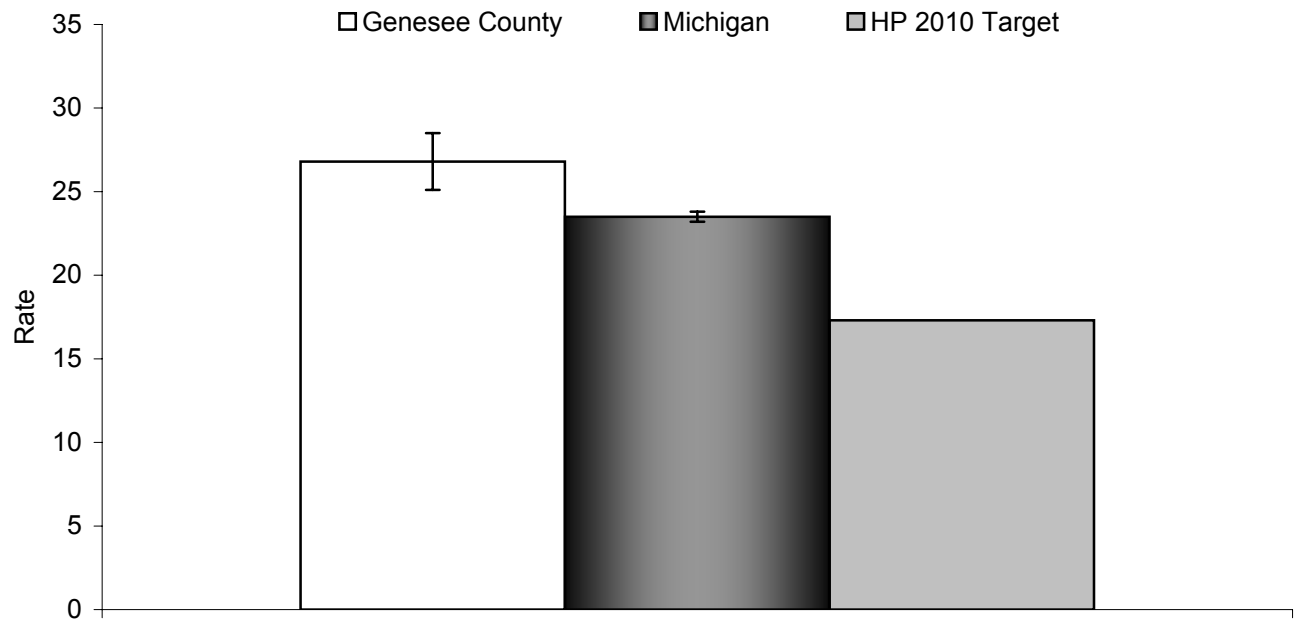
Targets: 1 per 1,000,000 (age 0-4 years)
1 per 1,000,000 (age 5-14 years)
2 per 1,000,000 (age 15-34 years)
9 per 1,000,000 (age 35-64 years)
60 per 1,000,000 (age ≥65 years)

Objective 24-2: Reduce hospitalizations for asthma.

Targets: 25 per 10,000 (age 0-4 years)
7.7 per 10,000 (age 5-64 years*)
11 per 10,000 (age ≥65 years*)

*Age adjusted to the 2000 U.S. standard population.

Figure 19. Rates (per 10,000) [1,2] of Hospitalization due to Asthma [3] for Children (aged less than 18 years) in Genesee County and the State of Michigan, 2000-2002, Compared to the Healthy People 2010 Target (Objective 1-9a).



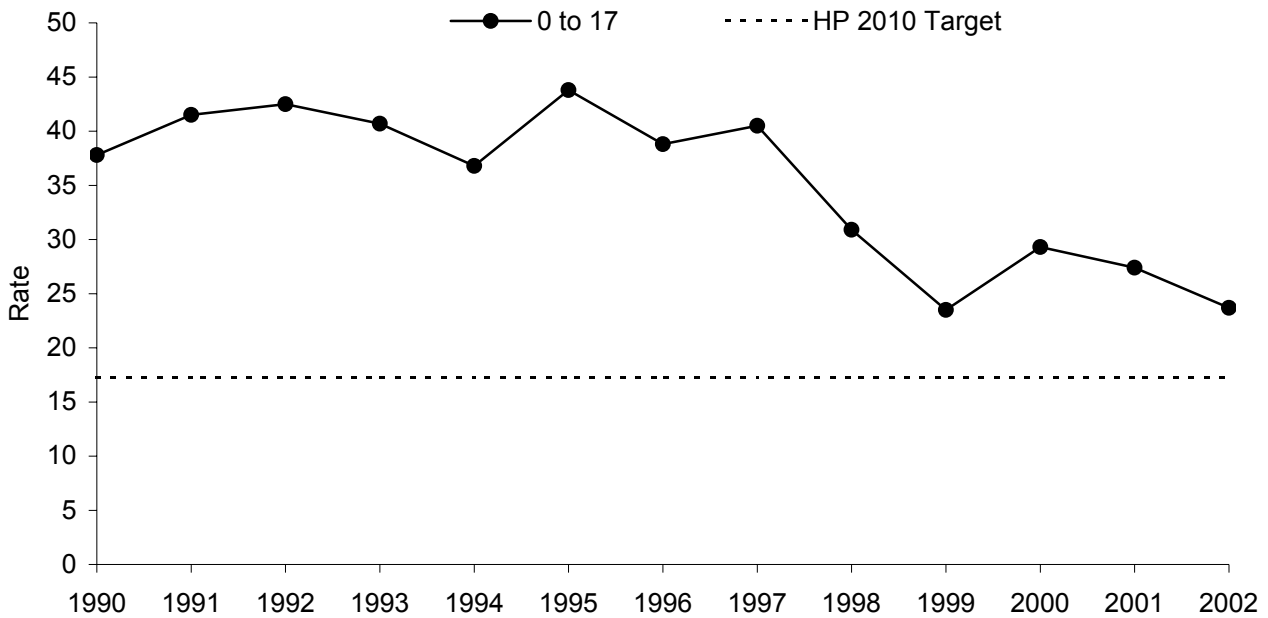
1 Population estimates are taken from the Michigan population estimates for 2001.
 2 Not age adjusted in accordance with analysis prescribed by Healthy People 2010 Objectives.
 3 Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

	Total Population
Genesee County Rate	26.8
95% CI	25.1 , 28.5
Count	958
Michigan Rate	23.5
95% CI	23.2 , 23.8
Count	18,141
HP 2010 Target	17.3

Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

- ✧ The average number of hospitalizations due to asthma per year for children aged less than 18 years in Genesee County, 2000-2002, is 319.
- ✧ The rate of asthma hospitalization for children aged less than 18 years in Genesee County, 2000-2002, is significantly higher than the *Healthy People 2010* objective.

Figure 20. Annual Rates (per 10,000) [1,2] of Asthma [3] Hospitalization for Children (aged less than 18 years) in Genesee County, 1990-2002, Compared to the Healthy People 2010 Target (Objective 1-9a).



- 1 Population estimates are taken from the Michigan population estimates for 1990-2002.
- 2 Not age adjusted in accordance with analysis prescribed by Healthy People 2010 Objectives.
- 3 Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

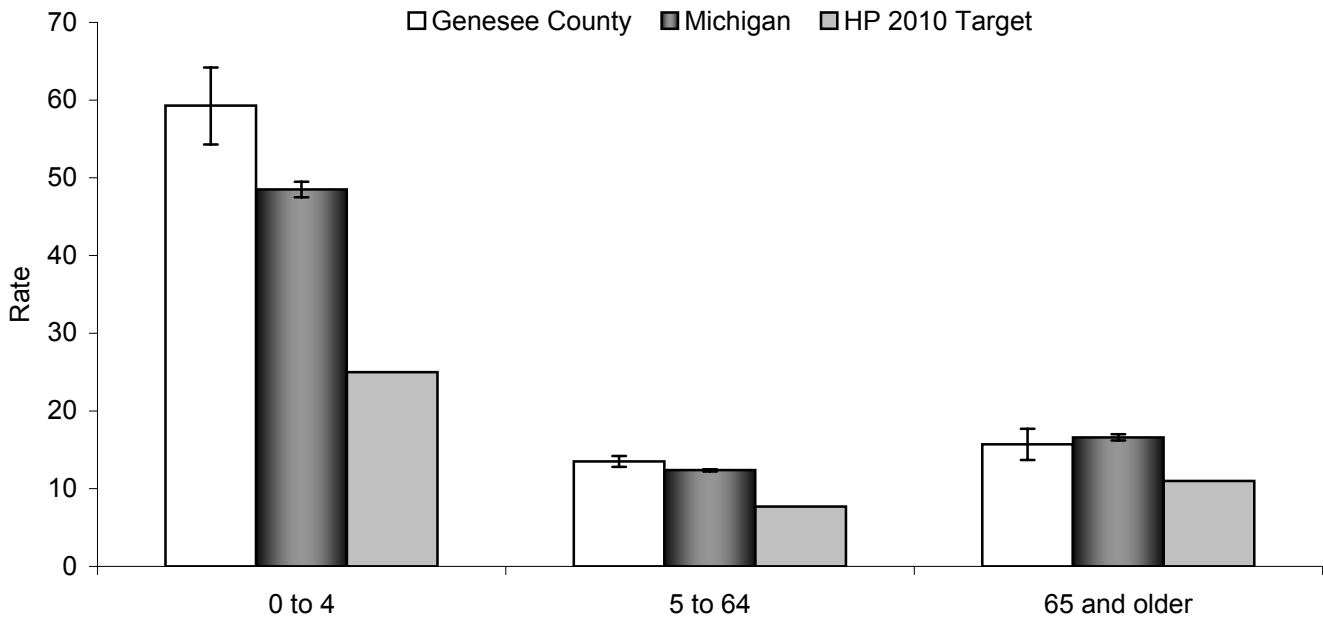
Year	0 to 17	
	Rate	Count
1990	37.8	456
1991	41.5	501
1992	42.5	512
1993	40.7	491
1994	36.8	443
1995	43.8	530
1996	38.8	470
1997	40.5	488
1998	30.9	369
1999	23.5	280
2000	29.3	349
2001	27.4	326
2002	23.7	283
HP 2010 Target	17.3	

Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

✧ Between 1990 and 2002, there has been a significant overall decrease in asthma hospitalization rates among persons aged less than 18 years in Genesee County ($\rho = -0.74$, $p < 0.01$).

See appendix page 53 for supporting data.

Figure 21. Rates (per 10,000) [1,2] of Hospitalization due to Asthma [3] by Age Group for Genesee County and the State of Michigan, 2000-2002, Compared to the Healthy People 2010 Targets (Objective 24-2).



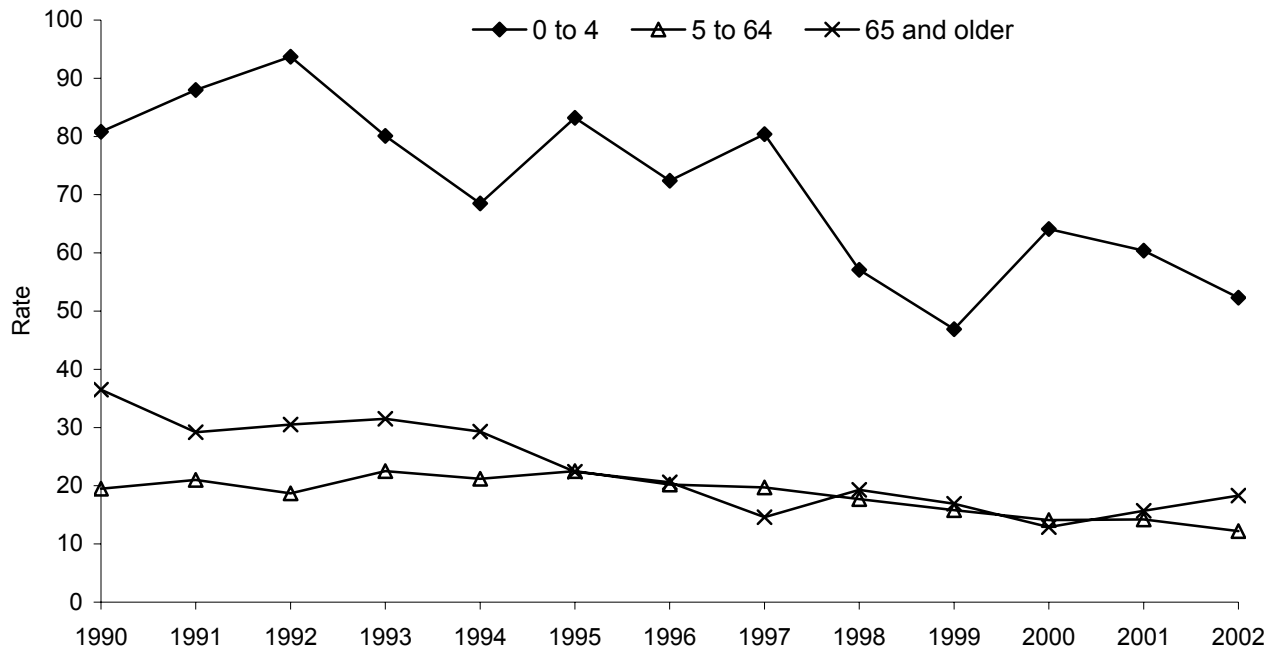
1 For age group 5-64 years and age group 65 and older, rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
 2 Population estimates are taken from the Michigan population estimates for 2001.
 3 Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

	0 to 4	5 to 64	65 and Older
Genesee County Rate	59.3	13.5	15.7
95% CI	54.3 , 64.2	12.8 , 14.2	13.7 , 17.7
Count	556	1,448	244
Michigan Rate	48.5	12.4	16.6
95% CI	47.5 , 49.5	12.2 , 12.5	16.2 , 17.0
Count	9,637	30,198	6,110
HP 2010 Target	25.0	7.7	11.0

Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

- ✧ The rate of asthma hospitalization in Genesee County is significantly higher than the *Healthy People 2010* Target Rate for the 0 to 4, 5 to 64, and 65 years and older age groups, 2000-2002.
- ✧ The rate of asthma hospitalization in Genesee County is significantly higher than the rate for Michigan as a whole for the 0 to 4 and 5 to 64 year age groups, 2000-2002.

Figure 22. Annual Rates (per 10,000) [1,2] of Asthma [3] Hospitalization by Age Group for Genesee County, 1990-2002, Compared to the Healthy People 2010 Targets (Objective 24-2).



1 For age group 5-64 years and age group 65 and older, rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.

2 Population estimates are taken from the Michigan population estimates for 1990-2002.

3 Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

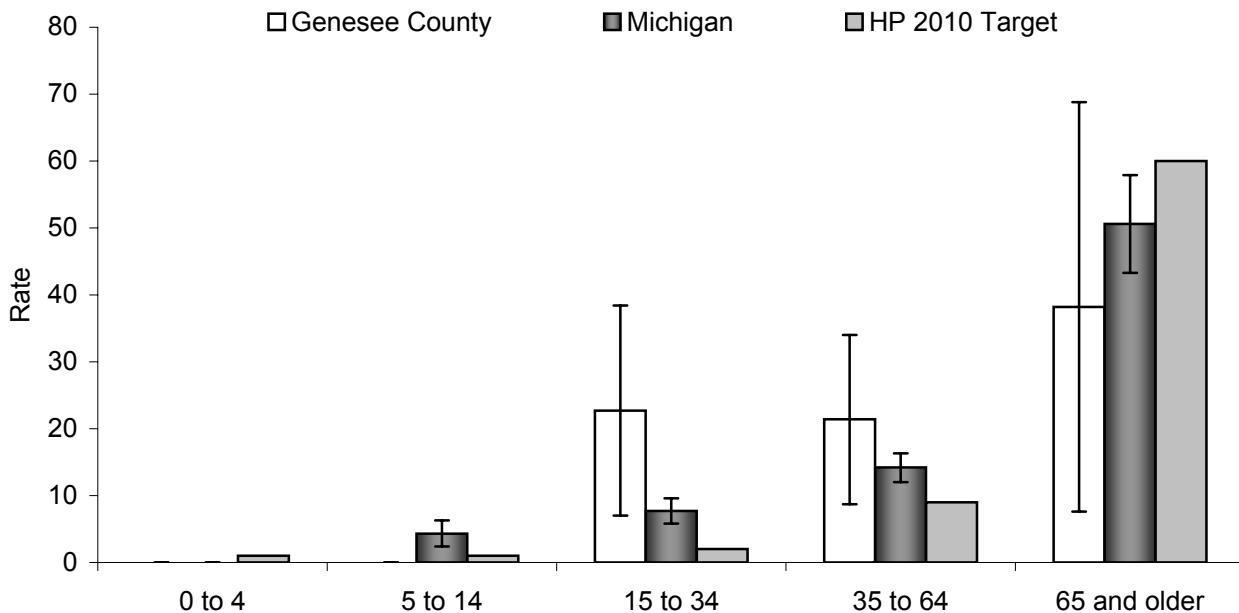
Year	0 to 4		5 to 64		65 and Older	
	Rate	Count	Rate	Count	Rate	Count
1990	80.8	275	19.5	683	36.5	163
1991	88.0	302	21.0	734	29.2	130
1992	93.7	322	18.7	650	30.5	145
1993	80.1	275	22.5	785	31.5	148
1994	68.5	232	21.2	736	29.3	139
1995	83.2	276	22.5	794	22.4	109
1996	72.4	235	20.2	717	20.6	102
1997	80.4	257	19.7	697	14.6	72
1998	57.1	181	17.7	627	19.3	97
1999	46.9	148	15.8	561	16.9	84
2000	64.1	202	14.1	501	12.9	67
2001	60.4	189	14.2	508	15.7	81
2002	52.3	165	12.2	439	18.3	96
HP 2010 Target	25.0		7.7		11.0	

Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

✧ Between 1990 and 2002, there has been a significant decrease in asthma hospitalization rates for persons aged 0 to 4, 5 to 64, and 65 years and older in Genesee County (0 to 4, $\rho = -0.82$, $p < 0.01$; 5 to 64, $\rho = -0.71$, $p < 0.01$; 65 and older, $\rho = -0.86$, $p < 0.01$).

See appendix pages 54 through 56 for supporting data.

Figure 23. Rates (per 1,000,000) [1] of Mortality due to Asthma [2] by Age Group for Genesee County and the State of Michigan, 2001-2003, Compared to the Healthy People 2010 Targets (Objective 24-1).



1 Population estimates are taken from the Michigan population estimates for 2002.

2 Asthma death is defined as a primary cause of death as asthma, ICD-10=J45 or J46.

	0 to 4	5 to 14	15 to 34	35 to 64	65 and Older
Genesee County Rate	‡	‡	22.7	21.4	38.2
95% CI	‡, ‡	‡, ‡	7.0, 38.4	8.7, 34.0	7.6, 68.8
Count	~	~	8	11	6
Michigan Rate	‡	4.3	7.7	14.2	50.6
95% CI	‡, ‡	2.4, 6.3	5.8, 9.6	12.0, 16.3	43.3, 57.9
Count	~	19	63	168	187
HP 2010 Target	1.0	1.0	2.0	9.0	60.0

‡ Insufficient data to compute a stable rate (number of events <5 or population <5000).

~ Due to a low number of events (<5), results are suppressed to protect the identity of the deceased.

Data Source: Michigan Resident Death Files, Bureau of Epidemiology, MDCH.

- ✧ The rate of asthma mortality in Genesee County is significantly higher than the *Healthy People 2010* Target Rate for the 15 to 34 year age group, 2001-2003.
- ✧ The rate of asthma mortality in the State of Michigan is significantly higher than the *Healthy People 2010* Target Rate for the 5 to 14, 15 to 34, and 35 to 64 year age groups, 2001-2003.
- ✧ The rate of asthma mortality in the State of Michigan is significantly lower than the *Healthy People 2010* Target Rate for the 65 years and older age group, 2001-2003.

Section 5: Appendix

This appendix includes a compilation of supporting data tables presenting annual hospitalization and mortality rates for Genesee County and the State of Michigan. It also includes a summary for Genesee County of 3-year hospitalization rates by age, race, and sex strata.

Counts and Rates (per 10,000) [1,2] of Asthma [3] Hospitalization [4] by Year, All Ages, for Genesee County and the State of Michigan, 1990-2002.

Year	Genesee County		Michigan	
	Rate	Count	Rate	Count
1990	25.9	1,121	19.1	17,790
1991	26.7	1,166	18.1	16,995
1992	25.4	1,117	18.4	17,597
1993	27.6	1,208	19.8	18,975
1994	25.5	1,107	18.4	17,609
1995	26.7	1,179	19.5	18,945
1996	23.8	1,054	18.5	18,058
1997	23.2	1,026	17.7	17,320
1998	20.7	905	15.6	15,289
1999	18.1	793	15.6	15,385
2000	17.4	770	16.0	15,886
2001	17.6	778	15.5	15,363
2002	15.8	700	14.7	14,696

Spearman's ρ	-0.89**	-0.79**
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- ¹ Population estimates are taken from the Michigan population estimates for 1990-2002.
- ² Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
- ³ Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.
- ⁴ Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

** Correlation is statistically significant; p-value < 0.01.

Sample Interpretation of Annual Rate:

In 2002, the rate of asthma hospitalization in Michigan was 14.7 per 10,000 population.

Sample Trend Interpretation:

Between 1990 and 2002, there has been a significant overall decrease in asthma hospitalization rates in Michigan.

Counts and Rates (per 10,000) [1,2] of Asthma [3] Hospitalization [4] by Year for MALES All Ages, for Genesee County and the State of Michigan, 1990-2002.

Year	Genesee County		Michigan	
	Rate	Count	Rate	Count
1990	23.1	500	17.1	7,951
1991	23.1	507	15.7	7,345
1992	21.6	485	16.1	7,666
1993	22.9	503	16.6	7,929
1994	21.4	460	15.4	7,339
1995	22.4	497	17.1	8,275
1996	19.6	435	15.9	7,725
1997	20.1	444	15.4	7,546
1998	17.3	384	12.7	6,199
1999	15.5	336	12.7	6,229
2000	14.9	332	13.7	6,745
2001	14.8	324	12.8	6,271
2002	12.8	281	12.2	5,971

Spearman's ρ	-0.97**	-0.82**
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¹ Population estimates are taken from the Michigan population estimates for 1990-2002.

² Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.

³ Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

⁴ Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

** Correlation is statistically significant; p-value < 0.01.

Sample Interpretation of Annual Rate:

In 2002, the rate of asthma hospitalization among males in Michigan was 12.2 per 10,000 population.

Sample Trend Interpretation:

Between 1990 and 2002, there has been a significant overall decrease in asthma hospitalization rates for males in Michigan.

Counts and Rates (per 10,000) [1,2] of Asthma [3] Hospitalization [4] by Year for FEMALES, All Ages, for Genesee County and the State of Michigan, 1990-2002.

Year	Genesee County		Michigan	
	Rate	Count	Rate	Count
1990	27.8	621	20.6	9,834
1991	29.3	659	20.0	9,648
1992	28.0	632	20.3	9,927
1993	31.4	705	22.6	11,043
1994	29.0	647	20.9	10,269
1995	30.2	680	21.6	10,668
1996	27.4	619	20.8	10,333
1997	25.8	582	19.6	9,774
1998	23.2	521	18.1	9,089
1999	20.2	457	18.1	9,155
2000	19.3	438	18.0	9,141
2001	20.0	454	17.8	9,092
2002	18.3	419	16.9	8,725

Spearman's ρ	-0.84**	-0.76**
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¹ Population estimates are taken from the Michigan population estimates for 1990-2002.

² Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.

³ Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

⁴ Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

** Correlation is statistically significant; p-value < 0.01.

Sample Interpretation of Annual Rate:

In 2002, the rate of asthma hospitalization among females in Michigan was 16.9 per 10,000 population.

Sample Trend Interpretation:

Between 1990 and 2002, there has been a significant overall decrease in asthma hospitalization rates for females in Michigan.

Counts and Rates (per 10,000) [1,2] of Asthma [3] Hospitalization [4] by Year for WHITES [5], All Ages, for Genesee County and the State of Michigan, 1990-2002.

Year	Genesee County		Michigan	
	Rate	Count	Rate	Count
1990	22.0	744	15.1	11,791
1991	22.3	751	14.2	11,148
1992	20.3	685	14.1	11,165
1993	22.0	741	14.8	11,757
1994	19.9	666	13.2	10,488
1995	18.3	614	13.2	10,586
1996	16.1	544	12.6	10,140
1997	16.1	537	12.2	9,849
1998	13.8	461	10.5	8,522
1999	13.8	463	10.7	8,716
2000	12.7	426	10.8	8,781
2001	12.2	413	10.5	8,541
2002	10.3	351	9.9	8,133

Spearman's ρ	-0.98**	-0.95**
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¹ Population estimates are taken from the Michigan population estimates for 1990-2002.

² Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.

³ Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

⁴ Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

⁵ For records that are missing data for race, race was assigned based on the 1990 census population for Michigan.

** Correlation is statistically significant; p-value < 0.01.

Sample Interpretation of Annual Rate:

In 2002, the rate of asthma hospitalization among whites in Michigan was 9.9 per 10,000 population.

Sample Trend Interpretation:

Between 1990 and 2002, there has been a significant overall decrease in asthma hospitalization rates for whites in Michigan.

Counts and Rates (per 10,000) [1,2] of Asthma [3] Hospitalization [4] by Year for BLACKS [5], All Ages, for Genesee County and the State of Michigan, 1990-2002.

Year	Genesee County		Michigan	
	Rate	Count	Rate	Count
1990	42.9	374	43.0	5,800
1991	45.1	412	41.4	5,715
1992	45.1	424	44.4	6,209
1993	48.5	462	49.1	6,948
1994	47.7	438	48.5	6,858
1995	56.2	558	54.0	8,031
1996	50.4	507	51.3	7,603
1997	48.4	487	48.0	7,246
1998	47.5	442	45.3	6,607
1999	34.1	324	44.2	6,459
2000	34.1	341	45.2	6,888
2001	36.6	359	43.2	6,518
2002	37.1	344	42.0	6,279

Spearman's ρ	-0.42	-0.07
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- ¹ Population estimates are taken from the Michigan population estimates for 1990-2002.
- ² Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
- ³ Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.
- ⁴ Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.
- ⁵ For records that are missing data for race, race was assigned based on the 1990 census population for Michigan.

Sample Interpretation of Annual Rate:

In 2002, the rate of asthma hospitalization among blacks in Michigan was 42.0 per 10,000 population.

Sample Trend Interpretation:

Between 1990 and 2002, a significant overall trend in asthma hospitalization rates has not been observed for blacks in Michigan.

Counts and Rates (per 10,000) [1,2] of Asthma [3] Hospitalization [4] by Year for WHITE MALES [5], All Ages, for Genesee County and the State of Michigan, 1990-2002.

Year	Genesee County		Michigan	
	Rate	Count	Rate	Count
1990	18.9	313	13.4	5,142
1991	18.7	310	12.0	4,632
1992	16.4	275	12.1	4,715
1993	18.0	294	11.9	4,633
1994	15.9	256	10.4	4,033
1995	14.8	241	10.9	4,285
1996	12.6	206	10.2	4,012
1997	12.9	208	10.1	3,993
1998	12.0	198	8.1	3,198
1999	11.2	181	8.5	3,338
2000	10.9	179	8.9	3,499
2001	10.3	167	8.4	3,284
2002	8.1	132	8.0	3,133

Spearman's ρ	-0.99**	-0.95**
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¹ Population estimates are taken from the Michigan population estimates for 1990-2002.

² Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.

³ Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

⁴ Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

⁵ For records that are missing data for race, race was assigned based on the 1990 census population for Michigan.

** Correlation is statistically significant; p-value < 0.01.

Sample Interpretation of Annual Rate:

In 2002, the rate of asthma hospitalization among white males in Michigan was 8.0 per 10,000 population.

Sample Trend Interpretation:

Between 1990 and 2002, there has been a significant overall decrease in asthma hospitalization rates for white males in Michigan.

Counts and Rates (per 10,000) [1,2] of Asthma [3] Hospitalization [4] by Year for WHITE FEMALES [5], All Ages, for Genesee County and the State of Michigan, 1990-2002.

Year	Genesee County		Michigan	
	Rate	Count	Rate	Count
1990	24.3	431	16.5	6,647
1991	25.0	441	16.0	6,514
1992	23.4	410	15.7	6,446
1993	25.4	447	17.3	7,122
1994	23.5	410	15.6	6,455
1995	21.5	373	15.2	6,301
1996	19.3	338	14.8	6,128
1997	19.1	329	14.1	5,856
1998	15.3	263	12.7	5,324
1999	16.1	282	12.7	5,378
2000	14.2	247	12.5	5,282
2001	13.9	246	12.4	5,257
2002	12.3	219	11.6	5,000

Spearman's ρ	-0.95**	-0.97**
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¹ Population estimates are taken from the Michigan population estimates for 1990-2002.

² Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.

³ Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

⁴ Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

⁵ For records that are missing data for race, race was assigned based on the 1990 census population for Michigan.

** Correlation is statistically significant; p-value < 0.01.

Sample Interpretation of Annual Rate:

In 2002, the rate of asthma hospitalization among white females in Michigan was 11.6 per 10,000 population.

Sample Trend Interpretation:

Between 1990 and 2002, there has been a significant overall decrease in asthma hospitalization rates for white females in Michigan.

Counts and Rates (per 10,000) [1,2] of Asthma [3] Hospitalization [4] by Year for BLACK MALES [5], All Ages, for Genesee County and the State of Michigan, 1990-2002.

Year	Genesee County		Michigan	
	Rate	Count	Rate	Count
1990	42.8	185	39.2	2,721
1991	42.9	197	36.6	2,660
1992	39.9	207	39.0	2,864
1993	39.8	208	42.8	3,169
1994	42.1	202	43.1	3,176
1995	48.6	254	48.6	3,838
1996	43.9	227	45.8	3,569
1997	45.7	236	43.7	3,452
1998	36.6	186	38.3	2,927
1999	32.7	154	37.0	2,796
2000	29.4	152	39.4	3,147
2001	29.9	153	36.6	2,856
2002	31.2	146	35.0	2,699

Spearman's ρ	-0.62*	-0.30
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¹ Population estimates are taken from the Michigan population estimates for 1990-2002.

² Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.

³ Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

⁴ Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

⁵ For records that are missing data for race, race was assigned based on the 1990 census population for Michigan.

* Correlation is statistically significant; p-value < 0.05.

Sample Interpretation of Annual Rate:

In 2002, the rate of asthma hospitalization among black males in Michigan was 35.0 per 10,000 population.

Sample Trend Interpretation:

Between 1990 and 2002, a significant overall trend in asthma hospitalization rates has not been observed for black males in Michigan.

Counts and Rates (per 10,000) [1,2] of Asthma [3] Hospitalization [4] by Year for BLACK FEMALES [5], All Ages, for Genesee County and the State of Michigan, 1990-2002.

Year	Genesee County		Michigan	
	Rate	Count	Rate	Count
1990	42.3	189	45.3	3,079
1991	46.4	215	44.3	3,055
1992	47.7	217	47.8	3,345
1993	53.8	254	53.4	3,779
1994	51.5	236	51.9	3,682
1995	61.7	304	57.1	4,193
1996	55.2	280	54.7	4,034
1997	49.6	251	50.6	3,794
1998	54.5	256	50.0	3,680
1999	35.0	170	49.4	3,663
2000	37.1	189	49.0	3,741
2001	41.2	206	48.0	3,662
2002	40.8	198	47.0	3,580

Spearman's ρ	-0.39	0.08
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- ¹ Population estimates are taken from the Michigan population estimates for 1990-2002.
- ² Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
- ³ Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.
- ⁴ Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.
- ⁵ For records that are missing data for race, race was assigned based on the 1990 census population for Michigan.

Sample Interpretation of Annual Rate:

In 2002, the rate of asthma hospitalization among black females in Michigan was 47.0 per 10,000 population.

Sample Trend Interpretation:

Between 1990 and 2002, a significant overall trend in asthma hospitalization rates has not been observed for black females in Michigan.

Counts and Rates (per 10,000) [1,2] of Asthma [3] Hospitalization [4] by Year for CHILDREN Aged 0 to 4 Years, for Genesee County and the State of Michigan, 1990-2002.

Year	Genesee County		Michigan	
	Rate	Count	Rate	Count
1990	80.8	275	66.1	4,712
1991	88.0	302	57.1	4,106
1992	93.7	322	64.4	4,638
1993	80.1	275	59.6	4,291
1994	68.5	232	53.2	3,783
1995	83.2	276	63.9	4,457
1996	72.4	235	59.6	4,092
1997	80.4	257	59.2	4,019
1998	57.1	181	40.5	2,734
1999	46.9	148	40.6	2,725
2000	64.1	202	48.8	3,257
2001	60.4	189	50.5	3,341
2002	52.3	165	45.8	3,039

Spearman's ρ	-0.82**	-0.76**
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¹ Population estimates are taken from the Michigan population estimates for 1990-2002.

² Rates are not age adjusted. Hospitalization records with missing age are excluded.

³ Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

⁴ Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

** Correlation is statistically significant; p-value < 0.01.

Sample Interpretation of Annual Rate:

In 2002, the rate of asthma hospitalization among children 0 to 4 years in Michigan was 45.8 per 10,000 population.

Sample Trend Interpretation:

Between 1990 and 2002, there has been a significant overall decrease in asthma hospitalization rates for children 0 to 4 years in Michigan.

Counts and Rates (per 10,000) [1,2] of Asthma [3] Hospitalization [4] by Year for CHILDREN Aged 5 to 14 Years, for Genesee County and the State of Michigan, 1990-2002.

Year	Genesee County		Michigan	
	Rate	Count	Rate	Count
1990	22.5	150	20.9	2,826
1991	24.9	167	19.4	2,666
1992	23.0	154	18.5	2,571
1993	26.8	180	21.1	2,972
1994	25.5	171	17.1	2,418
1995	27.1	184	21.9	3,152
1996	29.1	198	21.4	3,113
1997	29.3	200	22.1	3,244
1998	22.5	154	16.8	2,491
1999	16.4	113	16.8	2,497
2000	17.9	122	20.4	3,010
2001	17.1	117	16.0	2,363
2002	15.1	103	13.7	2,002

Spearman's ρ	-0.51	-0.48
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¹ Population estimates are taken from the Michigan population estimates for 1990-2002.

² Rates are not age adjusted. Hospitalization records with missing age are excluded.

³ Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

⁴ Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

Sample Interpretation of Annual Rate:

In 2002, the rate of asthma hospitalization among children 5 to 14 years in Michigan was 13.7 per 10,000 population.

Sample Trend Interpretation:

Between 1990 and 2002, a significant overall trend in asthma hospitalization rates has not been observed for children 5 to 14 years in Michigan.

Counts and Rates (per 10,000) [1,2] of Asthma [3] Hospitalization [4] by Year for CHILDREN/ADULTS Aged 15 to 34 Years, for Genesee County and the State of Michigan, 1990-2002.

Year	Genesee County		Michigan	
	Rate	Count	Rate	Count
1990	15.6	214	9.1	2,709
1991	18.4	247	8.9	2,628
1992	15.9	209	9.8	2,839
1993	19.3	248	11.7	3,352
1994	16.4	207	10.9	3,081
1995	21.7	271	11.8	3,341
1996	17.7	218	11.5	3,220
1997	15.6	189	10.6	2,959
1998	15.9	190	10.0	2,755
1999	13.2	156	9.2	2,526
2000	12.7	149	9.2	2,502
2001	10.5	123	8.2	2,253
2002	7.8	92	7.7	2,104

Spearman's ρ	-0.69*	-0.31
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¹ Population estimates are taken from the Michigan population estimates for 1990-2002.

² Rates are not age adjusted. Hospitalization records with missing age are excluded.

³ Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

⁴ Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

* Correlation is statistically significant; p-value < 0.05.

Sample Interpretation of Annual Rate:

In 2002, the rate of asthma hospitalization among children and adults 15 to 34 years in Michigan was 7.7 per 10,000 population.

Sample Trend Interpretation:

Between 1990 and 2002, a significant overall trend in asthma hospitalization rates has not been observed for children and adults 15 to 34 years in Michigan.

Counts and Rates (per 10,000) [1,2] of Asthma [3] Hospitalization [4] by Year for ADULTS Aged 35 to 64 Years, for Genesee County and the State of Michigan, 1990-2002.

Year	Genesee County		Michigan	
	Rate	Count	Rate	Count
1990	21.4	319	14.8	4,694
1991	21.2	320	15.0	4,838
1992	18.8	287	14.5	4,795
1993	23.1	357	15.9	5,369
1994	22.9	358	16.0	5,509
1995	21.4	339	15.6	5,493
1996	18.7	301	15.0	5,401
1997	19.0	308	13.8	5,065
1998	17.3	283	14.2	5,275
1999	17.6	292	14.7	5,547
2000	13.6	230	13.6	5,264
2001	15.8	268	13.8	5,383
2002	14.2	244	13.5	5,317

Spearman's ρ	-0.81**	-0.70**
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- ¹ Population estimates are taken from the Michigan population estimates for 1990-2002.
- ² Rates are not age adjusted. Hospitalization records with missing age are excluded.
- ³ Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.
- ⁴ Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

** Correlation is statistically significant; p-value < 0.01.

Sample Interpretation of Annual Rate:

In 2002, the rate of asthma hospitalization among adults 35 to 64 years in Michigan was 13.5 per 10,000 population.

Sample Trend Interpretation:

Between 1990 and 2002, there has been a significant overall decrease in asthma hospitalization rates for adults 35 to 64 years in Michigan.

Counts and Rates (per 10,000) [1,2] of Asthma [3] Hospitalization [4] by Year for ADULTS Aged 65 Years and Older, for Genesee County and the State of Michigan, 1990-2002.

Year	Genesee County		Michigan	
	Rate	Count	Rate	Count
1990	37.1	163	25.7	2,849
1991	29.0	130	24.4	2,757
1992	31.8	145	23.9	2,754
1993	31.8	148	25.6	2,991
1994	29.5	139	23.8	2,818
1995	22.7	109	20.9	2,502
1996	21.1	102	18.5	2,232
1997	14.7	72	16.8	2,033
1998	19.6	97	16.8	2,034
1999	16.8	84	17.2	2,090
2000	13.2	67	15.2	1,853
2001	15.7	81	16.5	2,023
2002	18.4	96	18.1	2,234

Spearman's ρ	-0.86**	-0.88**
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¹ Population estimates are taken from the Michigan population estimates for 1990-2002.

² Rates are not age adjusted. Hospitalization records with missing age are excluded.

³ Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

⁴ Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

** Correlation is statistically significant; p-value < 0.01.

Sample Interpretation of Annual Rate:

In 2002, the rate of asthma hospitalization among adults 65 years and older in Michigan was 18.1 per 10,000 population.

Sample Trend Interpretation:

Between 1990 and 2002, there has been a significant overall decrease in asthma hospitalization rates for adults 65 years and older in Michigan.

Counts and Rates (per 10,000) [1,2] of Asthma [3] Hospitalization [4] by Year for CHILDREN Aged Less Than 18 Years, for Genesee County and the State of Michigan, 1990-2002.

Year	Genesee County		Michigan	
	Rate	Count	Rate	Count
1990	37.1	456	31.7	8,063
1991	40.4	501	28.3	7,254
1992	41.3	512	29.9	7,735
1993	39.8	491	30.5	7,875
1994	36.2	443	26.2	6,757
1995	43.4	530	31.9	8,221
1996	38.8	470	30.2	7,769
1997	40.7	488	30.1	7,742
1998	30.9	369	21.8	5,594
1999	23.5	280	21.6	5,546
2000	29.4	349	26.3	6,693
2001	27.6	326	24.1	6,089
2002	23.9	283	21.3	5,359

Spearman's ρ	-0.69*	-0.68*
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¹ Population estimates are taken from the Michigan population estimates for 1990-2002.

² Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.

³ Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

⁴ Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

* Correlation is statistically significant; p-value < 0.05.

Sample Interpretation of Annual Rate:

In 2002, the rate of asthma hospitalization among children less than 18 years in Michigan was 21.3 per 10,000 population.

Sample Trend Interpretation:

Between 1990 and 2002, there has been a significant overall decrease in asthma hospitalization rates for children less than 18 years in Michigan.

Counts and Rates (per 10,000) [1,2] of Asthma [3] Hospitalization [4] by Year for ADULTS Aged 18 Years and Older, for Genesee County and the State of Michigan, 1990-2002.

Year	Genesee County		Michigan	
	Rate	Count	Rate	Count
1990	22.0	665	14.7	9,727
1991	21.9	665	14.5	9,741
1992	19.8	605	14.5	9,862
1993	23.4	717	16.1	11,100
1994	21.8	664	15.7	10,852
1995	20.9	649	15.2	10,724
1996	18.6	584	14.5	10,289
1997	17.2	538	13.3	9,578
1998	17.1	536	13.4	9,695
1999	16.3	513	13.5	9,839
2000	13.2	421	12.5	9,193
2001	14.1	452	12.5	9,274
2002	13.0	417	12.5	9,337

Spearman's ρ	-0.93**	-0.80**
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¹ Population estimates are taken from the Michigan population estimates for 1990-2002.

² Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.

³ Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

⁴ Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

** Correlation is statistically significant; p-value < 0.01.

Sample Interpretation of Annual Rate:

In 2002, the rate of asthma hospitalization among adults 18 years and older in Michigan was 12.5 per 10,000 population.

Sample Trend Interpretation:

Between 1990 and 2002, there has been a significant overall decrease in asthma hospitalization rates for adults 18 years and older in Michigan.

Genesee County

Counts and Rates (per 10,000) [1,2] of Asthma [3] Hospitalization [4] for Genesee County, 2000-2002.

		Count	Rate	95% Confidence Interval	
				Lower Limit	Upper Limit
Total Population		2,248	16.9	16.2	17.6
Sex	Male	937	14.2	13.3	15.1
	Female	1,311	19.2	18.2	20.3
Race ⁵	White	1,190	11.8	11.1	12.4
	Black	1,044	36.0	33.8	38.3
Sex and Race ⁵	White Male	478	9.8	8.9	10.7
	White Female	712	13.5	12.5	14.5
	Black Male	451	30.2	27.3	33.1
	Black Female	593	39.9	36.6	43.2
Age (unadjusted)	0-4 Years	556	59.3	54.3	64.2
	5-14 Years	342	16.7	14.9	18.4
	15-34 Years	364	10.3	9.3	11.4
	35-64 Years	742	14.5	13.5	15.6
	65+ Years	244	15.8	13.8	17.7
Age	<18 Years	958	27.1	25.3	28.8
	18+ Years	1,290	13.4	12.7	14.2

For comparison, State of Michigan and Genesee County 3-year rates are located within the Hospitalization section of this report.

Counts and Rates (per 10,000) [1,2] of Asthma [3] Hospitalization [4] for Genesee County, 2000-2002, Comparable to the Healthy People 2010 Targets.

		Count	Rate	95% Confidence Interval	
				Lower Limit	Upper Limit
Age	0-4 Years ⁶	556	59.3	54.3	64.2
	5-64 Years	1,448	13.5	12.8	14.2
	65+ Years	244	15.7	13.7	17.7
	<18 Years ⁶	958	26.8	25.1	28.5

For comparison, State of Michigan and Genesee County 3-year rates are located within the Healthy People 2010 section of this report.

1 Unless otherwise noted, rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.

2 Population estimates are taken from the Michigan population estimates for 2001.

3 Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

4 Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

5 For records that are missing data for race, race was assigned based on the 1990 census population for Michigan.

6 Not age adjusted in accordance with analysis prescribed by Healthy People 2010 Objectives.

Counts and Rates (per 1,000,000) [1,2] of Mortality [3] due to Asthma [4] by Year, All Ages, for Genesee County and the State of Michigan, 1990-2002 [5].

Year	Genesee County		Michigan	
	Rate	Count	Rate	Count
1990	‡	~	18.4	159
1991	25.4	10	20.5	179
1992	‡	~	18.8	165
1993	36.8	13	22.0	196
1994	21.2	8	21.1	193
1995	32.0	13	23.1	216
1996	32.5	13	20.4	190
1997	19.0	8	18.2	171
1998	27.6	11	22.7	217
1999	17.3	7	16.6	162
2000	11.2	5	16.7	164
2001	23.7	10	15.4	153
2002	14.0	6	15.1	152

¹ Population estimates are taken from the Michigan population estimates for 1990-2002.

² Rates are age adjusted to the 2000 US standard population by the direct standardization method.

³ Asthma death is defined as a primary cause of death as asthma, ICD-9=493.XX and ICD-10=J45 or J46.

⁴ Data Source: Michigan Resident Death Files, Bureau of Epidemiology, MDCH.

⁵ Due to a change in coding for asthma deaths beginning in 1999, rates calculated for 1999-2002 are not comparable to rates calculated for 1990-1998.

‡ Insufficient data to compute a stable rate (number of events <5 or population <5000).

~ Due to a low number of events, data are suppressed.

Sample Interpretation of Annual Rate:

In 2002, the rate of asthma mortality in Michigan was 15.1 per 1,000,000 population.

Counts and Rates (per 10,000) [1,2] of Asthma [3] Hospitalization [4] by Year for CHILDREN Aged Less Than 18 Years, for Genesee County and the State of Michigan, 1990-2002, Compared to the Healthy People 2010 Target (Objective 1-9a).

Year	HP 2010 Objective	Genesee County		Michigan	
		Rate	Count	Rate	Count
1990	17.3	37.8	456	32.8	8,063
1991	17.3	41.5	501	29.2	7,254
1992	17.3	42.5	512	30.9	7,735
1993	17.3	40.7	491	31.2	7,875
1994	17.3	36.8	443	26.6	6,757
1995	17.3	43.8	530	32.1	8,221
1996	17.3	38.8	470	30.1	7,769
1997	17.3	40.5	488	30.0	7,742
1998	17.3	30.9	369	21.7	5,594
1999	17.3	23.5	280	21.4	5,546
2000	17.3	29.3	349	26.0	6,693
2001	17.3	27.4	326	23.7	6,089
2002	17.3	23.7	283	20.8	5,359

Spearman's ρ	-0.74**	-0.79**
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¹ Population estimates are taken from the Michigan population estimates for 1990-2002.

² Rates are not age adjusted. Hospitalization records with missing age are excluded.

³ Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

⁴ Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

** Correlation is statistically significant; p-value < 0.01.

Sample Interpretation of Annual Rate:

In 2002, the rate of asthma hospitalization among children less than 18 years in Michigan was 20.8 per 10,000 population.

Sample Trend Interpretation:

Between 1990 and 2002, there has been a significant overall decrease in asthma hospitalization rates for children less than 18 years in Michigan.

Counts and Rates (per 10,000) [1,2] of Asthma [3] Hospitalization [4] by Year for CHILDREN Aged 0 to 4 Years, for Genesee County and the State of Michigan, 1990-2002, Compared to the Healthy People 2010 Target (Objective 24-2).

Year	HP 2010 Objective	Genesee County		Michigan	
		Rate	Count	Rate	Count
1990	25.0	80.8	275	66.1	4,712
1991	25.0	88.0	302	57.1	4,106
1992	25.0	93.7	322	64.4	4,638
1993	25.0	80.1	275	59.6	4,291
1994	25.0	68.5	232	53.2	3,783
1995	25.0	83.2	276	63.9	4,457
1996	25.0	72.4	235	59.6	4,092
1997	25.0	80.4	257	59.2	4,019
1998	25.0	57.1	181	40.5	2,734
1999	25.0	46.9	148	40.6	2,725
2000	25.0	64.1	202	48.8	3,257
2001	25.0	60.4	189	50.5	3,341
2002	25.0	52.3	165	45.8	3,039

Spearman's ρ	-0.82**	-0.76**
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¹ Population estimates are taken from the Michigan population estimates for 1990-2002.

² Rates are not age adjusted. Hospitalization records with missing age are excluded.

³ Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

⁴ Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

** Correlation is statistically significant; p-value < 0.01.

Sample Interpretation of Annual Rate:

In 2002, the rate of asthma hospitalization among children 0 to 4 years in Michigan was 45.8 per 10,000 population.

Sample Trend Interpretation:

Between 1990 and 2002, there has been a significant overall decrease in asthma hospitalization rates for children 0 to 4 years in Michigan.

Counts and Rates (per 10,000) [1,2] of Asthma [3] Hospitalization [4] by Year for CHILDREN/ADULTS Aged 5 to 64 Years, for Genesee County and the State of Michigan, 1990-2002, Compared to the Healthy People 2010 Target (Objective 24-2).

Year	HP 2010 Objective	Genesee County		Michigan	
		Rate	Count	Rate	Count
1990	7.7	19.5	683	14.0	10,229
1991	7.7	21.0	734	13.7	10,132
1992	7.7	18.7	650	13.6	10,205
1993	7.7	22.5	785	15.5	11,693
1994	7.7	21.2	736	14.5	11,008
1995	7.7	22.5	794	15.5	11,986
1996	7.7	20.2	717	15.0	11,734
1997	7.7	19.7	697	14.2	11,268
1998	7.7	17.7	627	13.2	10,521
1999	7.7	15.8	561	13.2	10,570
2000	7.7	14.1	501	13.3	10,776
2001	7.7	14.2	508	12.3	9,999
2002	7.7	12.2	439	11.5	9,423

Spearman's ρ	-0.71**	-0.63*
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¹ Population estimates are taken from the Michigan population estimates for 1990-2002.

² Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.

³ Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

⁴ Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

* Correlation is statistically significant; p-value < 0.05.

** Correlation is statistically significant; p-value < 0.01.

Sample Interpretation of Annual Rate:

In 2002, the rate of asthma hospitalization among children and adults 5 to 64 years in Michigan was 11.5 per 10,000 population.

Sample Trend Interpretation:

Between 1990 and 2002, there has been a significant overall decrease in asthma hospitalization rates for children and adults 5 to 64 years in Michigan.

Counts and Rates (per 10,000) [1,2] of Asthma [3] Hospitalization [4] by Year for ADULTS Aged 65 Years and Older, for Genesee County and the State of Michigan, 1990-2002, Compared to the Healthy People 2010 Target (Objective 24-2).

Year	HP 2010 Objective	Genesee County		Michigan	
		Rate	Count	Rate	Count
1990	11.0	36.5	163	25.8	2,849
1991	11.0	29.2	130	24.3	2,757
1992	11.0	30.5	145	23.9	2,754
1993	11.0	31.5	148	25.5	2,991
1994	11.0	29.3	139	23.9	2,818
1995	11.0	22.4	109	20.9	2,502
1996	11.0	20.6	102	18.6	2,232
1997	11.0	14.6	72	16.8	2,033
1998	11.0	19.3	97	16.8	2,034
1999	11.0	16.9	84	17.2	2,090
2000	11.0	12.9	67	15.2	1,853
2001	11.0	15.7	81	16.5	2,023
2002	11.0	18.3	96	18.1	2,234

Spearman's ρ	-0.86**	-0.87**
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¹ Population estimates are taken from the Michigan population estimates for 1990-2002.

² Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.

³ Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

⁴ Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

** Correlation is statistically significant; p-value < 0.01.

Sample Interpretation of Annual Rate:

In 2002, the rate of asthma hospitalization among adults 65 years and older in Michigan was 18.1 per 10,000 population.

Sample Trend Interpretation:

Between 1990 and 2002, there has been a significant overall decrease in asthma hospitalization rates for adults 65 years and older in Michigan.

Section 6: Data Sources

Name: Michigan Behavioral Risk Factor Surveillance System

Acronym: BRFSS

Basic Purpose and History: The BRFSS is a source of estimates of the prevalence of certain health behaviors, conditions, and practices associated with leading causes of death. Michigan has conducted the BRFSS survey since 1987. Asthma related questions were added to the survey in 2000.

Data Collection Process: Annual estimates are based on data collected from a random-digit dial telephone survey of a sample of Michigan households. It is a population-based representative sample of non-institutionalized Michigan residents. The data are weighted to represent estimates for the general adult population. BRFSS interviewers use a Computer Assisted Telephone Interviewing (CATI) system, which provides the interviewer with prompts. The interviewer types the respondent's responses directly onto the computer screen, providing quality control and minimizing interviewer error.

Population Included: A record is a completed telephone interview. The selected respondent must be a Michigan resident, 18 years of age or older who lives in a private residence and has a telephone. One randomly selected adult from a household is interviewed.

Asthma Data: There are two core questions dedicated to estimating asthma prevalence for the general population of adults. Michigan has opted to include the asthma module questions that include information about child prevalence and disease management/control. Finally, Michigan has also developed questions regarding work-related asthma. The following are the questions included on the Michigan BRFSS survey in 2001 regarding asthma:

Asthma Prevalence Questions for Adults:

- Have you ever been told by a doctor, nurse, or other health professional that you had asthma?
- Do you still have asthma?

Asthma Prevalence Questions for Children in the Household:

- Earlier you said there were <number> children, age 17 or younger, living in your household. How many of these children have ever been diagnosed with asthma?
- How many of these children/does this child still have asthma?

Additional Information: For more information about the BRFSS and national data for comparison, visit <http://www.cdc.gov/brfss/index.htm>. For a complete report of the Michigan BRFSS Survey, visit <http://www.michigan.gov/mdch/0,1607,7-132--12702--,00.html>.

Name: Michigan Inpatient Database

Acronym: MIDB

Basic Purpose and History: These data help support the State of Michigan health planning activities and are used by facilities themselves for internal evaluation. The Michigan Department of Community Health (MDCH) has purchased data since 1982.

Data Collection Process: Data are collected throughout a patient hospital stay by clinical and administrative staff and filed within a medical record. Hospital medical record personnel ascertain and keypunch information from these records. Some small hospitals complete data collection forms and send these directly to Michigan Health and Hospital Association (MHHA)

for processing. Depending on the facility, data are submitted on a voluntary basis monthly, quarterly, or annually to MHHA. Because data formats often differ by hospital, all coding is converted into standard formats at MHHA. The public use file provided to MDCH is stripped of all patient, provider, and hospital identifiers.

Population Included: Records include all hospital discharges from any of Michigan's reporting acute care hospitals or Michigan residents discharged from acute care hospitals in contiguous states. It includes virtually all hospitalizations in Michigan and for Michigan residents.

Asthma Data: The MIDB includes information on discharge diagnoses, which in the case of asthma includes the International Classification of Disease, Version 9, Clinical Modification (ICD-9-CM) codes 493.00-493.99. Procedure codes for treatments administered during the inpatient stay are also maintained in the dataset.

Additional Information: For the 2003 report on the *Michigan Hospital Profiles Project* published by MHHA, visit <http://www.michiganhospitalprofiles.org/>. For the latest data regarding preventable hospitalizations in Michigan, visit <http://www.mdch.state.mi.us/pha/osr/chi/hosp/frame.html>. The National Hospital Discharge Survey (NHDS) collects national data comparable to the MIDB. For more information about the NHDS and data for comparison, visit <http://www.cdc.gov/nchs/about/major/hdasd/nhds.htm>.

Name: Michigan Resident Death Files

Acronym: MRDF

Basic Purpose and History: The death certificate database is a high quality computerized data set containing demographic and cause of death information for all Michigan residents (out of state deaths included) and non-Michigan residents dying in Michigan. Death certificates are one of public health's vital records for monitoring the health of citizens. Death certificates have been collected in Michigan since 1897.

Data Collection Process: A funeral director, or another individual responsible for disposing of the body, completes the demographic and disposition components of the death certificate. When applicable, an attending physician or other hospital medical staff completes the portion of the death certificate describing the death (time, date, place, and immediate/underlying cause). A county medical examiner completes this section in all unexpected deaths including fatal injuries. The death certificate is then sent to the local registrar who verifies that the document has been properly filled out. If not, it is returned to the appropriate person for revision. Certificates for Michigan residents dying out-of-state are provided by those states (primarily Indiana, Ohio, and Wisconsin). Instructional materials to complete the death certificate are available at the state and local level for doctors, hospitals, medical examiners, and funeral directors. Michigan funeral director training also includes an annual seminar on death certificate completion.

Population Included: All in-state occurrences regardless of the state of residence and all Michigan residents regardless of location of death are included.

Asthma Data: The MRDF includes information on causes of death, which in the case of asthma includes the International Classification of Disease (ICD), Version 9 codes 493 (1990-1998) and Version 10 codes J45 and J46 (1999-present).

Additional Information: For more data regarding Michigan mortality, visit <http://www.mdch.state.mi.us/pha/osr/index.asp?ld=4>. The National Center for Health Statistics maintains the National Vital Statistics System that provides a natural comparison to the MRDF. For more information, visit <http://www.cdc.gov/nchs/about/major/dvs/mortdata.htm>.

Section 7: Methods

Topic 1: Prevalence

Prevalence is the proportion of individuals in a population who have the disease at a point in time or during a given time period. It is often used to describe the health burden on a given population.

Prevalence is computed by dividing the number of existing cases at a particular point or period in time by the total population from which the cases came. It is often multiplied by 100 and expressed as a percent.

$$\text{Prevalence} = \frac{\text{number of existing cases of disease}}{\text{total population}}$$

In this report, prevalence estimates are generated in the analysis of data from the Behavioral Risk Factor Surveillance System.

Topic 2: Incidence Rate

The incidence rate expresses the rate at which events occur in a population at risk at any given point in time during a defined time period. Rates presented in this report are used to estimate annual incidence for aggregates of individuals, defined by geographic area and demographic characteristics, over a given time period.

The numerator of the incidence rate is the number of new events in the population during a given time period. The denominator is the average population estimated for that same time period multiplied by the number of years in the interval. The use of this denominator assumes that the population and its demographic composition are relatively stable.

The population at the midpoint of a given time interval is used to estimate the average population over the entire interval. This is then multiplied by the number of years in the interval so that an *annual* rate is generated. For example, to compute a rate of asthma hospitalizations for 1998 through 2000, the population in 1999 (midpoint) multiplied by 3 is used as the denominator. Rates for single years are calculated using the estimated population for that year.

$$\text{Annual Incidence Rate} = \frac{\text{number of new events during given time period}}{\text{average population X number of years in time period}}$$

Incidence rates are generally multiplied by a factor of 10 so that they can be better understood in terms of a population. For asthma hospitalizations, rates are multiplied by 10,000, whereas for asthma deaths, rates are multiplied by 1,000,000.

In this report, incidence rates are generated in the analysis of data from the Michigan Inpatient Database, Michigan Resident Death File.

Topic 3: Age Adjustment by Direct Standardization

Populations often differ in their distribution of age, which may in turn affect the overall rate of events in that population. For example, if one population has a larger number of young children than another, it could demonstrate a higher asthma hospitalization rate simply due to its age structure. Therefore, when comparing rates of events in populations of different age distributions, it is important to account for those differences. In this report, age structure differences are accounted for in overall rates using direct standardization methodology to compute age-adjusted rates. Rates that are not age adjusted are referred to as crude rates.

An age-adjusted rate is a weighted average of age group specific rates in the population under study. The age group specific rates are weighted by the number of people in each age group of a selected *standard* population. When two or more age-adjusted rates are computed using the same *standard* population, they may be compared. Age-adjusted rates are presented in this report so that comparisons can be made between geographic subgroups (ex. County vs. County) and demographic subgroups (ex. White vs. Black). The *standard* population used in the calculation of age-adjusted rates in this report is the 2000 United States Standard Population.

To compute an age-adjusted incidence rate, the first step is to compute the comprising age specific rates. These are then multiplied by the corresponding age specific weight, i.e. the proportion of people in a particular age strata in the *standard* population. The products of these calculations are then summed and divided by the sum of all the age specific weights.

$$\text{Age-Adjusted Incidence Rate} = \frac{\text{Sum of (age specific rate X age specific weight)}}{\text{Sum of age specific weights}}$$

In this report, age-adjusted rates are generated in the analysis of data from the Michigan Inpatient Database and the Michigan Resident Death File.

Topic 4: Confidence Interval

The purpose of a confidence interval (CI) is to estimate the statistical uncertainty around a particular measure. For example, the *estimated* prevalence of asthma among Michigan adults is 8.8%, with a 95% confidence interval of 7.8% to 9.8%; we are 95% confident that the *true* prevalence in the population is no less than 7.8% and no greater than 9.8%.

In this report, 95% confidence intervals are provided for average annual incidence rates.

The confidence interval formula for a crude incidence rate is based on the Poisson distribution. The upper and lower limits are often multiplied by an appropriate factor of 10: 10,000 for asthma hospitalization rates and 1,000,000 for asthma mortality rates.

$$\text{Crude Incidence Rate CI} = \text{IR}_c \pm 1.96 \times \left(\frac{\text{IR}_c}{n} \right)^{1/2}$$

Where IR_c = crude incidence rate
 n = denominator of the rate

The confidence interval formula for an age-adjusted incidence rate is based on the Poisson distribution. The upper and lower limits are often multiplied by an appropriate factor of 10 – 10,000 for asthma hospitalization rates and 1,000,000 for asthma mortality rates.

$$\text{Age-Adjusted Incidence Rate CI} = \text{IR}_a \pm 1.96 \times \left(\frac{\text{Sum } (W^2 \times I)}{(\text{Sum } W)^2} \right)^{1/2}$$

Where IR_a = age-adjusted incidence rate
 W = age specific weights from the *standard* population
 I = variance of crude age specific rates

Confidence intervals can be used as a method to test whether a specific measure is statistically different between groups. For example, in comparing a county specific asthma hospitalization rate with that of the State of Michigan, they are considered statistically different if their confidence intervals do not overlap.

Topic 5: Data Suppression

Incidence rate estimates calculated with a small number of events or population sizes are statistically unstable. They exhibit wide confidence intervals indicative of great variability. In this report, data suppression rules are enforced so that the data presented are reliable. For demographic or geographic subgroups where there is less than or equal to 20 hospitalizations or less than 5000 population, asthma hospitalization rates are not presented. Mortality rates are suppressed when there is less than 5 deaths or less than 5000 population. In addition, to protect the identity of persons who have been hospitalized or died, counts less than 5 are not presented in this report.

Topic 6: Trend Analysis

To determine if there is an overall trend in annual asthma hospitalization and mortality rates over time, the Spearman Correlation Coefficient and its accompanying statistical Rank

Correlation Test were utilized. This test assesses whether there is a statistically significant monotonic relationship between 2 variables, in this case year and rate.

The Spearman Correlation Coefficient (ρ) ranges from -1.0 to 1.0 . If the coefficient equals -1.0 , it indicates a perfect negative correlation, where each year has a lower hospitalization rate than the previous year. If the coefficient equals 1.0 , it indicates a perfect positive correlation, where each year has a higher hospitalization rate than the previous year. As the correlation coefficient approaches 0.0 , from either direction, the relationship between the 2 variables weakens. For example, a correlation coefficient of 0.90 indicates a stronger positive relationship between 2 variables than a coefficient of 0.50 .

The p-value of the Rank Correlation test ranges from 0.0 to 1.0 and gives the probability of finding a significant overall monotonic trend in the asthma hospitalization rate data when, in reality, no trend exists. Again, the standard used to assess the significance of a statistical test is $p\text{-value} = 0.05$. A p value less than or equal to 0.05 indicates that there is at most a 5% chance of observing a trend, given that, in reality, rates are stable. In this case, the result is considered statistically significant. If the p value is greater than 0.05 , chance cannot be excluded as a likely explanation for the observed trend, so the result is not considered statistically significant.

From this, it follows that:

- If there is a statistically significant **increase** in asthma hospitalization rates over time, the Spearman Correlation Coefficient will be **positive** and the p-value for the test will be **less** than 0.05 .
- If there is a statistically significant **decrease** in asthma hospitalization rates over time, the Spearman Correlation Coefficient will be **negative** and the p-value for the test will be **less** than 0.05 .

IMPORTANT: This is a crude analysis that simply identifies whether there is an **overall** increase or decrease in the asthma hospitalization or mortality rates. This statistical test does not determine the significance of more complex trend patterns. There is no way to know from these statistics if a specific event or series of events caused an observed change in rates.

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