

# Epidemiology of Asthma

## In Washtenaw County, Michigan

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## 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 ( $\geq 18$  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 ( $\geq 18$  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 Washtenaw County and the State of Michigan.

	<b>Children (&lt;18 Years)</b>	<b>Adults (≥18 Years)</b>
	<b>2002</b>	<b>2003</b>
Washtenaw County	6,690	24,661
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.

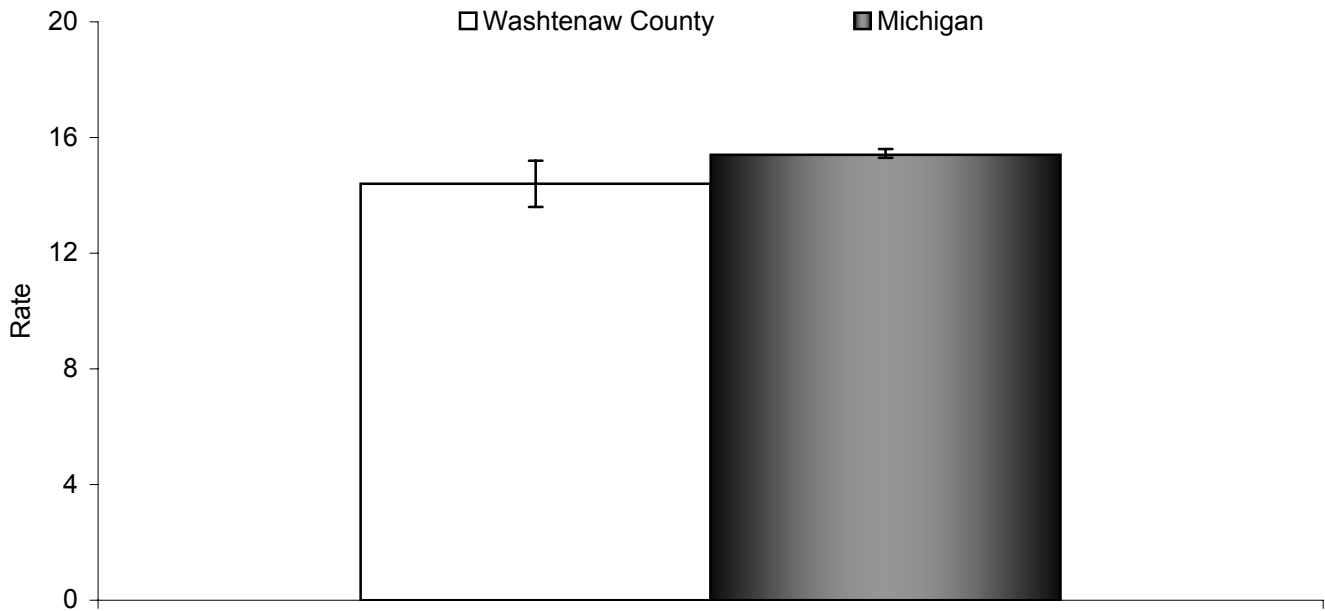
These data are the number of inpatient hospitalizations for asthma. This is not the same as the number of individual people hospitalized for asthma. An individual can be hospitalized more than once for the same condition during the study period and multiple hospitalizations cannot be distinguished from 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 Washtenaw 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.

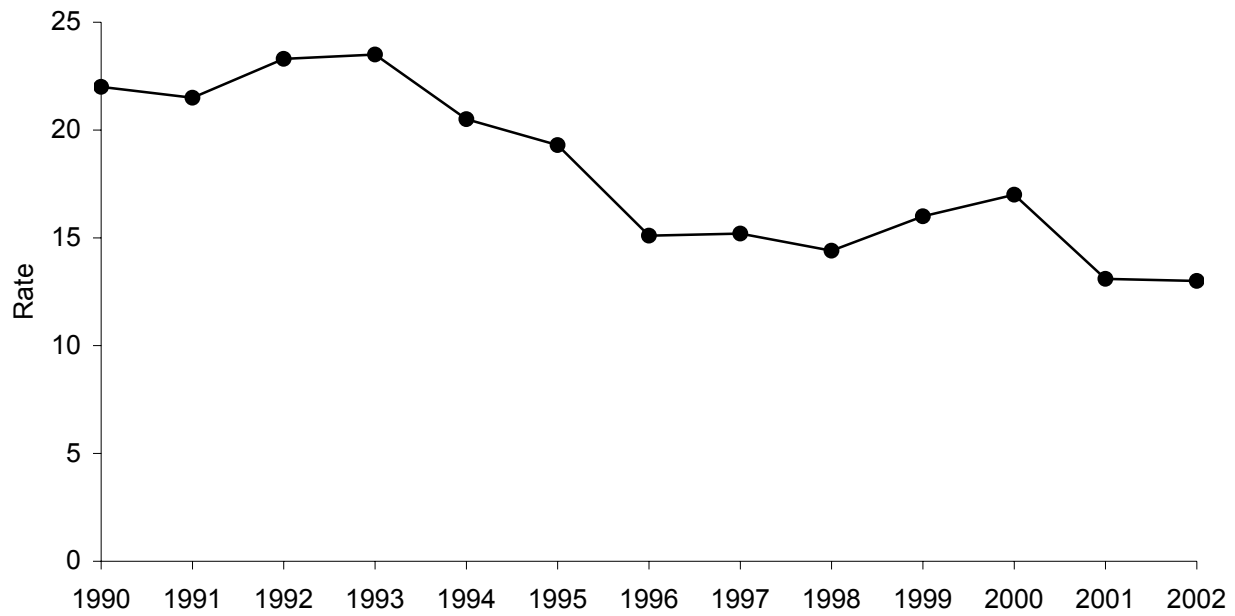
3 Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

	Total Population
Washtenaw County Rate	14.4
95% CI	13.6 , 15.2
Count	1,298
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 Washtenaw County, 2000-2002, is 433.
- ✧ Washtenaw County has significantly lower 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 Washtenaw 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.

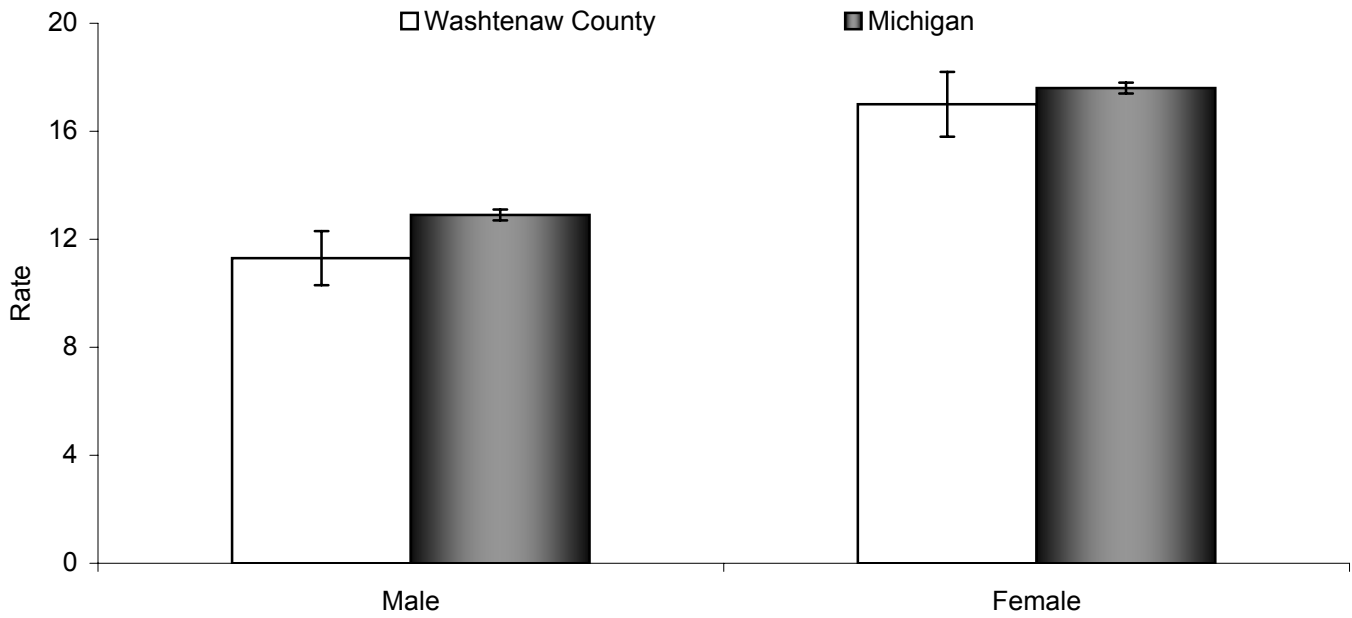
Year	Total Population	
	Rate	Count
1990	22.0	552
1991	21.5	551
1992	23.3	609
1993	23.5	631
1994	20.5	554
1995	19.3	526
1996	15.1	427
1997	15.2	432
1998	14.4	416
1999	16.0	463
2000	17.0	498
2001	13.1	401
2002	13.0	399

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 Washtenaw County ( $\rho = -0.86, p < 0.01$ ).

See appendix page 34 for supporting data.

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



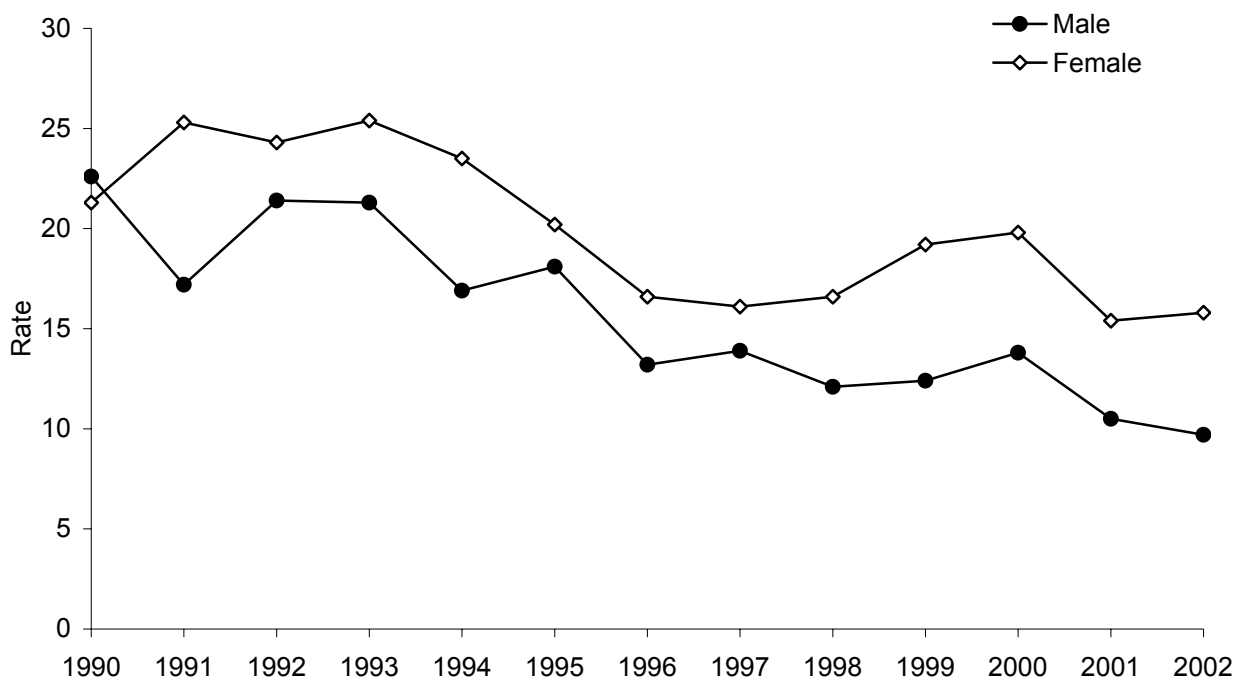
- 1 Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
- 2 Population estimates are taken from the Michigan population estimates for 2001.
- 3 Asthma hospitalization is defined as a primary discharge diagnosis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

	Male	Female
Washtenaw County Rate	11.3	17.0
95% CI	10.3 , 12.3	15.8 , 18.2
Count	513	785
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 rate for males in Washtenaw County is significantly lower than the rate for males in the State of Michigan as a whole, 2000-2002.
- ✧ In Washtenaw 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 Washtenaw 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.

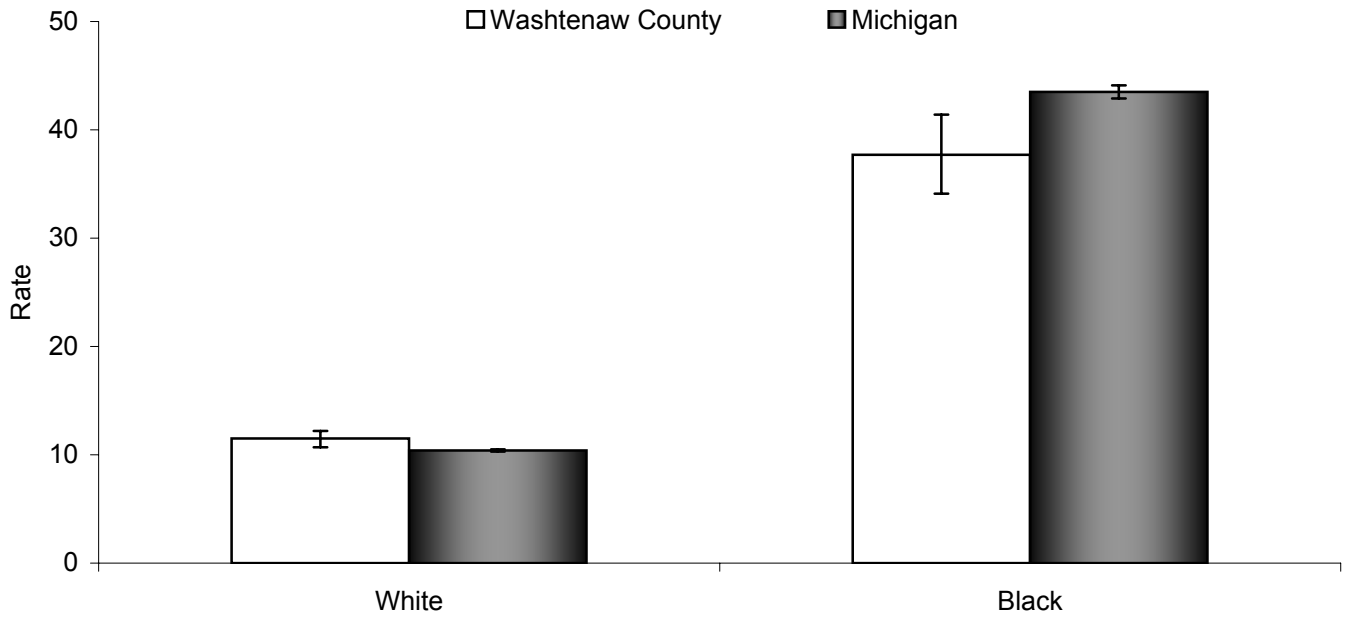
Year	Male		Female	
	Rate	Count	Rate	Count
1990	22.6	282	21.3	270
1991	17.2	221	25.3	330
1992	21.4	286	24.3	323
1993	21.3	282	25.4	349
1994	16.9	235	23.5	319
1995	18.1	249	20.2	277
1996	13.2	189	16.6	238
1997	13.9	202	16.1	230
1998	12.1	171	16.6	245
1999	12.4	179	19.2	284
2000	13.8	203	19.8	295
2001	10.5	159	15.4	242
2002	9.7	151	15.8	248

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 both the male and the female population in Washtenaw County (male,  $\rho = -0.91$ ,  $p < 0.01$ ; female,  $r = -0.83$ ,  $p < 0.01$ ).

See appendix pages 35 and 36 for supporting data.

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



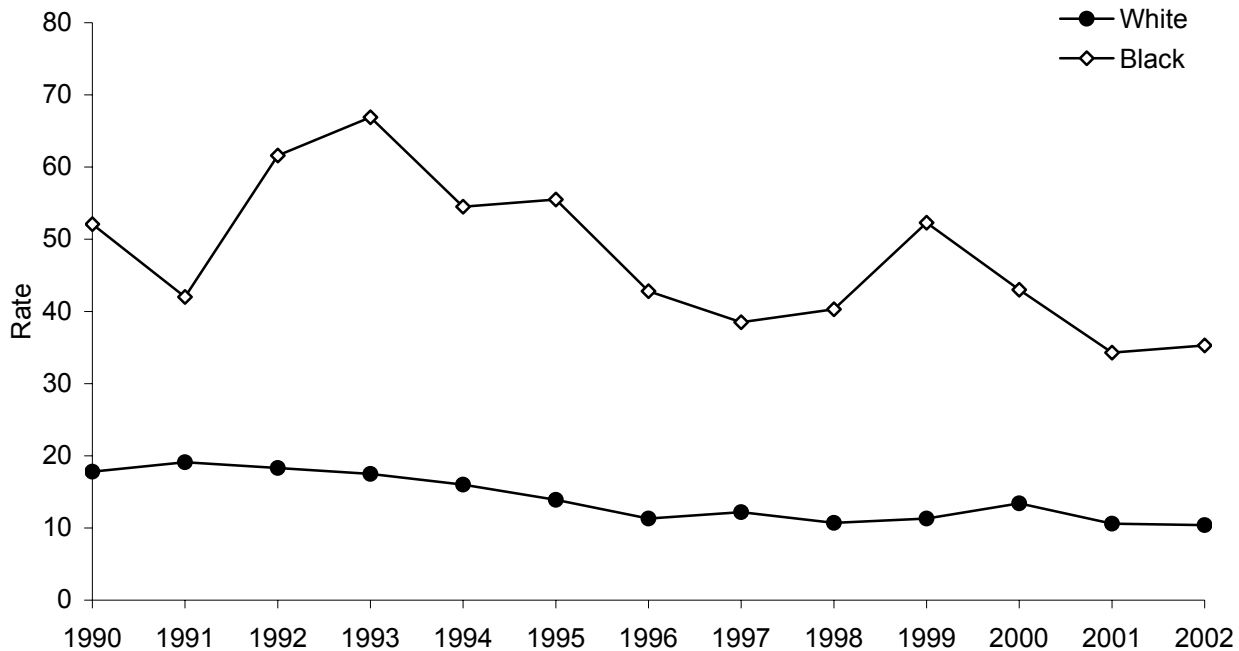
- 1 Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
- 2 Population estimates are taken from the Michigan population estimates for 2001.
- 3 Asthma hospitalization is defined as a primary discharge diagnosis 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
Washtenaw County Rate	11.5	37.7
95% CI	10.7 , 12.2	34.1 , 41.4
Count	818	464
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 Washtenaw 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 Washtenaw 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 Washtenaw County and the State of Michigan are significantly lower than the respective rates for black persons, 2000-2002.
- ✧ While black persons in Washtenaw 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 Washtenaw 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.

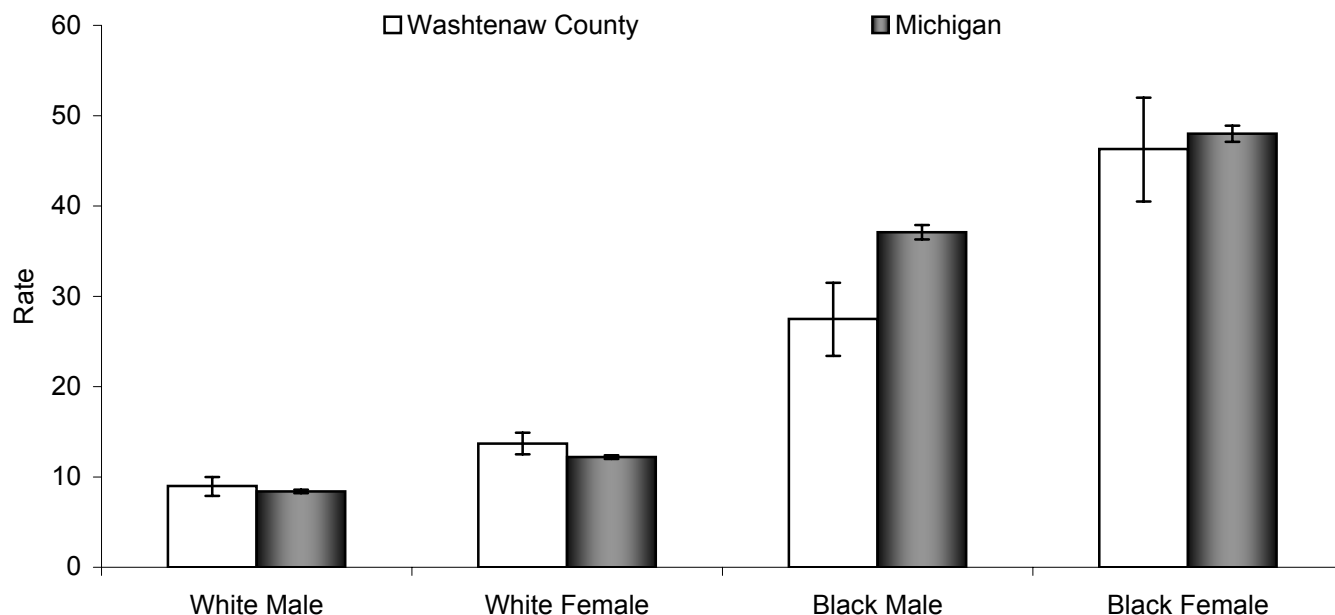
Year	White		Black	
	Rate	Count	Rate	Count
1990	17.8	367	52.1	172
1991	19.1	398	42.0	148
1992	18.3	393	61.6	205
1993	17.5	376	66.9	248
1994	16.0	347	54.5	204
1995	13.9	307	55.5	214
1996	11.3	261	42.8	162
1997	12.2	275	38.5	157
1998	10.7	248	40.3	162
1999	11.3	260	52.3	199
2000	13.4	310	43.0	182
2001	10.6	255	34.3	141
2002	10.4	253	35.3	141

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 both white persons and black persons in Washtenaw County (white,  $\rho = -0.91$ ,  $p < 0.01$ ; black,  $\rho = -0.59$ ,  $p < 0.05$ ).

See appendix pages 37 and 38 for supporting data.

Figure 7. Rates (per 10,000) [1,2] of Hospitalization due to Asthma [3] by Sex and Race [4] for Washtenaw 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.

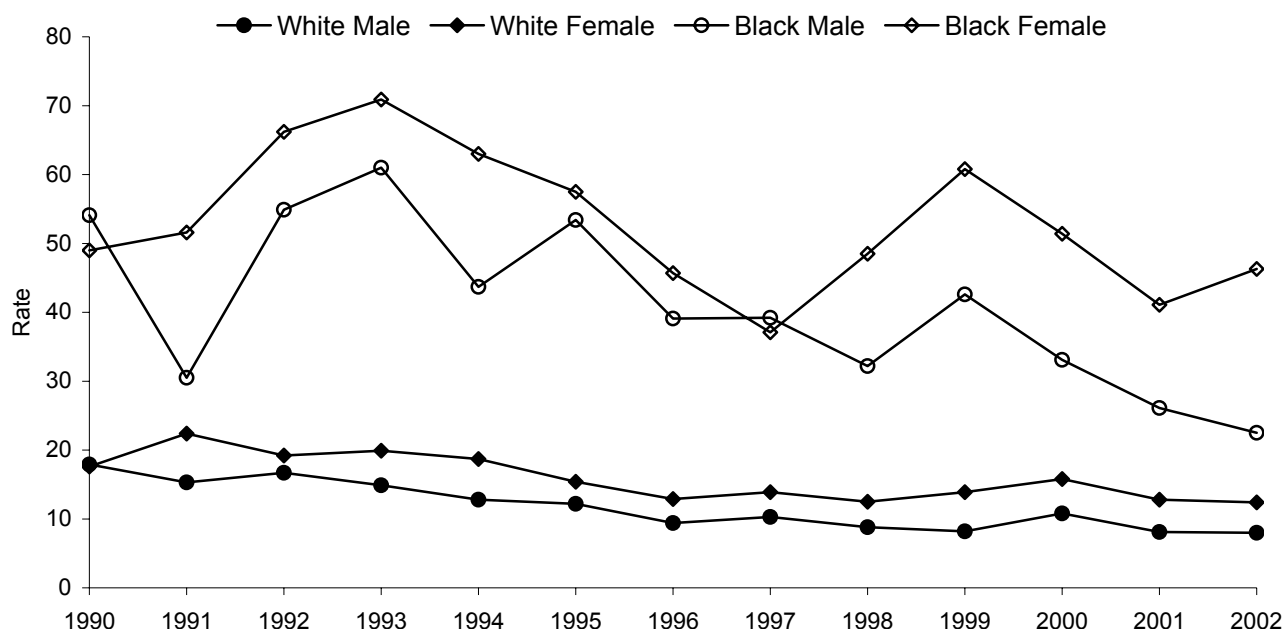
4 For records that are missing data for race, race was assigned based on the 1990 census population for Michigan.

	White Male	White Female	Black Male	Black Female
Washtenaw County Rate	9.0	13.7	27.5	46.3
95% CI	7.9 , 10.0	12.5 , 14.9	23.4 , 31.5	40.5 , 52.0
Count	308	510	194	270
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.

- ✧ The asthma hospitalization rate for black females in Washtenaw County is significantly higher than the rates among white males, white females, or black males in Washtenaw County, 2000-2002.
- ✧ The asthma hospitalization rate for black persons in Washtenaw County is significantly higher than the rate among white persons in Washtenaw County, 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 Washtenaw 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.

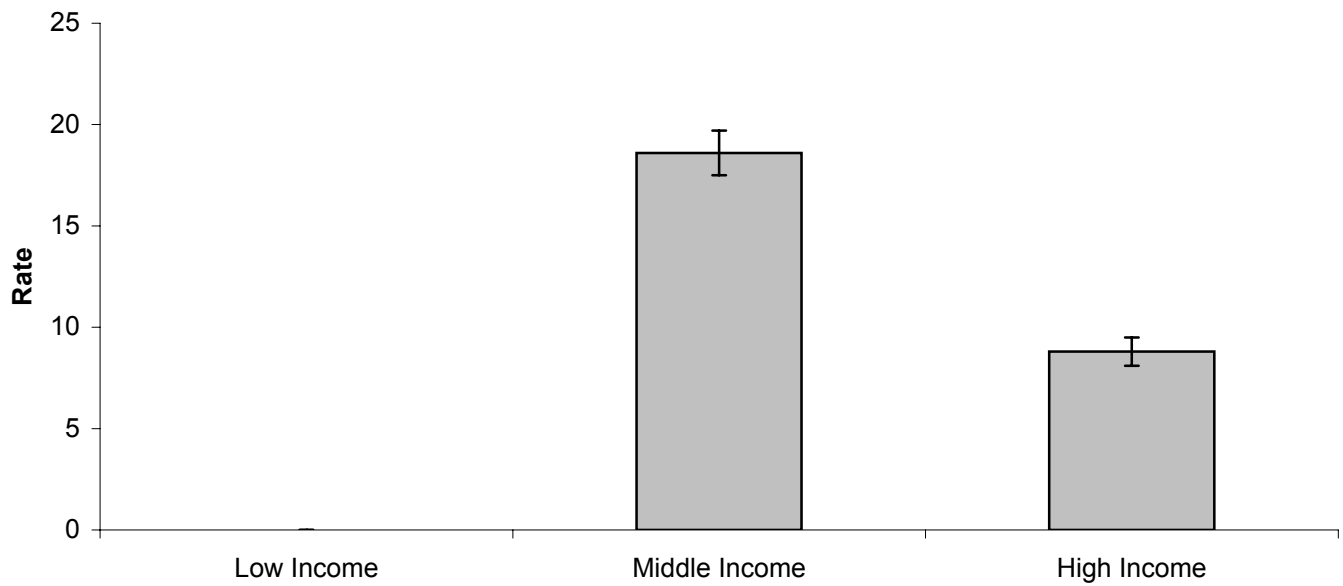
Year	White Male		White Female		Black Male		Black Female	
	Rate	Count	Rate	Count	Rate	Count	Rate	Count
1990	17.9	180	17.6	187	54.1	94	49.0	78
1991	15.3	159	22.4	239	30.5	59	51.6	89
1992	16.7	180	19.2	213	54.9	101	66.2	104
1993	14.9	155	19.9	221	61.0	122	70.9	126
1994	12.8	139	18.7	208	43.7	94	63.0	110
1995	12.2	132	15.4	175	53.4	112	57.5	102
1996	9.4	107	12.9	154	39.1	80	45.7	82
1997	10.3	114	13.9	161	39.2	88	37.1	69
1998	8.8	97	12.5	151	32.2	70	48.5	92
1999	8.2	92	13.9	168	42.6	85	60.8	114
2000	10.8	120	15.8	190	33.1	79	51.4	103
2001	8.1	93	12.8	162	26.1	62	41.1	79
2002	8.0	95	12.4	158	22.5	53	46.3	88

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 Washtenaw County (white male,  $\rho = -0.93$ ,  $p < 0.01$ ; white female,  $\rho = -0.81$ ,  $p < 0.01$ ; black male,  $\rho = -0.67$ ,  $p < 0.05$ ).

See appendix pages 39 through 42 for supporting data.

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

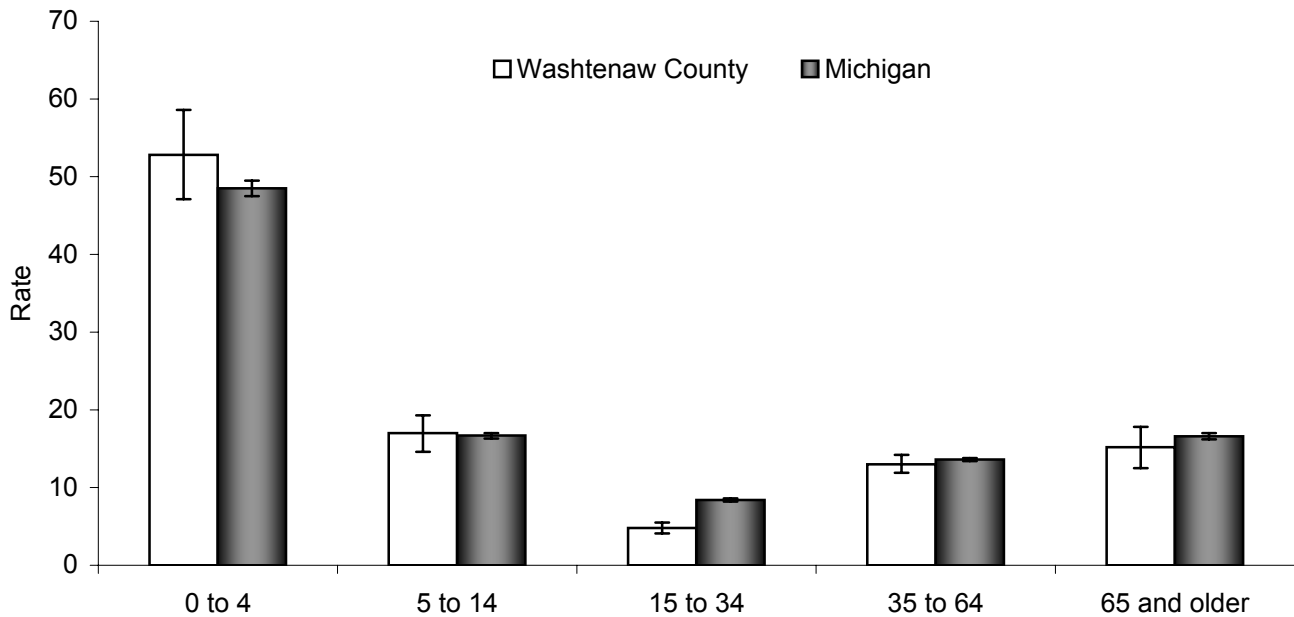
	Low Income	Medium Income	High Income
Washtenaw County Rate	‡	18.6	8.8
95% CI	‡ , ‡	17.5 , 19.7	8.1 , 9.5
Count	5	1,182	686

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

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

◇ The asthma hospitalization rate for middle income areas in Washtenaw County is significantly higher than the rate for high income areas in Washtenaw County, 2000-2002.

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



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

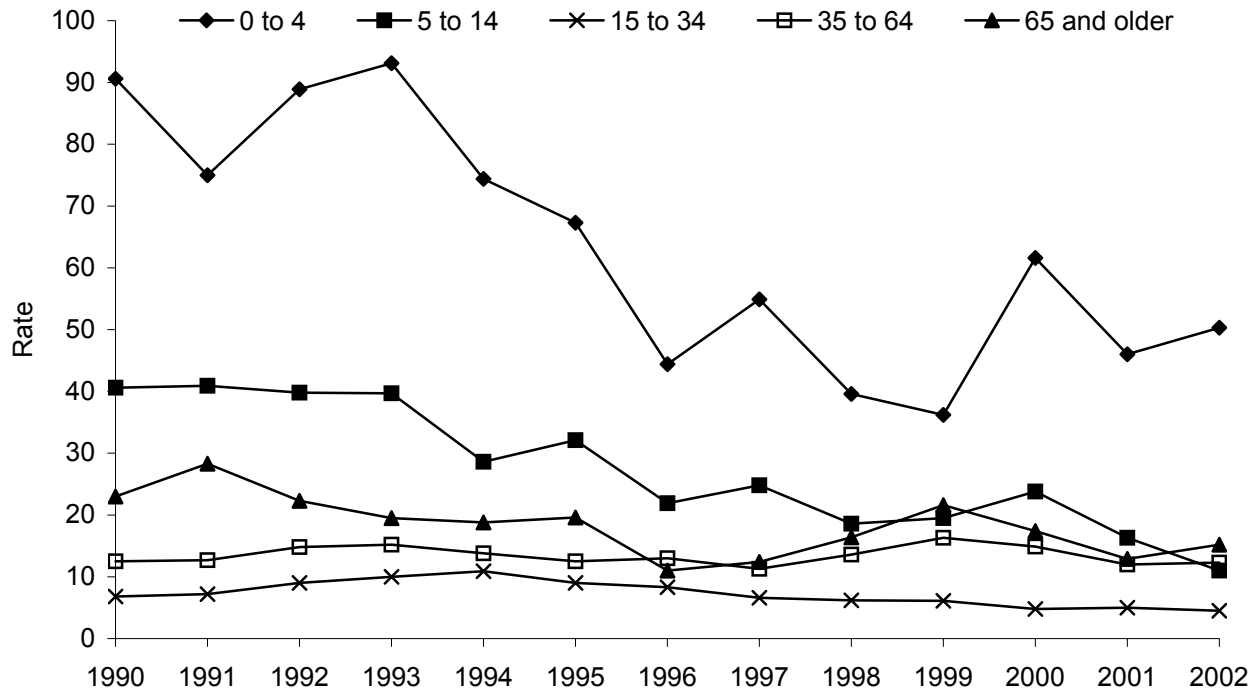
2 Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

	0 to 4	5 to 14	15 to 34	35 to 64	65 and older
Washtenaw County Rate	52.8	17.0	4.8	13.0	15.2
95% CI	47.1 , 58.6	14.6 , 19.3	4.1 , 5.5	11.9 , 14.2	12.5 , 17.8
Count	324	206	174	471	123
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 Washtenaw 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 Washtenaw 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 Washtenaw 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.

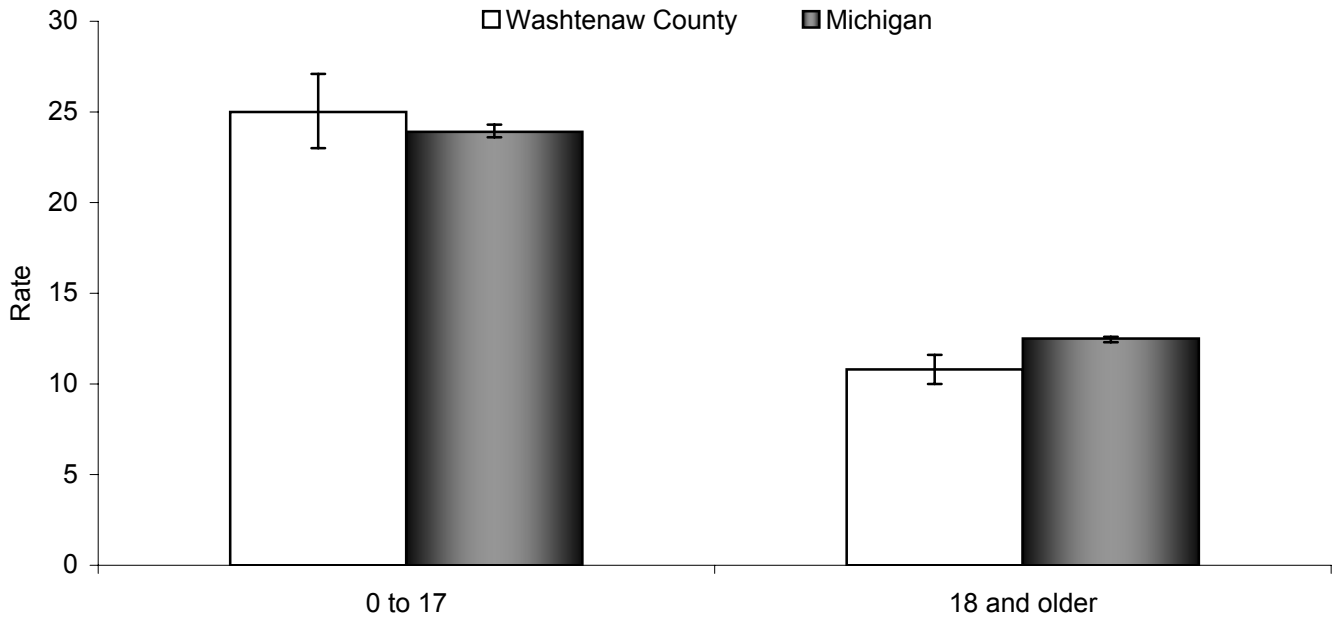
Year	0 to 4		5 to 14		15 to 34		35 to 64		65 and older	
	Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count
1990	90.6	176	40.6	133	6.8	82	12.5	112	23.0	49
1991	75.0	148	40.9	138	7.2	86	12.7	117	28.3	62
1992	88.9	176	39.8	136	9.0	107	14.8	140	22.3	50
1993	93.1	184	39.7	138	10.0	117	15.2	147	19.5	45
1994	74.4	146	28.6	101	10.9	127	13.8	136	18.8	44
1995	67.3	131	32.1	116	9.0	105	12.5	127	19.6	47
1996	44.4	86	21.9	81	8.3	97	13.0	136	11.0	27
1997	54.9	107	24.8	94	6.6	78	11.3	122	12.4	31
1998	39.6	78	18.6	72	6.2	73	13.6	151	16.4	42
1999	36.2	72	19.5	77	6.1	72	16.3	186	21.6	56
2000	61.6	125	23.8	95	4.8	58	14.9	174	17.4	46
2001	46.0	94	16.3	66	5.0	61	12.0	145	12.9	35
2002	50.3	105	11.0	45	4.5	55	12.3	152	15.2	42

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 population aged 0 to 4, 5 to 14, 15 to 34, and 65 years and older in Washtenaw County (0 to 4,  $\rho = -0.77$ ,  $p < 0.01$ ; 5 to 14,  $\rho = -0.94$ ,  $p < 0.01$ ; 15 to 34,  $\rho = -0.77$ ,  $p < 0.01$ ; 65 and older,  $\rho = -0.68$ ,  $p < 0.05$ ).

See appendix pages 43 through 47 for supporting data.

Figure 12. Rates (per 10,000) [1,2] of Hospitalization due to Asthma [3] by Age Group for Washtenaw 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.

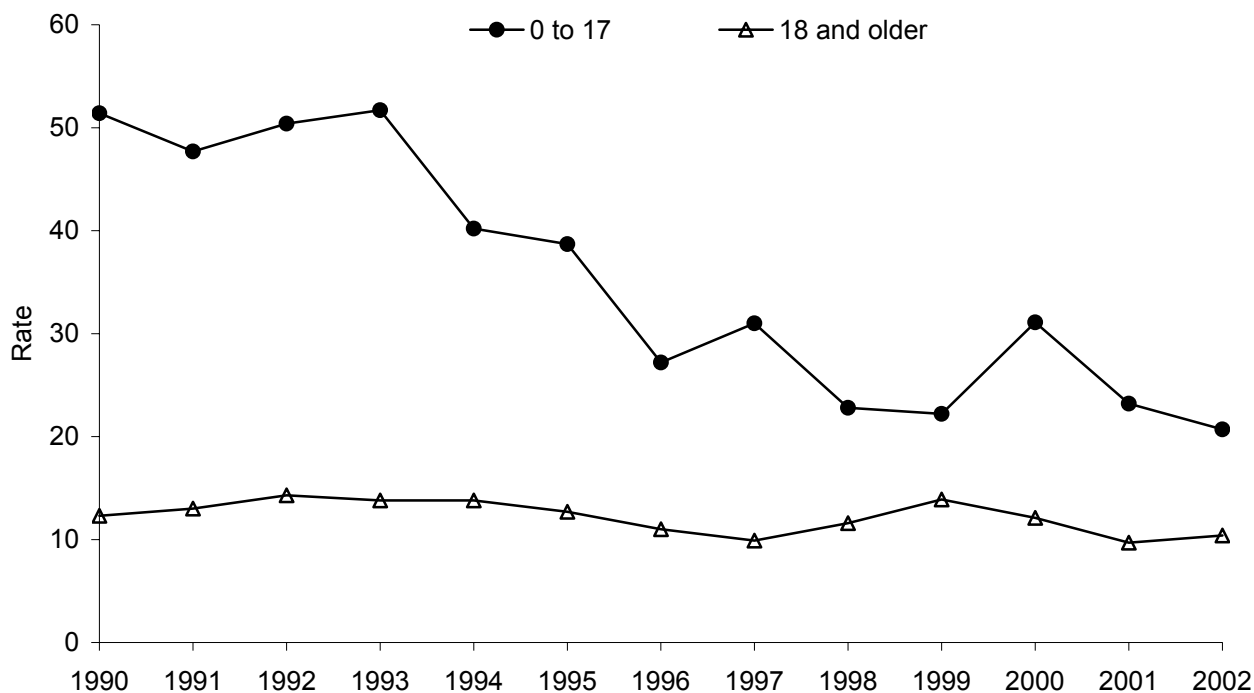
3 Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

	<b>0 to 17</b>	<b>18 and Older</b>
Washtenaw County Rate	25.0	10.8
95% CI	23.0 , 27.1	10.0 , 11.6
Count	557	741
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 Washtenaw 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 rate of asthma hospitalization for adults aged 18 years and older in Washtenaw County is significantly lower than the respective rate 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 Washtenaw 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	51.4	332	12.3	220
1991	47.7	311	13.0	240
1992	50.4	335	14.3	274
1993	51.7	347	13.8	284
1994	40.2	272	13.8	282
1995	38.7	264	12.7	262
1996	27.2	186	11.0	241
1997	31.0	217	9.9	215
1998	22.8	162	11.6	254
1999	22.2	159	13.9	304
2000	31.1	228	12.1	270
2001	23.2	172	9.7	229
2002	20.7	157	10.4	242

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 and persons aged 18 years and older in Washtenaw County (less than 18,  $\rho = -0.87$ ,  $p < 0.01$ ; 18 and older,  $\rho = -0.58$ ,  $p < 0.05$ ).

See appendix pages 48 and 49 for supporting data.

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

Zip Code	Count	Rate	95% Confidence Interval	
			Lower Limit	Upper Limit
48103	140	10.0	8.3	11.6
48104	71	10.1	7.5	12.6
48105	82	9.4	7.3	11.5
48108	98	15.2	12.0	18.3
48109	5	‡	‡	‡
48111	229	19.9	17.2	22.5
48118	22	6.8	3.9	9.8
48130	28	9.3	5.6	12.9
48137	7	‡	‡	‡
48158	8	‡	‡	‡
48160	65	18.4	13.8	22.9
48167	55	5.3	3.9	6.8
48169	42	7.6	5.2	10.1
48170	84	7.1	5.6	8.7
48176	55	10.4	7.6	13.2
48178	64	9.0	6.8	11.2
48189	63	15.8	11.9	19.8
48190	~	‡	‡	‡
48191	14	‡	‡	‡
48197	296	20.8	18.4	23.3
48198	382	32.2	28.9	35.5
49229	12	‡	‡	‡
49236	20	‡	‡	‡
49240	14	‡	‡	‡
49285	12	‡	‡	‡
49287	~	‡	‡	‡
<b>Washtenaw County</b>	<b>1,298</b>	<b>14.4</b>	<b>13.6</b>	<b>15.2</b>

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.

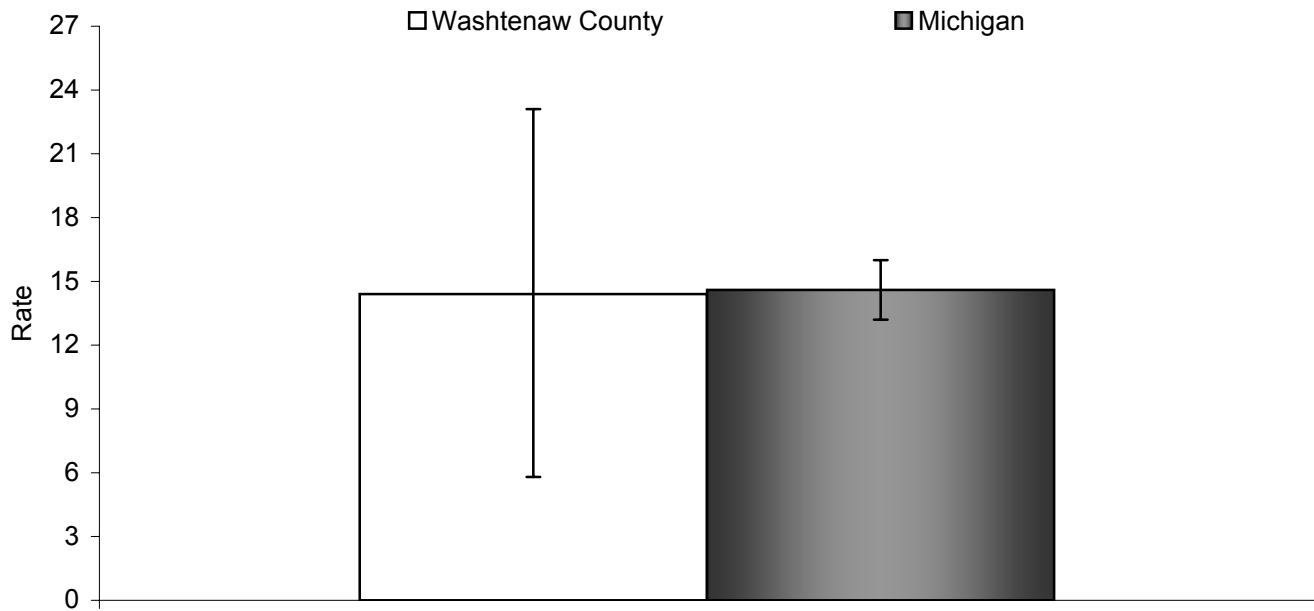
While a comparability ratio between ICD-9 and ICD-10 exists for asthma (0.8938; that is, for every 100 asthma deaths coded with ICD-9, only 89.38 would be coded as asthma using ICD-10), the analysis presented here does not attempt to compare pre-1999 data with asthma death occurring since 1999. (Anderson 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 was not conducted.

Figure 14. Rates (per 1,000,000) [1,2] of Mortality due to Asthma [3] for Washtenaw 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.

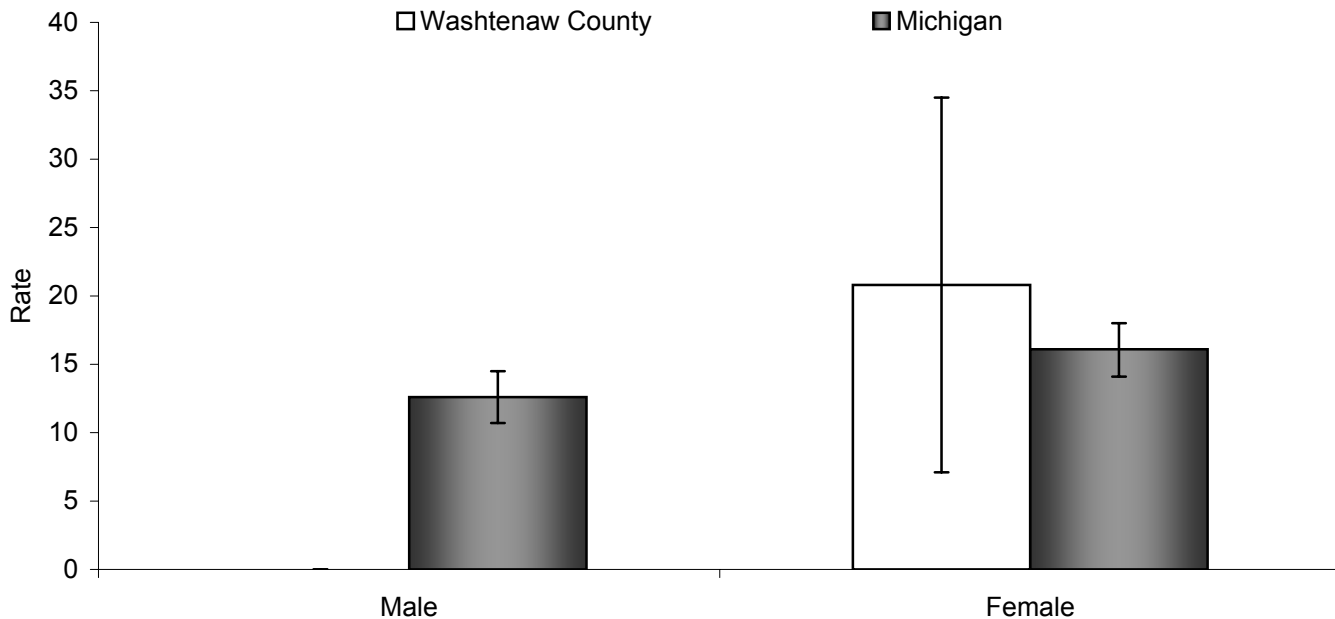
3 Asthma death is defined as a primary cause of death as asthma, ICD-10=J45 or J46.

	Total Population
Washtenaw County Rate	14.4
95% CI	5.8 , 23.1
Count	11
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 Washtenaw County, 2001-2003, is 4.
- ✧ The rate of asthma mortality in Washtenaw County is not significantly different than the rate for the State of Michigan as a whole, 2001-2003.

Figure 15. Rates (per 1,000,000) [1,2] of Mortality due to Asthma [3] by Sex for Washtenaw 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
Washtenaw County Rate	‡	20.8
95% CI	‡ , ‡	7.1 , 34.5
Count	~	9
Michigan Rate	12.6	16.1
95% CI	10.7 , 14.5	14.1 , 18.0
Count	171	270

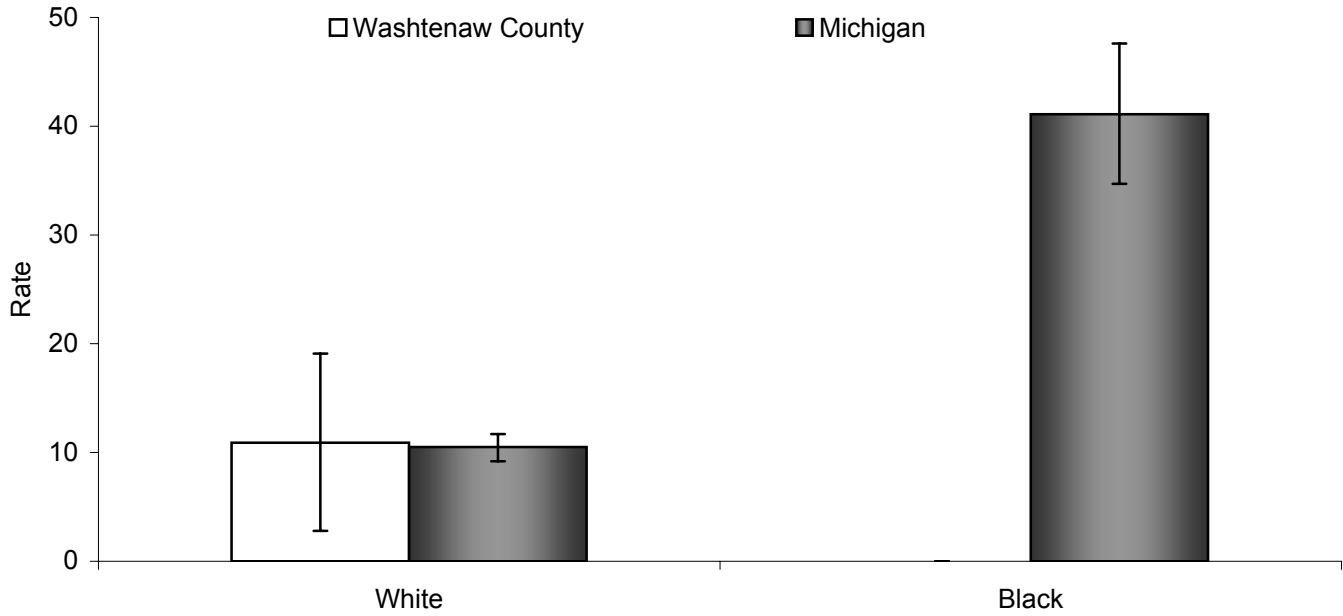
‡ Insufficient data to compute a stable rate (number of events <5 or population <5000).

~ 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.

✧ For the State of Michigan, the rate of asthma mortality for females is not significantly different than the rate for males, 2001-2003.

Figure 16. Rates (per 1,000,000) [1,2] of Mortality due to Asthma [3] by Race for Washtenaw 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.

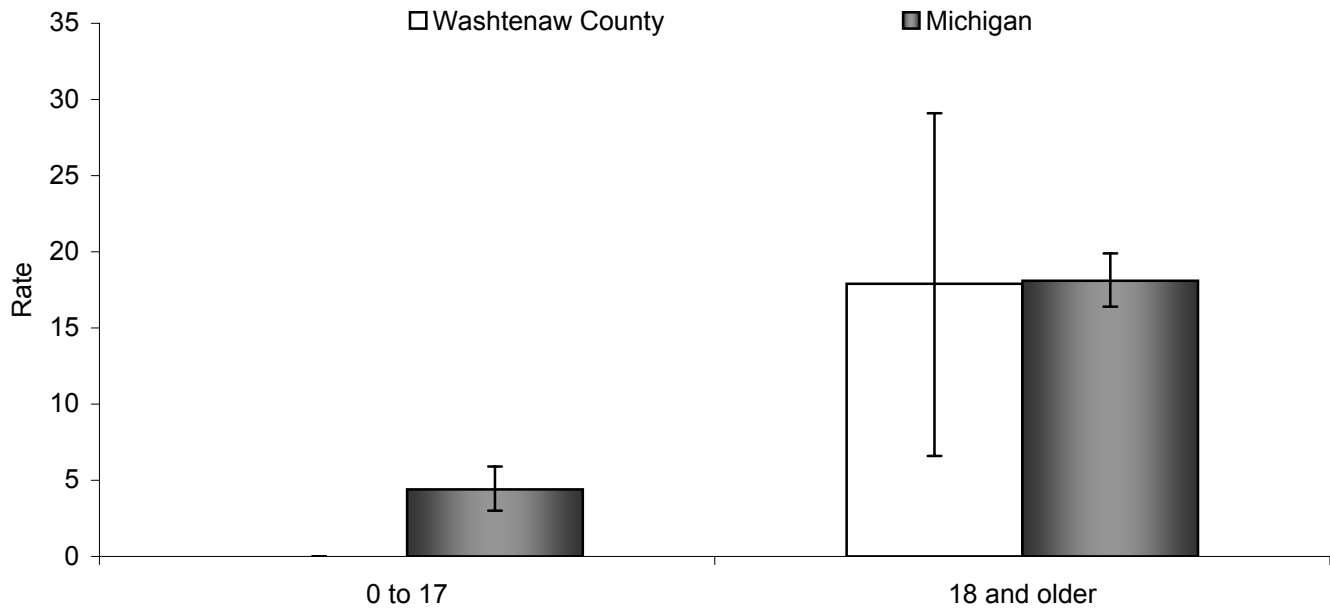
	White	Black
Washtenaw County Rate	10.9	‡
95% CI	2.8 , 19.1	‡ , ‡
Count	7	~
Michigan Rate	10.5	41.1
95% CI	9.2 , 11.7	34.7 , 47.6
Count	273	163

- ‡ 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.

✧ While black persons in the State of Michigan have a significantly higher asthma mortality rate, white persons experience more asthma related deaths, 2001-2003.

Figure 17. Rates (per 1,000,000) [1,2] of Mortality due to Asthma [3] by Age Group for Washtenaw 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
Washtenaw County Rate	‡	17.9
95% CI	‡ , ‡	6.6 , 29.1
Count	~	10
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 Washtenaw 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 Washtenaw 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.

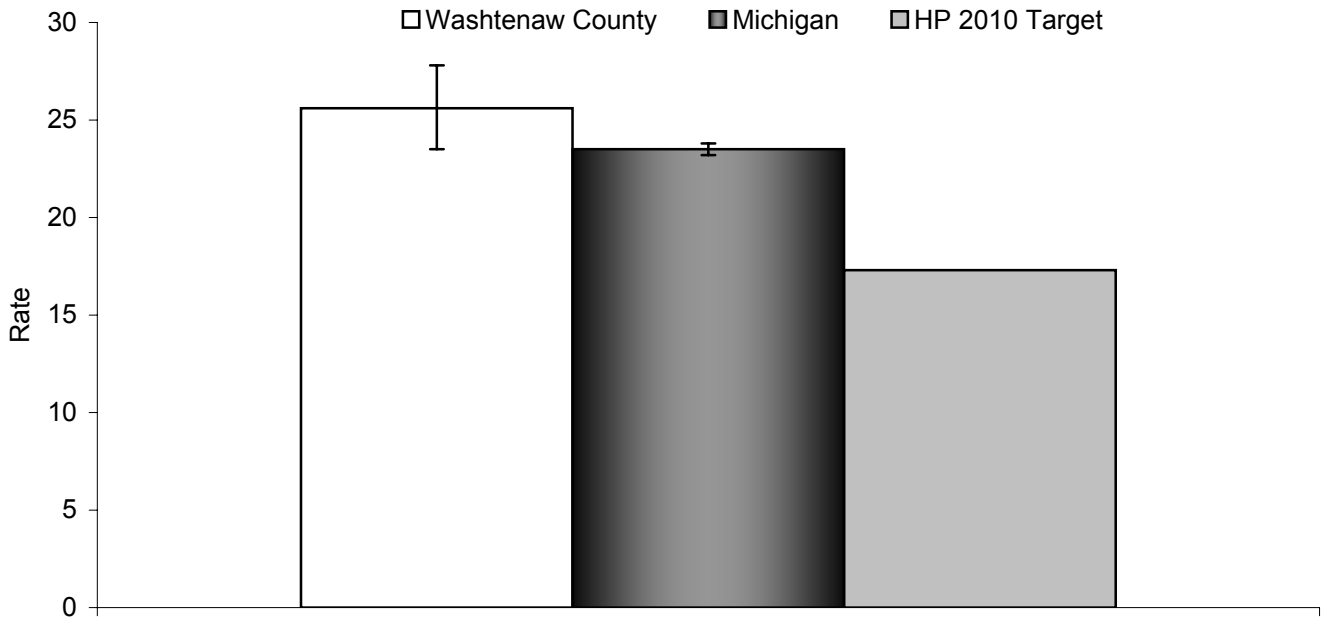
**Targets:** 1 per 1,000,000 (age 0-4 years)  
1 per 1,000,000 (age 5-14 years)  
2 per 1,000,000 (age 15-34 years)  
9 per 1,000,000 (age 35-64 years)  
60 per 1,000,000 (age ≥65 years)

**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 18. Rates (per 10,000) [1,2] of Hospitalization due to Asthma [3] for Children (aged less than 18 years) in Washtenaw 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.

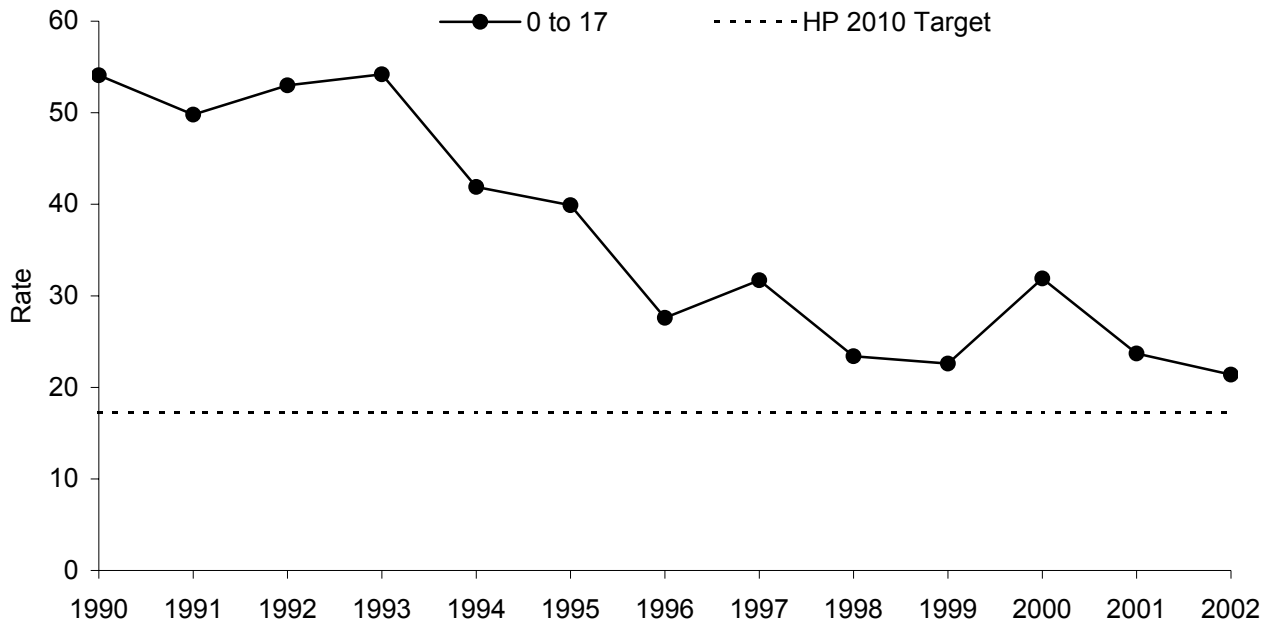
3 Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

	<b>Total Population</b>
Washtenaw County Rate	25.6
95% CI	23.5 , 27.8
Count	557
Michigan Rate	23.5
95% CI	23.2 , 23.8
Count	18,141
<b>HP 2010 Target</b>	<b>17.3</b>

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 Washtenaw County, 2000-2002, is 186.
- ✧ The rate of asthma hospitalization for children aged less than 18 years in Washtenaw County, 2000-2002, is significantly higher than the *Healthy People 2010* target.

Figure 19. Annual Rates (per 10,000) [1,2] of Asthma [3] Hospitalization for Children (aged less than 18 years) in Washtenaw 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	54.1	332
1991	49.8	311
1992	53.0	335
1993	54.2	347
1994	41.9	272
1995	39.9	264
1996	27.6	186
1997	31.7	217
1998	23.4	162
1999	22.6	159
2000	31.9	228
2001	23.7	172
2002	21.4	157

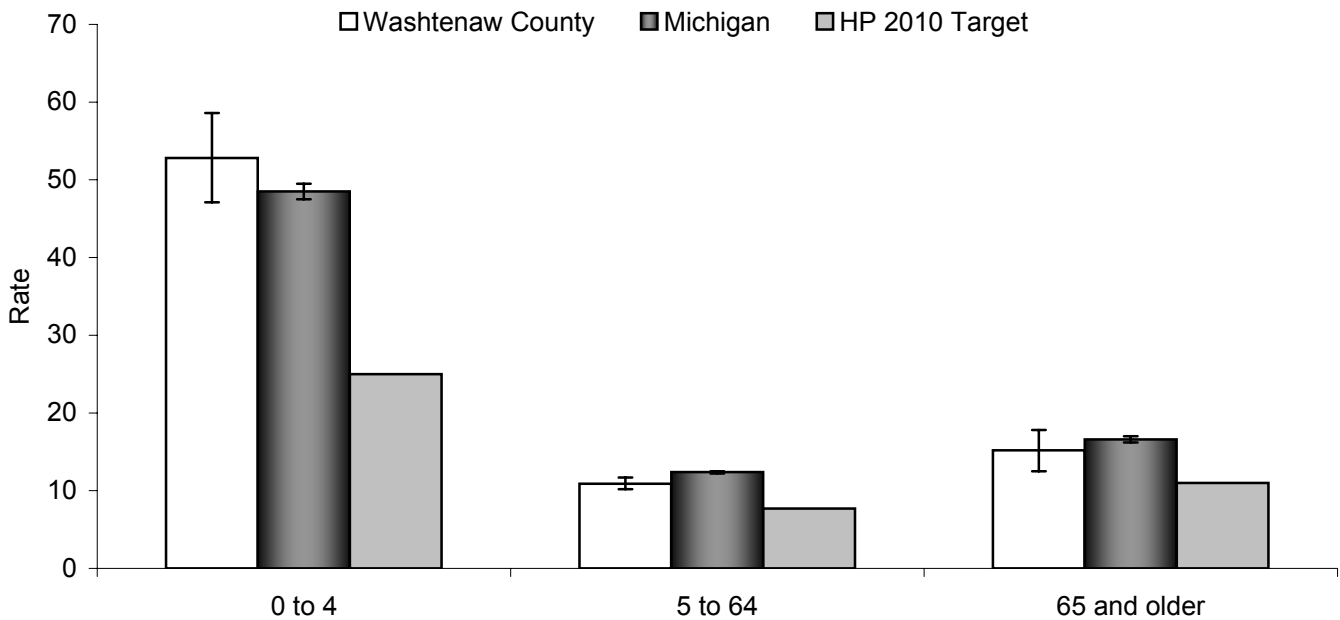
<b>HP 2010 Target</b>	<b>17.3</b>
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Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

✧ Between 1990 and 2002, there has been a significant overall decrease in asthma hospitalization rates among persons aged less than 18 years in Washtenaw County ( $\rho = -0.87$ ,  $p < 0.01$ ).

See appendix page 51 for supporting data.

Figure 20. Rates (per 10,000) [1,2] of Hospitalization due to Asthma [3] by Age Group for Washtenaw County and the State of Michigan, 2000-2002, Compared to the Healthy People 2010 Targets (Objective 24-2).



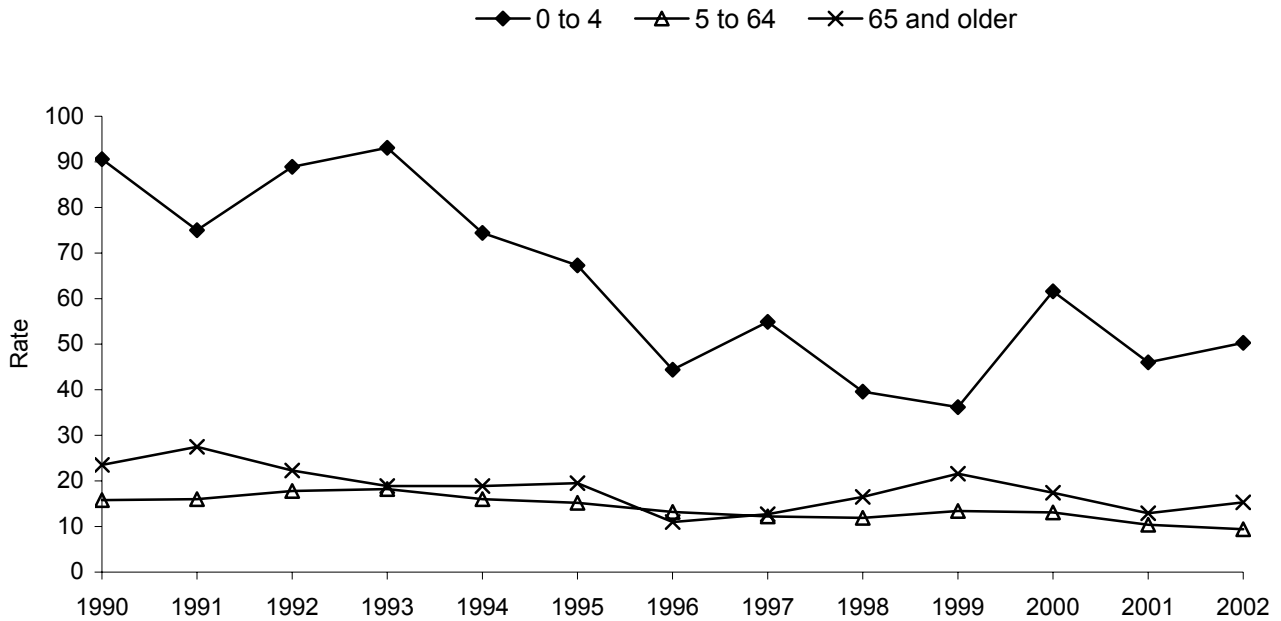
- 1 For age group 5-64 years and age group 65 and older, rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
- 2 Population estimates are taken from the Michigan population estimates for 2001.
- 3 Asthma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

	0 to 4	5 to 64	65 and Older
Washtenaw County Rate	52.8	10.9	15.2
95% CI	47.1 , 58.6	10.2 , 11.7	12.5 , 17.8
Count	324	851	123
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
<b>HP 2010 Target</b>	<b>25.0</b>	<b>7.7</b>	<b>11.0</b>

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

- ✧ The rate of asthma hospitalization in Washtenaw County is significantly lower than the rate for Michigan as a whole for the 5 to 64 year age group, 2000-2002.
- ✧ The rates of asthma hospitalization for the populations aged 0 to 4, 5 to 64, and 65 years and older in Washtenaw County are significantly higher than the respective *Healthy People 2010* target rates, 2000-2002.

Figure 21. Annual Rates (per 10,000) [1,2] of Asthma [3] Hospitalization by Age Group for Washtenaw 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.

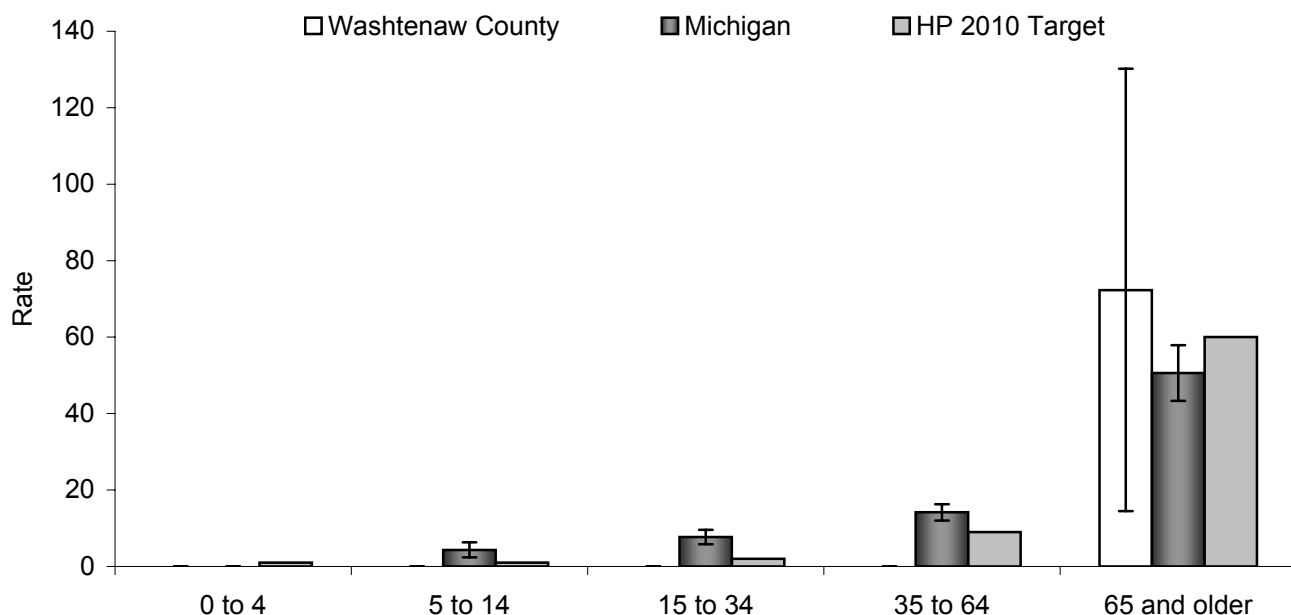
Year	0 to 4		5 to 64		65 and Older	
	Rate	Count	Rate	Count	Rate	Count
1990	90.6	176	15.8	327	23.5	49
1991	75.0	148	16.0	341	27.5	62
1992	88.9	176	17.8	383	22.3	50
1993	93.1	184	18.2	402	18.9	45
1994	74.4	146	16.0	364	18.9	44
1995	67.3	131	15.2	348	19.5	47
1996	44.4	86	13.2	314	11.0	27
1997	54.9	107	12.2	294	12.7	31
1998	39.6	78	11.9	296	16.5	42
1999	36.2	72	13.4	335	21.6	56
2000	61.6	125	13.1	327	17.4	46
2001	46.0	94	10.4	272	12.9	35
2002	50.3	105	9.4	252	15.3	42
<b>HP 2010 Target</b>	<b>25.0</b>		<b>7.7</b>		<b>11.0</b>	

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 0 to 4, 5 to 64, and 65 years and older in Washtenaw County (0 to 4,  $r = -0.77$ ,  $p < 0.01$ ; 5 to 64,  $\rho = -0.86$ ,  $p < 0.01$ ; 65 and older,  $\rho = -0.67$ ,  $p < 0.05$ ).

See appendix pages 52 through 54 for supporting data.

Figure 22. Rates (per 1,000,000) [1] of Mortality due to Asthma [2] by Age Group for Washtenaw 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
Washtenaw County Rate	‡	‡	‡	‡	72.3
95% CI	‡ , ‡	‡ , ‡	‡ , ‡	‡ , ‡	14.5 , 130.2
Count	~	~	~	~	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
<b>HP 2010 Target</b>	<b>1.0</b>	<b>1.0</b>	<b>2.0</b>	<b>9.0</b>	<b>60.0</b>

‡ 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 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 Washtenaw County and the State of Michigan. It also includes a summary for Washtenaw 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 Washtenaw County and the State of Michigan, 1990-2002.**

Year	Washtenaw County		Michigan	
	Rate	Count	Rate	Count
1990	22.0	552	19.1	17,790
1991	21.5	551	18.1	16,995
1992	23.3	609	18.4	17,597
1993	23.5	631	19.8	18,975
1994	20.5	554	18.4	17,609
1995	19.3	526	19.5	18,945
1996	15.1	427	18.5	18,058
1997	15.2	432	17.7	17,320
1998	14.4	416	15.6	15,289
1999	16.0	463	15.6	15,385
2000	17.0	498	16.0	15,886
2001	13.1	401	15.5	15,363
2002	13.0	399	14.7	14,696

Spearman's $\rho$	-0.86**	-0.79**
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<sup>1</sup> Population estimates are taken from the Michigan population estimates for 1990-2002.

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

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

<sup>4</sup> 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 Washtenaw County and the State of Michigan, 1990-2002.**

Year	Washtenaw County		Michigan	
	Rate	Count	Rate	Count
1990	22.6	282	17.1	7,951
1991	17.2	221	15.7	7,345
1992	21.4	286	16.1	7,666
1993	21.3	282	16.6	7,929
1994	16.9	235	15.4	7,339
1995	18.1	249	17.1	8,275
1996	13.2	189	15.9	7,725
1997	13.9	202	15.4	7,546
1998	12.1	171	12.7	6,199
1999	12.4	179	12.7	6,229
2000	13.8	203	13.7	6,745
2001	10.5	159	12.8	6,271
2002	9.7	151	12.2	5,971

Spearman's $\rho$	-0.91**	-0.82**
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<sup>1</sup> Population estimates are taken from the Michigan population estimates for 1990-2002.

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

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

<sup>4</sup> 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 Washtenaw County and the State of Michigan, 1990-2002.**

Year	Washtenaw County		Michigan	
	Rate	Count	Rate	Count
1990	21.3	270	20.6	9,834
1991	25.3	330	20.0	9,648
1992	24.3	323	20.3	9,927
1993	25.4	349	22.6	11,043
1994	23.5	319	20.9	10,269
1995	20.2	277	21.6	10,668
1996	16.6	238	20.8	10,333
1997	16.1	230	19.6	9,774
1998	16.6	245	18.1	9,089
1999	19.2	284	18.1	9,155
2000	19.8	295	18.0	9,141
2001	15.4	242	17.8	9,092
2002	15.8	248	16.9	8,725

Spearman's $\rho$	-0.83**	-0.76**
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<sup>1</sup> Population estimates are taken from the Michigan population estimates for 1990-2002.

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

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

<sup>4</sup> 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 Washtenaw County and the State of Michigan, 1990-2002.**

Year	Washtenaw County		Michigan	
	Rate	Count	Rate	Count
1990	17.8	367	15.1	11,791
1991	19.1	398	14.2	11,148
1992	18.3	393	14.1	11,165
1993	17.5	376	14.8	11,757
1994	16.0	347	13.2	10,488
1995	13.9	307	13.2	10,586
1996	11.3	261	12.6	10,140
1997	12.2	275	12.2	9,849
1998	10.7	248	10.5	8,522
1999	11.3	260	10.7	8,716
2000	13.4	310	10.8	8,781
2001	10.6	255	10.5	8,541
2002	10.4	253	9.9	8,133

Spearman's $\rho$	-0.91**	-0.95**
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- <sup>1</sup> Population estimates are taken from the Michigan population estimates for 1990-2002.
- <sup>2</sup> Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
- <sup>3</sup> Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.
- <sup>4</sup> Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.
- <sup>5</sup> 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 Washtenaw County and the State of Michigan, 1990-2002.**

Year	Washtenaw County		Michigan	
	Rate	Count	Rate	Count
1990	52.1	172	43.0	5,800
1991	42.0	148	41.4	5,715
1992	61.6	205	44.4	6,209
1993	66.9	248	49.1	6,948
1994	54.5	204	48.5	6,858
1995	55.5	214	54.0	8,031
1996	42.8	162	51.3	7,603
1997	38.5	157	48.0	7,246
1998	40.3	162	45.3	6,607
1999	52.3	199	44.2	6,459
2000	43.0	182	45.2	6,888
2001	34.3	141	43.2	6,518
2002	35.3	141	42.0	6,279

Spearman's $\rho$	-0.59*	-0.07
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- <sup>1</sup> Population estimates are taken from the Michigan population estimates for 1990-2002.
- <sup>2</sup> Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
- <sup>3</sup> Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.
- <sup>4</sup> Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.
- <sup>5</sup> 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 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 Washtenaw County and the State of Michigan, 1990-2002.**

Year	Washtenaw County		Michigan	
	Rate	Count	Rate	Count
1990	17.9	180	13.4	5,142
1991	15.3	159	12.0	4,632
1992	16.7	180	12.1	4,715
1993	14.9	155	11.9	4,633
1994	12.8	139	10.4	4,033
1995	12.2	132	10.9	4,285
1996	9.4	107	10.2	4,012
1997	10.3	114	10.1	3,993
1998	8.8	97	8.1	3,198
1999	8.2	92	8.5	3,338
2000	10.8	120	8.9	3,499
2001	8.1	93	8.4	3,284
2002	8.0	95	8.0	3,133

Spearman's $\rho$	-0.93**	-0.95**
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<sup>1</sup> Population estimates are taken from the Michigan population estimates for 1990-2002.

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

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

<sup>4</sup> Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

<sup>5</sup> 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 Washtenaw County and the State of Michigan, 1990-2002.**

Year	Washtenaw County		Michigan	
	Rate	Count	Rate	Count
1990	17.6	187	16.5	6,647
1991	22.4	239	16.0	6,514
1992	19.2	213	15.7	6,446
1993	19.9	221	17.3	7,122
1994	18.7	208	15.6	6,455
1995	15.4	175	15.2	6,301
1996	12.9	154	14.8	6,128
1997	13.9	161	14.1	5,856
1998	12.5	151	12.7	5,324
1999	13.9	168	12.7	5,378
2000	15.8	190	12.5	5,282
2001	12.8	162	12.4	5,257
2002	12.4	158	11.6	5,000

Spearman's $\rho$	-0.81**	-0.97**
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<sup>1</sup> Population estimates are taken from the Michigan population estimates for 1990-2002.

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

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

<sup>4</sup> Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

<sup>5</sup> 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 Washtenaw County and the State of Michigan, 1990-2002.**

Year	Washtenaw County		Michigan	
	Rate	Count	Rate	Count
1990	54.1	94	39.2	2,721
1991	30.5	59	36.6	2,660
1992	54.9	101	39.0	2,864
1993	61.0	122	42.8	3,169
1994	43.7	94	43.1	3,176
1995	53.4	112	48.6	3,838
1996	39.1	80	45.8	3,569
1997	39.2	88	43.7	3,452
1998	32.2	70	38.3	2,927
1999	42.6	85	37.0	2,796
2000	33.1	79	39.4	3,147
2001	26.1	62	36.6	2,856
2002	22.5	53	35.0	2,699

Spearman's $\rho$	-0.67*	-0.30
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- <sup>1</sup> Population estimates are taken from the Michigan population estimates for 1990-2002.
- <sup>2</sup> Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
- <sup>3</sup> Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.
- <sup>4</sup> Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.
- <sup>5</sup> 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 Washtenaw County and the State of Michigan, 1990-2002.**

Year	Washtenaw County		Michigan	
	Rate	Count	Rate	Count
1990	49.0	78	45.3	3,079
1991	51.6	89	44.3	3,055
1992	66.2	104	47.8	3,345
1993	70.9	126	53.4	3,779
1994	63.0	110	51.9	3,682
1995	57.5	102	57.1	4,193
1996	45.7	82	54.7	4,034
1997	37.1	69	50.6	3,794
1998	48.5	92	50.0	3,680
1999	60.8	114	49.4	3,663
2000	51.4	103	49.0	3,741
2001	41.1	79	48.0	3,662
2002	46.3	88	47.0	3,580

Spearman's $\rho$	-0.50	0.08
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<sup>1</sup> Population estimates are taken from the Michigan population estimates for 1990-2002.

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

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

<sup>4</sup> Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

<sup>5</sup> 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 Washtenaw County and the State of Michigan, 1990-2002.**

Year	Washtenaw County		Michigan	
	Rate	Count	Rate	Count
1990	90.6	176	66.1	4,712
1991	75.0	148	57.1	4,106
1992	88.9	176	64.4	4,638
1993	93.1	184	59.6	4,291
1994	74.4	146	53.2	3,783
1995	67.3	131	63.9	4,457
1996	44.4	86	59.6	4,092
1997	54.9	107	59.2	4,019
1998	39.6	78	40.5	2,734
1999	36.2	72	40.6	2,725
2000	61.6	125	48.8	3,257
2001	46.0	94	50.5	3,341
2002	50.3	105	45.8	3,039

Spearman's $\rho$	-0.77**	-0.76**
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<sup>1</sup> Population estimates are taken from the Michigan population estimates for 1990-2002.

<sup>2</sup> Rates are not age adjusted. Hospitalization records with missing age are excluded.

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

<sup>4</sup> 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 Washtenaw County and the State of Michigan, 1990-2002.**

Year	Washtenaw County		Michigan	
	Rate	Count	Rate	Count
1990	40.6	133	20.9	2,826
1991	40.9	138	19.4	2,666
1992	39.8	136	18.5	2,571
1993	39.7	138	21.1	2,972
1994	28.6	101	17.1	2,418
1995	32.1	116	21.9	3,152
1996	21.9	81	21.4	3,113
1997	24.8	94	22.1	3,244
1998	18.6	72	16.8	2,491
1999	19.5	77	16.8	2,497
2000	23.8	95	20.4	3,010
2001	16.3	66	16.0	2,363
2002	11.0	45	13.7	2,002

Spearman's $\rho$	-0.94**	-0.48
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<sup>1</sup> Population estimates are taken from the Michigan population estimates for 1990-2002.

<sup>2</sup> Rates are not age adjusted. Hospitalization records with missing age are excluded.

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

<sup>4</sup> 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 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 Washtenaw County and the State of Michigan, 1990-2002.**

Year	Washtenaw County		Michigan	
	Rate	Count	Rate	Count
1990	6.8	82	9.1	2,709
1991	7.2	86	8.9	2,628
1992	9.0	107	9.8	2,839
1993	10.0	117	11.7	3,352
1994	10.9	127	10.9	3,081
1995	9.0	105	11.8	3,341
1996	8.3	97	11.5	3,220
1997	6.6	78	10.6	2,959
1998	6.2	73	10.0	2,755
1999	6.1	72	9.2	2,526
2000	4.8	58	9.2	2,502
2001	5.0	61	8.2	2,253
2002	4.5	55	7.7	2,104

Spearman's $\rho$	-0.77**	-0.31
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<sup>1</sup> Population estimates are taken from the Michigan population estimates for 1990-2002.

<sup>2</sup> Rates are not age adjusted. Hospitalization records with missing age are excluded.

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

<sup>4</sup> 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 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 Washtenaw County and the State of Michigan, 1990-2002.**

Year	Washtenaw County		Michigan	
	Rate	Count	Rate	Count
1990	12.5	112	14.8	4,694
1991	12.7	117	15.0	4,838
1992	14.8	140	14.5	4,795
1993	15.2	147	15.9	5,369
1994	13.8	136	16.0	5,509
1995	12.5	127	15.6	5,493
1996	13.0	136	15.0	5,401
1997	11.3	122	13.8	5,065
1998	13.6	151	14.2	5,275
1999	16.3	186	14.7	5,547
2000	14.9	174	13.6	5,264
2001	12.0	145	13.8	5,383
2002	12.3	152	13.5	5,317

Spearman's $\rho$	-0.15	-0.70**
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<sup>1</sup> Population estimates are taken from the Michigan population estimates for 1990-2002.

<sup>2</sup> Rates are not age adjusted. Hospitalization records with missing age are excluded.

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

<sup>4</sup> 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 Washtenaw County and the State of Michigan, 1990-2002.**

Year	Washtenaw County		Michigan	
	Rate	Count	Rate	Count
1990	23.0	49	25.7	2,849
1991	28.3	62	24.4	2,757
1992	22.3	50	23.9	2,754
1993	19.5	45	25.6	2,991
1994	18.8	44	23.8	2,818
1995	19.6	47	20.9	2,502
1996	11.0	27	18.5	2,232
1997	12.4	31	16.8	2,033
1998	16.4	42	16.8	2,034
1999	21.6	56	17.2	2,090
2000	17.4	46	15.2	1,853
2001	12.9	35	16.5	2,023
2002	15.2	42	18.1	2,234

Spearman's $\rho$	-0.68*	-0.88**
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<sup>1</sup> Population estimates are taken from the Michigan population estimates for 1990-2002.

<sup>2</sup> Rates are not age adjusted. Hospitalization records with missing age are excluded.

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

<sup>4</sup> 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 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 Washtenaw County and the State of Michigan, 1990-2002.**

Year	Washtenaw County		Michigan	
	Rate	Count	Rate	Count
1990	51.4	332	31.7	8,063
1991	47.7	311	28.3	7,254
1992	50.4	335	29.9	7,735
1993	51.7	347	30.5	7,875
1994	40.2	272	26.2	6,757
1995	38.7	264	31.9	8,221
1996	27.2	186	30.2	7,769
1997	31.0	217	30.1	7,742
1998	22.8	162	21.8	5,594
1999	22.2	159	21.6	5,546
2000	31.1	228	26.3	6,693
2001	23.2	172	24.1	6,089
2002	20.7	157	21.3	5,359

Spearman's $\rho$	-0.87**	-0.68*
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<sup>1</sup> Population estimates are taken from the Michigan population estimates for 1990-2002.

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

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

<sup>4</sup> 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 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 Washtenaw County and the State of Michigan, 1990-2002.**

Year	Washtenaw County		Michigan	
	Rate	Count	Rate	Count
1990	12.3	220	14.7	9,727
1991	13.0	240	14.5	9,741
1992	14.3	274	14.5	9,862
1993	13.8	284	16.1	11,100
1994	13.8	282	15.7	10,852
1995	12.7	262	15.2	10,724
1996	11.0	241	14.5	10,289
1997	9.9	215	13.3	9,578
1998	11.6	254	13.4	9,695
1999	13.9	304	13.5	9,839
2000	12.1	270	12.5	9,193
2001	9.7	229	12.5	9,274
2002	10.4	242	12.5	9,337

Spearman's $\rho$	-0.58*	-0.80**
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<sup>1</sup> Population estimates are taken from the Michigan population estimates for 1990-2002.

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

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

<sup>4</sup> 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 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.

## Washtenaw County

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

		Count	Rate	95% Confidence Interval	
				Lower Limit	Upper Limit
Total Population		1,298	14.4	13.6	15.2
Sex	Male	513	11.3	10.3	12.3
	Female	785	17.0	15.8	18.2
Race <sup>5</sup>	White	818	11.5	10.7	12.2
	Black	464	37.7	34.1	41.4
Sex and Race <sup>5</sup>	White Male	308	9.0	7.9	10.0
	White Female	510	13.7	12.5	14.9
	Black Male	194	27.5	23.4	31.5
	Black Female	270	46.3	40.5	52.0
Age (unadjusted)	0-4 Years	324	52.8	47.1	58.6
	5-14 Years	206	17.0	14.6	19.3
	15-34 Years	174	4.8	4.1	5.5
	35-64 Years	471	13.0	11.9	14.2
	65+ Years	123	15.2	12.5	17.8
Age	<18 Years	557	25.0	23.0	27.1
	18+ Years	741	10.8	10.0	11.6

For comparison, State of Michigan and Washtenaw 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 Washtenaw County, 2000-2002, Comparable to the Healthy People 2010 Targets.

		Count	Rate	95% Confidence Interval	
				Lower Limit	Upper Limit
Age	0-4 Years <sup>6</sup>	324	52.8	47.1	58.6
	5-64 Years	851	10.9	10.2	11.7
	65+ Years	123	15.2	12.5	17.8
	<18 Years <sup>6</sup>	557	25.6	23.5	27.8

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

Year	HP 2010 Target	Washtenaw County		Michigan	
		Rate	Count	Rate	Count
1990	17.3	54.1	332	32.8	8,063
1991	17.3	49.8	311	29.2	7,254
1992	17.3	53.0	335	30.9	7,735
1993	17.3	54.2	347	31.2	7,875
1994	17.3	41.9	272	26.6	6,757
1995	17.3	39.9	264	32.1	8,221
1996	17.3	27.6	186	30.1	7,769
1997	17.3	31.7	217	30.0	7,742
1998	17.3	23.4	162	21.7	5,594
1999	17.3	22.6	159	21.4	5,546
2000	17.3	31.9	228	26.0	6,693
2001	17.3	23.7	172	23.7	6,089
2002	17.3	21.4	157	20.8	5,359

Spearman's $\rho$	-0.87**	-0.79**
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- <sup>1</sup> Population estimates are taken from the Michigan population estimates for 1990-2002.
- <sup>2</sup> Rates are not age adjusted. Hospitalization records with missing age are excluded.
- <sup>3</sup> Asthma hospitalization is defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.
- <sup>4</sup> 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 Washtenaw County and the State of Michigan, 1990-2002, Compared to the Healthy People 2010 Target (Objective 24-2).**

Year	HP 2010 Target	Washtenaw County		Michigan	
		Rate	Count	Rate	Count
1990	25.0	90.6	176	66.1	4,712
1991	25.0	75.0	148	57.1	4,106
1992	25.0	88.9	176	64.4	4,638
1993	25.0	93.1	184	59.6	4,291
1994	25.0	74.4	146	53.2	3,783
1995	25.0	67.3	131	63.9	4,457
1996	25.0	44.4	86	59.6	4,092
1997	25.0	54.9	107	59.2	4,019
1998	25.0	39.6	78	40.5	2,734
1999	25.0	36.2	72	40.6	2,725
2000	25.0	61.6	125	48.8	3,257
2001	25.0	46.0	94	50.5	3,341
2002	25.0	50.3	105	45.8	3,039

Spearman's $\rho$	-0.77**	-0.76**
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<sup>1</sup> Population estimates are taken from the Michigan population estimates for 1990-2002.

<sup>2</sup> Rates are not age adjusted. Hospitalization records with missing age are excluded.

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

<sup>4</sup> 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 Washtenaw County and the State of Michigan, 1990-2002, Compared to the Healthy People 2010 Target (Objective 24-2).**

Year	HP 2010 Target	Washtenaw County		Michigan	
		Rate	Count	Rate	Count
1990	7.7	15.8	327	14.0	10,229
1991	7.7	16.0	341	13.7	10,132
1992	7.7	17.8	383	13.6	10,205
1993	7.7	18.2	402	15.5	11,693
1994	7.7	16.0	364	14.5	11,008
1995	7.7	15.2	348	15.5	11,986
1996	7.7	13.2	314	15.0	11,734
1997	7.7	12.2	294	14.2	11,268
1998	7.7	11.9	296	13.2	10,521
1999	7.7	13.4	335	13.2	10,570
2000	7.7	13.1	327	13.3	10,776
2001	7.7	10.4	272	12.3	9,999
2002	7.7	9.4	252	11.5	9,423

Spearman's $\rho$	-0.86**	-0.63*
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<sup>1</sup> Population estimates are taken from the Michigan population estimates for 1990-2002.

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

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

<sup>4</sup> 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 Washtenaw County and the State of Michigan, 1990-2002, Compared to the Healthy People 2010 Target (Objective 24-2).**

Year	HP 2010 Target	Washtenaw County		Michigan	
		Rate	Count	Rate	Count
1990	11.0	23.5	49	25.8	2,849
1991	11.0	27.5	62	24.3	2,757
1992	11.0	22.3	50	23.9	2,754
1993	11.0	18.9	45	25.5	2,991
1994	11.0	18.9	44	23.9	2,818
1995	11.0	19.5	47	20.9	2,502
1996	11.0	11.0	27	18.6	2,232
1997	11.0	12.7	31	16.8	2,033
1998	11.0	16.5	42	16.8	2,034
1999	11.0	21.6	56	17.2	2,090
2000	11.0	17.4	46	15.2	1,853
2001	11.0	12.9	35	16.5	2,023
2002	11.0	15.3	42	18.1	2,234

Spearman's $\rho$	-0.67*	-0.87**
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<sup>1</sup> Population estimates are taken from the Michigan population estimates for 1990-2002.

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

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

<sup>4</sup> 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 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?Id=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  $\text{IR}_c$  = 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  $\text{IR}_a$  = 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 ( $\rho$ ) 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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