

THE EPIDEMIOLOGY OF ASTHMA AND HAY FEVER IN A TOTAL COMMUNITY, TECUMSEH, MICHIGAN

I. Description of Study and General Findings

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(Reporting for the Research Staff of the Tecumseh Community Health Study)*

THE Tecumseh Community Health Study is a continuing project which was started in 1957 by the University of Michigan School of Public Health. The general aim has been to study the epidemiology of health and disease in a total community.^{1, 2, 3} This report presents both a brief description of the study and the currently available data which deal with asthma and hay fever.

Tecumseh is in southeast Michigan and has a population of approximately 9,800. A variety of socioeconomic and occupational groups are represented in this community and the ethnic composition is almost entirely Caucasian. The proportion of urban to rural households is estimated to be 4 to 1.

METHOD

The study on which this report is based was begun in March, 1959, and completed in October, 1960. The purpose was to obtain on all residents a record of past and present illnesses, a family medical history, a complete physical examination, and certain physical and laboratory measurements. These data were collected by means of a detailed medical questionnaire and the facilities of a special clinic which was established in the community.

The questionnaires were administered in the homes by a group of 10 trained interviewers. Persons 16 years of age and over were questioned directly and data for those under this age were obtained from a parent or other close adult relation. Standard questions concerning asthma and hay fever were asked of all persons 8 years of age and older, 70 per cent of those 7 years of age, and 34 per cent of those 6; these included questions regarding age at onset, treatment,

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and seasonal pattern of symptoms. Neither asthma nor hay fever were uniformly asked about in the remainder of the persons 6 and 7 years old and all those under this age; this entire group has been excluded from consideration in this report.

After the questionnaire was completed, an appointment was made for each person to be seen at the special clinic which was established in the community hospital. These visits were arranged to last approximately 1½ hours, during which time each person was seen by a physician and certain physical measurements, chest x-ray, electrocardiogram, and blood and urine specimens were collected. The physicians were from either the Medical School or the School of Public Health at the University of Michigan and the majority were from the Departments of Internal Medicine and Pediatrics; most were at the level of instructor or higher and approximately one third had worked at some time in the Allergy Section. The physician reviewed all of the positive sections of the questionnaire, asked appropriate additional questions, and carried out a complete physical examination. A list of diagnoses was then made which applied to all conditions present either currently or at any time in the past. In order to minimize the possible loss of information the physicians were encouraged to make diagnoses even in cases in which the indications were only suggestive. For each diagnosis recorded, the physician selected one of two possible categories of diagnostic certainty: if a given diagnosis was considered to be reasonably firm, the term "probable" was applied; if it entailed some degree of doubt, the term "possible" was applied. We have chosen to refer to cases in the "probable" category as the "more certain group" and those having the designation "possible" as the "less certain group."

The charts were finally reviewed by one of the staff physicians associated with the project and an independent list of diagnoses was made from the more complete information then available. On the whole, the reviewing physician tended to introduce some degree of uniformity to the diagnoses, rarely excluded a diagnosis made by the examining physician, and, at times, was able to include diagnoses which had been overlooked in the initial examination.

Although diagnostic criteria were not rigidly defined for this phase of the study, the term "asthma" was generally used in a broad context and applied to manifestations which were either brief or prolonged, a single episode or recurrent ones, and occurred either alone or in association with other upper or lower respiratory symptoms. The term "hay fever" was applied to upper respiratory symptoms which were believed to be allergic in origin and occurred predominantly in the spring, summer, or fall.

The analyses to be presented were studied separately on the basis of diagnoses made by both the examining and reviewing physicians. Although the number of cases found in the groups diagnosed by the reviewing physicians were consistently larger than in the comparable groups diagnosed by the examining physicians, all of the trends to be pointed out were similar, regardless of which group of diagnoses was used. In order to simplify presentation, only those data which are based on the diagnoses of the reviewing physicians will be shown.

The data for the more certain and less certain diagnostic groups were also

examined separately and, here again, there were no critical differences in the trends shown by either. In order to preserve the greater reliability of the more certain group and yet retain the inclusiveness provided by the other, the various data are presented separately for the more certain group alone, as well as for a "combined group" which includes all cases of a given diagnosis without regard to certainty.

As has been pointed out, the diagnoses were applied to conditions which were present at the time of the study or at any time in the past. The term "cumulative prevalence" will be used in describing these data, to emphasize their cumulative nature as contrasted with the usual context of the term "prevalence" which applies to the occurrence of some event within a more confined interval of time.

RESULTS

In this community, 9,823 persons were known by census and, of these, interviews and examinations were completed in 88 per cent (Table I). The age and sex distribution of the 6,995 persons aged 6 and over on whom this report is based are shown in Table II.

TABLE I. THE TOTAL POPULATION OF THE TECUMSEH AREA AND THE SEGMENT IN WHICH FULL PARTICIPATION WAS OBTAINED

	MALE	FEMALE	TOTAL
Number in census	4,868	4,955	9,823
Number interviewed and examined	4,238	4,403	8,641
Per cent of those in census	87.1	88.9	88.0
Number used in this report*	3,403	3,592	6,995

*Those 6 years of age and over on whom the subsequent analyses are based.

TABLE II. THE CURRENT AGE DISTRIBUTION OF THE INTERVIEWED AND EXAMINED POPULATION ON WHICH THIS REPORT IS BASED

CURRENT AGE	MALE	FEMALE	TOTAL
6-9	357	342	699
10-14	521	485	1,006
15-19	286	316	602
20-24	181	257	438
25-29	274	328	602
30-34	333	365	698
35-39	346	340	686
40-44	243	262	505
45-49	225	212	437
50-54	170	169	339
55-59	162	158	320
60 and over	305	358	663
Totals	3,403	3,592	6,995

The total cumulative prevalence of persons with a more certain diagnosis of asthma and hay fever per hundred members of the population was found to be, respectively, 4.1 and 6.3, and that of the combined groups was 10.2 and 9.7 (Table III). Each disease occurred with equal frequency in males and females. As will be dealt with further in Part II, 128 persons in the more certain asthma and hay fever groups and 254 in the combined groups had both diseases diag-

TABLE III. THE TOTAL NUMBER OF PERSONS WITH A HISTORY OF ASTHMA OR HAY FEVER AND THE CUMULATIVE PREVALENCE OF EACH PER HUNDRED MEMBERS OF THE POPULATION

	MALE		FEMALE		TOTAL	
	NO.	CASES PER 100 POP.	NO.	CASES PER 100 POP.	NO.	CASES PER 100 POP.
<i>More Certain Group</i>						
Asthma	137	4.0	148	4.1	285	4.1
Hay fever	213	6.3	226	6.3	439	6.3
<i>Combined Group</i>						
Asthma	361	10.6	350	9.7	711	10.2
Hay fever	322	9.5	359	10.0	681	9.7

nosed and, therefore, appeared both as persons having asthma and persons having hay fever.

The age-specific cumulative prevalence of the more certain asthma group in the general population was relatively constant, whereas that of the combined group showed an increase at both ends of the age scale (Table IV). In hay fever, both the more certain and combined groups demonstrated identical trends; the cumulative prevalence was relatively low in the youngest groups, rose into the second and third decades, and then varied somewhat in the older groups (Table V).

The age of onset data for both asthma and hay fever were more complete in the more certain than the combined diagnostic groups (Table VI). Of those

TABLE IV. THE AGE-SPECIFIC CUMULATIVE PREVALENCE OF PERSONS WITH A HISTORY OF ASTHMA IN THE GENERAL POPULATION

CURRENT AGE	MALE		FEMALE		TOTAL	
	NO.	CASES PER 100 POP.	NO.	CASES PER 100 POP.	NO.	CASES PER 100 POP.
<i>More Certain Group</i>						
6-9	17	4.8	16	4.7	33	4.7
10-14	21	4.0	16	3.3	37	3.7
15-19	10	3.5	10	3.2	20	3.3
20-24	6	3.3	7	2.7	13	3.0
25-29	8	2.9	19	5.8	27	4.5
30-34	16	4.8	14	3.8	30	4.3
35-39	11	3.2	15	4.4	26	3.8
40-44	11	4.5	12	4.6	23	4.6
45-49	8	3.6	5	2.4	13	3.0
50-54	7	4.1	8	4.7	15	4.4
55-59	7	4.3	6	3.8	13	4.1
60 and over	15	4.9	20	5.6	35	5.3
Totals	137	4.0	148	4.1	285	4.1
<i>Combined Group</i>						
6-9	54	15.1	47	13.7	101	14.4
10-14	75	14.4	47	9.7	122	12.1
15-19	25	8.7	22	7.0	47	7.8
20-24	14	7.7	21	8.2	35	8.0
25-29	19	6.9	34	10.4	53	8.8
30-34	31	9.3	26	7.1	57	8.2
35-39	29	8.4	33	9.7	62	9.0
40-44	27	11.1	25	9.5	52	10.3
45-49	21	9.3	24	11.3	45	10.3
50-54	13	7.6	11	6.5	24	7.1
55-59	15	9.3	18	11.4	33	10.3
60 and over	38	12.5	42	11.7	80	12.1
Totals	361	10.6	350	9.7	711	10.2

TABLE V. THE AGE-SPECIFIC CUMULATIVE PREVALENCE OF PERSONS WITH A HISTORY OF HAY FEVER IN THE GENERAL POPULATION

CURRENT AGE	MALE		FEMALE		TOTAL	
	NO.	CASES PER 100 POP.	NO.	CASES PER 100 POP.	NO.	CASES PER 100 POP.
<i>More Certain Group</i>						
6-9	15	4.2	10	2.9	25	3.6
10-14	26	5.0	25	5.2	51	5.1
15-19	28	9.8	17	5.4	45	7.5
20-24	12	6.6	24	9.3	36	8.2
25-29	18	6.6	32	9.8	50	8.3
30-34	22	6.6	24	6.6	46	6.6
35-39	16	4.6	26	7.6	42	6.1
40-44	16	6.6	20	7.6	36	7.1
45-49	17	7.6	9	4.2	26	5.9
50-54	14	8.2	16	9.5	30	8.8
55-59	5	3.1	3	1.9	8	2.5
60 and over	24	7.9	20	5.6	44	6.6
Totals	213	6.3	226	6.3	439	6.3
<i>Combined Group</i>						
6-9	21	5.9	26	7.6	47	6.7
10-14	44	8.4	39	8.0	83	8.3
15-19	36	12.6	26	8.2	62	10.3
20-24	16	8.8	34	13.2	50	11.4
25-29	35	12.8	42	12.8	77	12.8
30-34	32	9.6	44	12.1	76	10.9
35-39	25	7.2	40	11.8	65	9.5
40-44	28	11.5	28	10.7	56	11.1
45-49	24	10.7	16	7.5	40	9.2
50-54	16	9.4	19	11.2	35	10.3
55-59	11	6.8	11	7.0	22	6.9
60 and over	34	11.1	34	9.5	68	10.3
Totals	322	9.5	359	10.0	681	9.7

persons with a history of asthma in whom this information was available, the onset was most frequently reported to have been in the youngest age group; there was a steep decline in the frequency for the subsequent age groups (Table VII). The onset of asthma occurred before the age of 10 in a higher percentage of males (58.7 to 59.6) than females (37.3 to 40.6). Hay fever more frequently began at a later age and, here again, a difference between the sexes was apparent: the peak for males occurred in the group 5 to 9 years of age whereas that for females was 15 to 19 (Table VIII).

Information regarding the seasonal pattern of asthma and hay fever symptoms was available in over 80 per cent of all but the combined asthma group

TABLE VI. THE NUMBER OF PERSONS REPORTING THE AGE AT ONSET FOR ASTHMA AND HAY FEVER IS EXPRESSED AS A PER CENT OF THE TOTAL DIAGNOSES IN EACH GROUP

	MALE		FEMALE		TOTAL	
	NO.	%	NO.	%	NO.	%
<i>More Certain Group</i>						
Asthma	104	75.9	118	79.7	222	77.9
Hay fever	165	77.5	181	80.1	346	78.8
<i>Combined Group</i>						
Asthma	235	65.1	224	64.0	459	64.6
Hay fever	227	70.5	252	70.2	479	70.3

TABLE VII. THE DISTRIBUTION OF AGE AT ONSET FOR ASTHMA*

AGE OF ONSET	MALE		FEMALE		TOTAL	
	NO.	%	NO.	%	NO.	%
<i>More Certain Group</i>						
0- 4	38	36.5	31	26.3	69	31.1
5- 9	24	23.1	13	11.0	37	16.7
10-14	11	10.6	11	9.3	22	9.9
15-19	7	6.7	17	14.4	24	10.8
20-24	4	3.8	9	7.6	13	5.9
25-29	4	3.8	10	8.5	14	6.3
30-34	3	2.9	7	5.9	10	4.5
35-39	8	7.7	7	5.9	15	6.8
40-44	2	1.9	6	5.1	8	3.6
45-49	3	2.9	2	1.7	5	2.3
50-54	—	—	3	2.5	3	1.4
55-59	—	—	1	0.8	1	0.5
60 and over	—	—	1	0.8	1	0.5
Totals	104	99.9	118	99.8	222	100.3
<i>Combined Group</i>						
0- 4	98	41.7	71	31.7	169	36.8
5- 9	40	17.0	20	8.9	60	13.1
10-14	21	8.9	17	7.6	38	8.3
15-19	9	3.8	21	9.4	30	6.5
20-24	9	3.8	16	7.1	25	5.4
25-29	11	4.7	16	7.1	27	5.9
30-34	10	4.3	12	5.4	22	4.8
35-39	10	4.3	11	4.9	21	4.6
40-44	8	3.4	16	7.1	24	5.2
45-49	5	2.1	7	3.1	12	2.6
50-54	7	3.0	10	4.5	17	3.7
55-59	2	0.9	3	1.3	5	1.1
60 and over	5	2.1	4	1.8	9	2.0
Totals	235	100.0	224	99.9	459	100.0

*The number of persons in each age segment is expressed as a per cent of the total in the respective group.

(Table IX). Symptoms were classified as being perennial if present throughout the entire year and without a tendency to flare in any season; otherwise, they were assigned to a single season or up to a maximum of three seasons if tending to occur predominantly in the winter (December, January, February, March), spring (April, May), summer (June, July) or fall (August, September, October, November). In analyzing these data, spring and summer were combined in order to provide comparable seasonal groups with 4 months in each (Table X). Perennial symptoms were reported in approximately 30 per cent of persons with a history of asthma and 5 per cent of those with hay fever. On dividing both disease groups into persons under the age of 30 and those 30 and over, it was found that the tendency for symptoms to follow this pattern did not increase significantly with age; these data have not been tabulated here. Of the three seasonal groupings, spring-summer and fall were commonly reported in both asthma and hay fever; a higher per cent of persons with a history of hay fever were represented in the fall group than those with asthma. Winter symptoms were reported in 14 to 19 per cent of persons with a history of asthma, but only 2 per cent of those with hay fever.

Information regarding treatment was reported in a large proportion of persons with a history of asthma and hay fever (Table XI). Although almost

TABLE VIII. THE DISTRIBUTION OF AGE AT ONSET FOR HAY FEVER*

AGE OF ONSET	MALE		FEMALE		TOTAL	
	NO.	%	NO.	%	NO.	%
<i>More Certain Group</i>						
0-4	19	11.5	14	7.7	33	9.5
5-9	32	19.4	23	12.7	55	15.9
10-14	30	18.2	31	17.1	61	17.6
15-19	19	11.5	38	21.0	57	16.5
20-24	15	9.1	22	12.2	37	10.7
25-29	9	5.5	21	11.6	30	8.7
30-34	12	7.3	11	6.1	23	6.6
35-39	9	5.5	7	3.9	16	4.6
40-44	10	6.1	7	3.9	17	4.9
45-49	1	0.6	1	0.6	2	0.6
50-54	3	1.8	3	1.7	6	1.7
55-59	1	0.6	—	—	1	0.3
60 and over	5	3.0	3	1.7	8	2.3
Totals	165	100.1	181	100.2	346	99.9
<i>Combined Group</i>						
0-4	24	10.6	21	8.3	45	9.4
5-9	43	18.9	26	10.3	69	14.4
10-14	36	15.9	41	16.3	77	16.1
15-19	27	11.9	56	22.2	83	17.3
20-24	20	8.8	26	10.3	46	9.6
25-29	11	4.8	29	11.5	40	8.4
30-34	20	8.8	15	6.0	35	7.3
35-39	13	5.7	13	5.2	26	5.4
40-44	13	5.7	10	4.0	23	4.8
45-49	6	2.6	3	1.2	9	1.9
50-54	4	1.8	6	2.4	10	2.1
55-59	3	1.3	1	0.4	4	0.8
60 and over	7	3.1	5	2.0	12	2.5
Totals	227	99.9	252	100.1	479	100.0

*The number of persons in each age segment is expressed as a per cent of the total in the respective group.

TABLE IX. THE NUMBER OF PERSONS REPORTING THE SEASONAL PATTERN OF THEIR SYMPTOMS IS EXPRESSED AS A PER CENT OF THE TOTAL DIAGNOSES IN EACH GROUP

	MALE		FEMALE		TOTAL	
	NO.	%	NO.	%	NO.	%
<i>More Certain Group</i>						
Asthma	110	80.3	119	80.4	229	80.4
Hay fever	190	89.2	202	89.4	392	89.3
<i>Combined Group</i>						
Asthma	217	60.1	200	57.1	417	58.6
Hay fever	259	80.4	294	81.9	553	81.2

TABLE X. THE SEASONAL DISTRIBUTION OF ASTHMA AND HAY FEVER SYMPTOMS*

	MORE CERTAIN GROUP				COMBINED GROUP			
	TOTAL				TOTAL			
	PEREN- NIAL	WINTER	SPRING- SUMMER	FALL	PEREN- NIAL	WINTER	SPRING- SUMMER	FALL
Asthma	28.4	14.0	42.4	38.4	30.5	19.2	35.3	33.3
Hay fever	3.8	2.0	48.0	72.4	5.1	2.4	50.3	65.6

*The recorded figures represent the per cent of the total persons with available information in whom symptoms were either perennial or occurred predominantly during the designated seasons. By definition, if a given person had perennial symptoms, this would exclude him from the other groups; any other persons might be represented in as many as 2 of the 3 seasonal groups.

the entire asthma group had been seen by a physician, this had been the case in two thirds or less of those with hay fever (Table XII). Injection therapy was more frequently reported in the asthma group than in persons having hay fever.

TABLE XI. THE NUMBER OF PERSONS WHO ANSWERED THE TREATMENT QUESTION IS EXPRESSED AS A PER CENT OF THE TOTAL DIAGNOSES IN EACH GROUP

	MALE		FEMALE		TOTAL	
	NO.	%	NO.	%	NO.	%
<i>More Certain Group</i>						
Asthma	127	92.7	137	92.6	264	92.6
Hay fever	191	89.7	206	91.2	397	90.4
<i>Combined Group</i>						
Asthma	272	75.3	254	72.6	526	74.0
Hay fever	265	82.3	296	82.5	561	82.4

TABLE XII. THE NUMBER OF PERSONS WHO WERE SEEN BY A PHYSICIAN AND THOSE WHO RECEIVED INJECTION THERAPY IS EXPRESSED AS A PER CENT OF THE TOTAL PERSONS IN EACH GROUP WHO ANSWERED THE TREATMENT QUESTION

	MALE		FEMALE		TOTAL	
	SAW DOCTOR	INJECTION THERAPY	SAW DOCTOR	INJECTION THERAPY	SAW DOCTOR	INJECTION THERAPY
<i>More Certain Group</i>						
Asthma	99.2	40.1	98.6	46.0	98.9	43.2
Hay fever	64.9	21.5	66.5	22.8	65.7	22.2
<i>Combined Group</i>						
Asthma	99.7	23.2	97.7	33.5	98.6	28.1
Hay fever	58.1	17.7	59.1	18.9	58.6	18.4

DISCUSSION

A good deal of information is available regarding the characteristics of asthma and hay fever in different populations. Much of this is summarized in two reviews^{4, 5} and no attempt will be made here to treat the existing data in detail. Previous studies have been based either on clinical experience,⁶⁻²² insurance examinations,^{23, 24} student groups,²⁵⁻³² or population surveys carried out by means of questionnaires.³³⁻⁴³ A number of the population studies combine the groups with asthma and hay fever rather than assessing the two as separate entities. There is some lack of information at the level of the total community which is based on diagnoses made by a participating physician.⁴³

A liberal diagnostic policy was emphasized in this study. It is considered that the term "asthma" has been applied in its broadest context and includes conditions which might be classified as acute bronchiolitis in the younger groups or bronchitis or emphysema with wheezing in the older ones. There is likely less latitude for this type of diagnostic variation in the hay fever group. The less certain groups with either disease contain a number of persons in whom the diagnosis was considered to be somewhat doubtful.

The data presented in Table III show a difference in the cumulative prevalence of asthma relative to that of hay fever on comparing the more certain and

combined diagnostic groups. In the first group, asthma was found to be approximately two thirds as prevalent as hay fever, whereas, in the second, both diseases were approximately equal in frequency. It is apparent from this that the qualification "less certain" was applied to a higher proportion of the asthma than the hay fever diagnoses. This may be a manifestation of the greater ease with which a firm retrospective diagnosis of hay fever can be made; in the absence of active disease there is likely a greater tendency to assign a lesser degree of certainty to a diagnosis of asthma. From the distribution of asthma in the current age groups (Table IV), there appears to be a trend for this less firm type of diagnosis to have been made more commonly in the oldest and youngest groups.

As the data presented here are cumulative in nature and most of those from other sources are not, it is difficult to make many valid comparisons. However, data somewhat comparable to those in Table III are available from several studies. In a small community which was surveyed by an interviewer, Vaughn⁴¹ found that asthma had been present at some time in 6.2 per cent and nasal allergy in 26.4 per cent. Three studies of university students provide a further source of information: Van Arsdel and Motulsky³² reported that, of a group at the University of Washington, 4.7 per cent had a history of asthma and 14.7 per cent hay fever; at the University of Michigan, Maternowski and Mathews²⁸ found cumulative prevalence rates of 5.7 per cent for asthma and 16.6 per cent for hay fever; Grant²⁶ found at the University of Wales that 3.3 per cent had asthma either currently or at some time in the past. Although there are some differences among these results and our own, the various data are not grossly discordant.

In this study, the total cumulative prevalence rates of both asthma and hay fever were similar in males and females. However, on comparing the distribution of age at onset in the two sexes, it was found that both diseases demonstrated a trend toward an earlier onset in males (Tables VII and VIII). This has been observed by others in both asthma and hay fever.^{6, 11, 14, 15, 19, 21, 22, 29, 31}

The seasonal pattern of hay fever symptoms helps to clarify retrospectively one important criterion which was used to characterize this group. Perennial symptoms were found to be quite infrequent, and symptoms occurred predominantly in the spring-summer and fall in over 90 per cent (Table X). As would be anticipated in this geographic area, fall was the most common season reported. In the asthma group, 42 to 50 per cent of persons had symptoms which were either perennial or occurred predominantly in the winter.

The treatment data (Table XII) demonstrate that medical attention was sought in the asthma group considerably more often than in those with hay fever and are in keeping with the expectation that people would tend to find symptoms of bronchoconstriction considerably more alarming than those of upper respiratory allergy. The fact that the lower respiratory symptoms were sufficient to warrant medical attention, in almost all cases, helps to enhance the acceptability of this diagnostic group. The term "injection therapy" was applied to any form of injectable medication and did not necessarily indicate that treatment with an allergenic extract had been reported.

SUMMARY

An epidemiological study of a total community has been described in which a detailed medical history, family history, physical examination, and certain physical and laboratory measurements were obtained in 88 per cent of all residents. Cumulative prevalence rates for asthma and hay fever are presented which are based on the population 6 years of age and older. A diagnosis of asthma was made in 711 persons and hay fever in 681; these included 285 persons with a history of asthma and 439 with hay fever in whom the diagnoses were considered to be more firm than in the remainder. The age-specific cumulative prevalence of the more certain asthma group was relatively constant, while that for hay fever rose to a plateau in the second and third decades. Of those persons with a history of asthma, the first episode most commonly occurred under the age of 5 years; hay fever more frequently began at a later age. Although there were no appreciable sex differences in the total cumulative prevalence of asthma and hay fever, both diseases demonstrated a trend toward an earlier onset in males than females. Forty-two to 50 per cent of persons having a history of asthma had symptoms which were either perennial or occurred predominantly in the winter; almost everyone with hay fever had symptoms in the spring, summer, or fall. Persons in the asthma group were more commonly seen by a physician than those with hay fever.

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