METHOD OF STATISTICAL ANALYSIS OF CHRONIC DISEASE IN A LONGITUDINAL STUDY OF ILLNESS

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THE purpose of this paper is to present a detailed description of the method employed in the statistical treatment and presentation of data of chronic disease reported in the study of illness in the Eastern Health District of Baltimore (1).

White families living in thirty-four city blocks formed the sample population. The plan of the study was to follow families that lived in a group of houses in certain blocks rather than to follow a selected group of families. No attempt was made to continue visiting families which moved out of these houses during the period of the study, but the new families that moved into the houses vacated in the sample blocks were included in the study. The record of illness started with the first visit to the family and each family was visited once a month thereafter.

In seventeen of the thirty-four city blocks the families were visited over a period of five years; in the other seventeen, visiting was continued for three years. The data include illness in families observed two months or longer. Hence the shortest possible period of observation was two months and the longest was from three to five years. This fact must be kept in mind when considering chronic conditions present in the population, since these illnesses have a relatively long duration.

A meaningful presentation of cases of chronic disease observed in a longitudinal study such as this, which extends beyond a twelve-month period, requires a type of analysis which is different from that employed in past studies of morbidity.

Briefly, the problem is this: When a population of families is first surveyed for illness, the chronic diseases usually form the major proportion of the total illnesses present at that time. In the study of illness in the Eastern Health District of Baltimore,

[1] From the Milbank Memorial Fund.

from 60 to 70 per cent of the total illnesses reported as present in the family at the time of the first visit were those of a chronic nature. These were all conditions which had their onset prior to observation of the family and cannot properly be considered as incidence of illness within the period of observation. In a population observed over a period of time, illnesses of a chronic nature have a low incidence, that is, occurrence of newly-diagnosed cases, in comparison with their prevalence at any given time during the period. For example, in the population observed in the Eastern Health District, the annual incidence of new diagnoses of major chronic illness was 23.6 per 1,000 person-years compared with a prevalence of 178 per 1,000 person-years. It is apparent that if prevalence in each year of observation is not considered, incidence of new cases alone will not reveal the true state of the population with respect to the presence of chronic disease.

This problem was encountered in the earliest longitudinal study, namely, the Hagerstown study which was initiated and conducted by Edgar Sydenstricker (2). This study included observation of families over a period of twenty-eight months. In the first published paper from the study it is evident that Sydenstricker realized that a morbidity rate of a specific chronic illness based upon "years of life exposed" over a twenty-eight-month period did not give a true picture of that particular chronic disease in the population studied. Consequently, he presented a table (Table 4 in his text) which shows the prevalence of chronic illness in the population of the 8,587 persons in the Hagerstown study instead of using for a population base the years of life exposed which numbered 16,517. The effect of this procedure upon the chronic illness rates is readily apparent. For example, morbidity from heart disease in Table 2 of Sydenstricker's text was 10.1 per 1,000 when based upon years of life exposed and 21.2 per 1,000 when based upon persons. In this paper, he gave a definite clue as to how morbidity from chronic disease could best be treated in the longitudinal study which extends beyond a twelve-month period.

The morbidity study made by the Committee for the Cost of Medical Care and reported upon by Collins (3) indicated that a relatively high proportion, 44 per cent, of certain of the chronic illnesses noted had their onset prior to observation of the population studied.[2] All cases of illness which had their onset prior to observation of the population were included in the annual attack rate but the data were shown in such a way that prevalence of illness could be distinguished from incidence of attacks of illness. Since this study was limited to twelve months, the problem of how to count chronic illnesses present in the population in successive years did not arise.

Chronic Disease in the Eastern Health District of Baltimore

The problem of obtaining an accurate and complete picture of the extent of chronic disease in an observed population was of particular concern in the study in the Eastern Health District. Careful inquiry was made concerning members of the family who were in institutions for the mentally ill, for the feeble-minded, for the tuberculous, and for other chronic diseases requiring institutional care. The instructions for the use of the family visitors contained a list of the more common chronic diseases about which inquiry was to be made.

Special information was sought for all diseases of a chronic nature. This special information included data concerning the onset of the first symptoms of the disease, their nature and date, the date first diagnosed, and whether or not the diagnosis was made by a private physician, at a clinic, or at a hospital. Illnesses that were reported as chronic were asked about on each subsequent visit to the family. Inquiry was made concerning the amount of discomfort or disability suffered from the condition since the last visit and the amount and nature of medical care received for it.

Coding of Chronic Disease

It is of interest at this point to explain how the data of

[2] These chronic illnesses include cancer, rheumatism, diabetes, epilepsy, chorea, heart disease, varicose veins, high blood pressure, peptic ulcer, tuberculosis, and syphilis.

chronic disease were coded and the purposes of the coding.

Editing. Careful editing of the illness records was a prerequisite to their coding. Editing was necessary for two reasons: (1) to distinguish chronic illness from nonchronic illnesses which had the same name or diagnosis; and (2) to avoid consideration of symptoms of a chronic disease as though each symptom were a distinct disease entity.[3] It is appropriate to cite examples under each of the reasons for editing.

Not all cases of gall-bladder disease were considered as chronic. A single acute attack of illness followed by surgery or other treatment did not warrant classification of the condition as chronic. Repeated attacks were considered as evidence of chronicity. In these instances the attending physician's statement concerning the cause of illness indicated the condition to be chronic. Not all hernias were considered as chronic. If remedial surgery took place soon after discovery of the condition, the illness was classed as acute.

A rise in blood pressure during pregnancy was not considered as a chronic condition unless the attending physician indicated that the patient had chronic hypertension. Embolism as a cause of death subsequent to an operation was not considered as a chronic condition even though it is classed as a disease of the arteries. The doctor's diagnosis and the patient's complaints over a period of time were the important guides as to whether certain conditions should be considered as chronic or as an acute illness.

A single example of the second reason for editing may be cited. A patient with coronary disease may have reported repeated attacks of neuritis in the left shoulder and arm. The attending physician's statement attributed these attacks to coronary disease and coronary disease was considered as the sole chronic condition.

The editing of all but twenty-four of the 1,465 major chronic diagnoses was done by one person, the author of this paper.

[3] Cecil's TEXTBOOK OF MEDICINE, 5th and 6th Editions, were used as a guide in the editing process (4).

Then each case was re-edited by another member of the staff in order to detect inconsistencies in the first editing. The cases were then all checked again by the first editor.

A consistent effort was made to avoid overstatement or understatement of the amount of chronic illness reported by the observed population. Most of the illnesses reported were those known to be of a progressive nature and there was no question as to their classification. Rheumatoid arthritis and osteoarthritis may be cited as examples.

Coding of Chronic Disease. The code provided for division of cases of chronic disease into the following classes:

Ambulatory

Class 1. These cases had no disability from the condition and no medical care for it during observation.

Class 2. These cases had no disability but did have medical care at some time during observation.

Class 3. These cases had one or more disabling episodes of illness from the chronic disease at some time during observation.

Ambulatory But Disabled for Work Throughout Observation

Class 4. These cases had no episodes of more severe disability, that is, no bed attacks during observation.

Class 5. These cases had one or more episodes of bed illness which were due to the particular chronic illness present.

Nonambulatory (Bed Cases)

Class 6. These cases were confined to bed throughout observation. Cases in institutions for the tuberculous, for the feebleminded, and for mental disorder were included in this class even though not all of their time was spent in bed.

Except for the cases in Class 1, a card was coded for each study-year that the case was present in the population. A study-year was a twelve-month period beginning, respectively, in June, 1938, June, 1939, June, 1940, June, 1941, and June, 1942. It was indicated on each card the particular study-year in which the case was present. The single card for cases in Class

1 gave the date of onset or first diagnosis of illness, the study-year of first observation, the study-year in which the case was terminated, and the total months observed in the morbidity study. Thus it was possible to count these cases in each of the specific study-years in which they were present.

For cases in Class 3 a card was coded for each study-year that the case was present in the population observed that year. In addition, a special card was coded for each disabling episode suffered by these cases. The code for these cards included the date of onset of disability, the duration of disability, and the study-year of termination of the disabling attack. Thus each disabling episode could be allocated to the specific study-year in which it occurred.

The special card (disabling attack) for this class was coded in order to study the risk of disabling episodes for persons with a specific diagnosis of chronic disease and who were not disabled throughout the entire period of their observation. All persons in Classes 1, 2, and 3 may be considered as those at special risk of such episodes. Also, these episodes can be related to the total observed population in order to express the general risk of such illness.

There was a further reason for coding the special card (disabling attack) for cases in Class 3. It is of interest to learn how chronic illness manifests itself over a period of time. Is the risk of disability for specific diagnoses greatest at the time of first diagnosis and does that risk diminish with time? Or is the disease of such a rapidly progressive nature that the risk of disability increases with time? It may be that such questions cannot be answered in a period so short as five years. However, it will be of interest to examine the data from this point of view.

It should be pointed out that cases of chronic disease were not transferred from one class to another in different years. For example, if a case in Class 3 became permanently disabled he was not transferred to one of the permanently disabled classes (4, 5, or 6) but remained in Class 3.

Table 1 shows the number of diagnoses of major chronic

Classification of Condition of Person with Specific Diagnosis During Observation	Number of Diagnoses of Chronic Illness	Per Cent
Total	1,465	100.0
Ambulatory:		
1. No Disability, no Medical Care During Observation	281	19.2
2. No Disability, but Medical Care at Some Time During Observation	344	23.5
3. Disability at Some Time During Observation	695	47.4
Ambulatory, but Disabled for Work Throughout Observation		
4. Disabled for Usual Work but no Bed Attacks from Chronic Conditions	85	5.8
5. Disabled for Usual Work and Bed Attack at Some Time During Observation		
Nonambulatory, Bed Case Throughout Observation		
6. Bed Cases Throughout Observation	60	4.1

Table 1. Classification of diagnoses of major chronic illness, Eastern Health District of Baltimore, June, 1938–May, 1943.

disease in each of the classes which have been outlined. Only about 10 per cent of the total were disabled throughout observation and at the other extreme 19 per cent had no disability or medical care during that period.

The classification "major" chronic disease includes heart disease, hypertension or high blood pressure, arthritis, tuberculosis, diabetes, chronic nephritis, rheumatic fever, varicose veins, chronic gall-bladder disease, syphilis, malignant neoplasm, peptic ulcer, toxic goiter, epilepsy, mental deficiency, psychoses and psychoneuroses, and other important but relatively rare conditions, such as Parkinson's disease, cerebral palsy, and multiple sclerosis. (*See* Appendix 1)

Method of Counting Cases of Chronic Disease

There is need to stress the fact that the counting of chronic disease cases among persons observed over a considerable period

of time presents a problem more complex than is true for a relatively short time period such as one year. At the beginning of observation a certain proportion of the population is reported to be affected by the presence of chronic illness. As time goes on those persons not affected are at risk of developing a chronic condition to the point that a first diagnosis of the condition is made. In addition, those persons who reported the presence of a chronic disease at the beginning of observation are also at risk of developing a different and unrelated chronic condition. For example, a person with mild hypertrophic arthritis has the risk of developing heart disease or cancer as do others of the same age and sex in the general population. If heart disease or

Table 2. Diagnoses of major chronic disease among males and females, Eastern Health District of Baltimore, June, 1938–May, 1943.[1]

Diagnosis Class	Annual Rate Per 1,000 Population[3]			Number of Continuing and New Cases		
	Total	Male	Female	Total	Male	Female
Total Cases	198.4	155.6	240.3	4,134	1,599	2,535
Arthritis	40.4	25.7	54.8	842	264	578
Heart Disease	33.6	27.3	39.7	700	281	419
Hypertensive Vascular Disease and Arteriosclerosis	20.4	13.6	26.9	424	140	284
Psychoneurosis and Nervousness	15.1	9.1	20.9	315	94	221
Rheumatic Fever[2]	13.5	12.5	14.4	282	130	152
Varicose Veins	10.5	2.9	17.9	219	30	189
Gall-Bladder Disease	7.6	1.4	13.7	159	14	145
Diabetes	7.4	4.5	10.3	155	46	109
Mental Deficiency	7.1	8.1	6.3	148	83	65
Psychoses	5.3	5.1	5.4	111	54	57
Tuberculosis	5.1	5.4	4.8	107	56	51
Syphilis	4.6	4.4	4.7	95	45	50
Neoplasm (Malignant)	3.6	2.6	4.5	74	27	47
Peptic Ulcer	3.3	6.6	0.5	68	64	4
Goiter (Toxic)	1.9	0.7	3.0	39	7	32
Other Chronic Disease	19.0	25.7	12.5	396	264	132

[1] This Table excludes "crippling conditions" shown in Table 9, in "Cause of Illness Among Males and Females." Milbank Memorial Fund *Quarterly*, October, 1950, xxviii, No. 4, p. 417.
[2] Includes cases of rheumatic fever with rheumatic heart disease.
[3] Based upon 10,282 male-person years and 10,550 female-person years.

cancer did develop in such a person the condition was considered as a new case of chronic disease. It was not regarded as a complication of arthritis nor as contributory to any illness from arthritis; nor was arthritis considered as contributory to illness from heart disease or cancer. If there were disability from either illness or medical care for either illness, disabling days and medical care were assigned only to the particular chronic condition which caused the disability and for which medical care was given.

In this study all diagnoses of chronic disease were counted because, in community planning for adequate facilities for care and treatment of chronic disease, it is advantageous to know the size of the problem in terms of the number of diagnoses rather than solely on the basis of persons affected. For example, the patient with arthritis and heart disease or cancer needs treatment for both conditions.

The population was composed of person-years of life of people who were observed for varying time periods in the thirty-four blocks which were studied from three to five years. A person observed for five years was counted as five person-years of life. If that same person reported the presence of diabetes during the first year of the study, he was counted as a diabetic also in the subsequent four years of his observation. Thus the rate of illness of chronic disease is an average annual rate based on all cases diagnosed as conditions in the category "chronic disease."

Table 2 shows the number of diagnoses of specific major chronic diseases present in the population of the Eastern Health District during the period June, 1938, to May, 1943.[4] The cases are counted as those continuing in each year in which they were present plus the new diagnoses during the period. This table presents the same data as Table 9 in the previous publication "Cause of Illness Among Males and Females." (1) Table

[4] There were printer's errors in this table in the reprint publication. In cases of syphilis and neoplasm, digits were transposed. Cases of syphilis among females should have been 50 instead of 05 and neoplasm among females should have been 47 instead of 74.

3 presents the annual incidence of new diagnoses of specific major chronic disease among males and females. The population base for both of these tables is composed of the total years of life observed. The data in both of these tables represent the average annual experience throughout the study; one table indicates the amount of chronic disease present in the population, old plus new diagnoses, and the other (Table 3) the incidence of new diagnoses of chronic illness.

The method of counting cases of chronic illness is shown in greater detail in Tables 4 and 5. Table 4 shows the data for arthritis and Table 5 presents the same type of data for heart disease. Both are based upon the population of the seventeen blocks observed for five years. Column 1 shows the persons

Table 3. Annual incidence of new diagnoses of major chronic disease among males and females, Eastern Health District of Baltimore, June, 1938–May, 1943.[1]

Diagnosis Class	Rate Per 1,000 Population			Number of Cases		
	Total	Male	Female	Total	Male	Female
Total Cases	23.62	18.19	28.91	492	187	305
Arthritis	4.61	2.92	6.26	96	30	66
Heart Disease	5.14	4.77	5.50	107	49	58
Hypertensive Vascular Disease and Arteriosclerosis	3.26	2.24	4.27	68	23	45
Psychoneurosis and Nervousness	2.16	0.78	3.51	45	8	37
Rheumatic Fever[2]	1.20	1.46	0.95	25	15	10
Varicose Veins	0.62	0.39	0.85	13	4	9
Gall-Bladder Disease	1.06	0.19	1.90	22	2	20
Diabetes	0.48	0.58	0.38	10	6	4
Mental Deficiency	0.0			0		
Psychoses	0.38	0.29	0.47	8	3	5
Tuberculosis	0.86	0.78	0.95	18	8	10
Syphilis	0.34	0.29	0.38	7	3	4
Neoplasm (Malignant)	1.15	0.88	1.42	24	9	15
Peptic Ulcer	0.48	0.78	0.19	10	8	2
Goiter (Toxic)	0.10	0.0	0.19	2	0	2
Other Chronic Diseases	1.78	1.85	1.71	37	19	18

[1] Person years = 10,282 male years and 10,550 female years.
[2] Includes cases of rheumatic fever with rheumatic heart disease.

present in June of each study-year; Column 2 indicates the number of cases present (onset prior to observation) in June of each study-year; Column 3 records the number of new diagnoses during each year; the reason for termination of cases is indicated in Columns 4 and 5; Column 6 shows the cases that moved into the population, all of whom were diagnosed prior to observation; and Column 7 indicates the total number of cases present in each study-year.

In morbidity studies, person-years of life form the denominators for obtaining rates of illness. In dealing with chronic disease the problem is determination of the numerator. For example, if this were a one-year study a rate expressing the amount of arthritis in the population offers no particular prob-

Table 4. Count of cases of arthritis in each year—seventeen city blocks observed for five years. Eastern Health District of Baltimore, 1938–1943.

Study Year	Persons Present June of Each Study Year	Cases Present in June of Each Year (Onset Prior to Observation)	New Cases Diagnosed During Year	Terminations During Study Year		Case Moved in (Onset Prior to Observation)	Total Cases Present During Year
				Moved Out During Year	Deaths During Year[1]		
	Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6	Col. 7
1st Study Year (6, 1938–5, 1939)	2,969	81	12	7	0	7	100
2nd Study Year (6, 1939–5, 1940)	2,893	93	12	5	0	10	115
3rd Study Year (6, 1940–5, 1941)	2,838	110	14	7	2	5	129
4th Study Year (6, 1941–5, 1942)	2,894	120	13	9	1	3	136
5th Study Year (6, 1942–5, 1943)	2,743	126	5	9	0	6	137
Total for 5 Years	14,337	530	56	37	3	31	617

[1] Cause of death was not due to arthritis; all died from heart diseases.

lem. The numerator is the 100 cases present during the year divided by 3,014 years of life. The rate is then 33.2 per 1,000. Following the same procedure over a period of two years, the numerator becomes 122, that is, 81 plus 24 new cases diagnosed in the two years, plus 17 who moved into the population. The denominator is 5,931 and the resulting rate is 20.5 per 1,000 person-years. If this same procedure be carried out over the entire five-year period, the rate becomes 12.0 per 1,000 person-years.

It is obvious that to obtain a meaningful rate of arthritis based on a population observed over a period of two years or five years, the same method of determination of the denominator must be applied to the determination of the numerator. In other words, cases of arthritis must be counted in each year

Table 5. Count of cases of heart disease in each year—seventeen city blocks observed for five years. Eastern Health District of Baltimore, 1938–1943.

Study Year	Persons Present June of Each Study Year	Cases Present in June of Each Year (Onset Prior to Observation)	New Cases Diagnosed During Year	Terminations During Study Year		Case Moved in (Onset Prior to Observation)	Total Cases Present During Year
				Moved Out During Year	Deaths During Year		
	Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6	Col. 7
1st Study Year (6, 1938–5, 1939)	2,969	75	11	5	11	5	91
2nd Study Year (6, 1939–5, 1940)	2,893	75	14	7	12	4	93
3rd Study Year (6, 1940–5, 1941)	2,838	74	19	11	7	6	99
4th Study Year (6, 1941–5, 1942)	2,894	81	18	9	9	6	105
5th Study Year (6, 1942–5, 1943)	2,743	87	9	6	5	2	98
Total for 5 Years	14,337	392	71	38	44	23	486

in which they are present in the population. This principle applies to any chronic condition.

In Tables 4 and 5, which present cases of arthritis and heart disease, recovery from illness did not appear as a reason for termination of the case. However, recovery is a possibility for specific chronic illnesses. Cases may recover from such major chronic conditions as tuberculosis, syphilis, peptic ulcer, rheumatic fever, toxic goiter, cancer, psychoneurosis, psychosis, gall-bladder disease, and hernia. Time and medical care are important factors in recovery from these illnesses. If recovery takes place during observation, the case should be terminated so that the count of cases of chronic illness does not at any time include persons with a history of disease. It should include only those with a chronic condition present at the time of observation. For example, in this study the category "tuberculosis" does not include cases classed as "arrested" or "apparently cured"; only those with active disease were counted.

Table 6 shows the incidence of new diagnoses of arthritis

Table 6. Incidence of new diagnoses (cases) of arthritis and heart disease—seventeen city blocks studied for five years. Eastern Health District of Baltimore, 1938–1943.

Study Year	Rate Per 1,000 Person Years		Number of Cases with First Diagnosis		Person Years of Observation
	Arthritis	Heart Disease	Arthritis	Heart Disease	
1st Study Year (6, 1938–5, 1939)	3.98	3.65	12	11	3,014
2nd Study Year (6, 1939–5, 1940)	4.11	4.78	12	14	2,917
3rd Study Year (6, 1940–5, 1941)	4.94	6.70	14	19	2,835
4th Study Year (6, 1941–5, 1942)	4.85	6.71	13	18	2,683
5th Study Year (6, 1942–5, 1943)	1.99	3.58	5	9	2,515
Total for 5 Years	4.01	5.08	56	71	13,964

and heart disease in each study-year in the seventeen city blocks observed for five years. It is apparent that in the fifth study-year incidence fell sharply. This was true of both conditions. Evidently by the fifth year some selection in the observed population had taken place.

Tables 7, 8, and 9 show various ways of expressing the amount of arthritis and heart disease present in the population in each of the five study-years. Table 7 shows the prevalence of these conditions in June of each year. Table 8 shows the number of cases present in each year; here the denominator is the total persons observed in each year. Table 9 shows the number of cases of arthritis and heart disease and the rate is based on person-years of observation.

It is evident that in this study rates based upon person-years of observation are higher than when based upon persons observed at the beginning of each study-year (June) or on total persons observed during the year. The reason for this is the relatively high rate of moving of the population in each year.

Table 7. Prevalence of cases of arthritis and heart disease in June of each year—seventeen city blocks observed for five years. Eastern Health District of Baltimore, 1938–1943.

Study Year	Cases Per 1,000 Population (Cases Onset Prior to Obs.)		Cases Present in June of Each Year (Onset Prior to Obs.)		Persons Present in June of Each Year
	Arthritis	Heart Disease	Arthritis	Heart Disease	
1st Study Year (6, 1938–5, 1939)	27.28	25.26	81	75	2,969
2nd Study Year (6, 1939–5, 1940)	32.15	25.92	93	75	2,893
3rd Study Year (6, 1940–5, 1941)	38.76	26.07	110	74	2,838
4th Study Year (6, 1941–5, 1942)	41.47	28.00	120	81	2,894
5th Study Year (6, 1942–5, 1943)	45.94	31.72	126	87	2,743
Total for 5 Years	36.97	27.34	530	392	14,337

Study Year	Rate Per 1,000 Persons		Total Cases Present During Year		Total Persons Present During Year
	Arthritis	Heart Disease	Arthritis	Heart Disease	
1st Study Year (6, 1938–5, 1939)	27.38	24.92	100	91	3,652
2nd Study Year (6, 1939–5, 1940)	32.37	26.18	115	93	3,553
3rd Study Year (6, 1940–5, 1941)	37.85	29.05	129	99	3,408
4th Study Year (6, 1941–5, 1942)	41.39	31.95	136	105	3,286
5th Study Year (6, 1942–5, 1943)	44.98	32.17	137	98	3,046
Total for 5 Years	36.41	28.68	617	486	16,945

Table 8. Number of cases of arthritis and heart disease present in each year—seventeen city blocks observed for five years. Eastern Health District of Baltimore, 1938–1943.

Table 9. Number of cases of arthritis and heart disease present in each year—seventeen city blocks observed for five years. Eastern Health District of Baltimore, 1938–1943.

Study Year	Rate Per 1,000 Person Years		Total Cases Present During the Year		Person Years of Observation
	Arthritis	Heart Disease	Arthritis	Heart Disease	
1st Study Year (6, 1938–5, 1939)	33.18	30.19	100	91	3,014
2nd Study Year (6, 1939–5, 1940)	39.42	31.88	115	93	2,917
3rd Study Year (6, 1940–5, 1941)	41.97	34.92	129	99	2,835
4th Study Year (6, 1941–5, 1942)	50.69	39.14	136	105	2,683
5th Study Year (6, 1942–5, 1943)	54.47	38.97	137	98	2,515
Total for 5 Years	44.19	34.80	617	486	13,964

The rates shown in Table 8 which include new cases are too low because the person observed two months has the same weight in the denominator as one observed twelve months although the risk for each is different. Addition of the rates in Tables 6 and 7, incidence based on person-years of observation and prevalence in June, probably affords the best expression of chronic illness. For example, this results in a rate of arthritis of 31.26 per 1,000 in the first study year. This rate is only slightly lower than the rate for this year shown in Table 9.

Rates based on person years of observation were used in the total experience presented in Table 2 of this paper and in Table 9 of the paper "Cause of Illness Among Males and Females." (1) This type of rate was not considered the best or the most accurate expression of the amount of chronic disease in the observed population. However, it was desired to show the total amount of illness in the population and most of the total is composed of cases of acute illness. The rate of chronic illness, most of which is prevalence, cannot be added to the total illness rate unless the same denominator or population base is used for both acute and chronic illness.[5]

This brings us to the dilemma of all longitudinal morbidity studies. Sydenstricker called the illness rate based upon a period of twenty-eight months, "morbidity." In the study of the Committee on the Costs of Medical Care, Collins also called the total illness rate "morbidity." Morbidity in both studies includes prevalence and incidence of illness. The same is true of the study in the Eastern Health District of Baltimore. It is necessary to combine prevalence of illness with incidence of illness in order to express the total amount of illness present in the population over a period of time.

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[5] It is recognized that for purposes of accuracy when dealing with the incidence of chronic disease that specific chronic illnesses should not be included in the population at risk. For example, if arthritis be considered, those known to have arthritis should be excluded from the population at risk of developing arthritis. Corrections such as this were not made when the total rate of illness from all causes was considered because it was thought best not to change the population base being used.

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Appendix I.

MAJOR CHRONIC ILLNESSES

	Code Numbers[1]
1. Tuberculosis	020–036, 038, 039
2. Syphilis	060–069
(061 is classed with cardiovascular disease)	
(063 is classed with psychoses)	
3. Malignant neoplasms	100–169
4. Rheumatic fever	200–202
5. Diabetes	210–219
6. Goiter—toxic	220, 222
7. Pernicious anemia	250
8. Aplastic anemia	259
9. Alcoholism (chronic)	270
10. Apoplexy (stroke)	290
11. Multiple sclerosis	303
12. Parkinson's disease	305
13. Spastic paraplegia	307
14. Psychoses	320–329
15. Psychoneuroses	330–334
16. Mental deficiency	335

	Code Numbers[1]
17. Epilepsy	336
18. Heart disease	360–365
19. Hypertensive heart disease	370–375
20. Other heart	380, 381, 382, 389
21. Functional disease of heart	388
22. Hypertensive vascular disease	390–399
23. Arteriosclerosis	400
24. Other diseases of the arteries	403, 409
25. Varicose veins of lower extremities	410
26. Plebitis and thrombophlebitis	420, 421
27. Peptic ulcer	520–527
28. Hernia	550, 553
29. Diverticulosis	579
30. Choleocystitis with or without calculi	585, 586
31. Nephritis (chronic)	600
32. Hypertensive vascular-renal disease	607
33. Calculi of kidneys and ureters	619, 620
34. Prostatitis (chronic)	632
35. Arthritis, rheumatoid, osteo-arthritis and other forms	620–629
36. Osteomyelitis	730
37. Osteitis deformans (Paget's disease)	731
38. Brittle bones (Perthes disease)	734
39. Spina Bifida	750
40. Congenital malformation of the heart	753
41. Nervousness	786
42. Behavior problems	787

CRIPPLING AND DISABLING CONDITIONS

1. Cataract	341
2. Other conditions of vision	349
3. Deafness	352
4. Old fracture	733
5. Other diseases of the joints	739
6. Other deformities due to previous disease or injury	742
7. Other diseases of organs of movement	749
8. Ill-defined diseases	789

MINOR CHRONIC ILLNESSES

1. Gonococcus infection	041
2. Dermatophytosis	092
3. Non-malignant tumors	170–199
4. Goiter—non-toxic	221, 229
5. Diseases of endocrine glands	230–239
6. Obesity	241
7. Malnutrition	242

[1] Code numbers are those from the Manual For Coding Causes of Illness—according to a Diagnosis Code For Tabulating Morbidity Statistics: U. S. Public Health Service, Miscellaneous Publication, No. 32, U. S. Government Printing Office, Washington, 1944.

	Code Numbers[1]
8. Facial paralysis	310
9. Neuritis	316
10. Migraine	337
11. Glaucoma	340
12. Strabismus	342
13. Otitis media and other ear	350–359 (except 352)
14. Hemorrhoids	415
15. Other circulatory	429
16. Bronchitis	471
17. Sinusitis	495
18. Asthma	501
19. Other respiratory (emphysema)	509
20. Colitis (chronic)	539
21. Appendicitis (chronic)	549
22. Indigestion (chronic)	560
23. Salpingitis	650
24. Chronic cervicitis	652
25. Pelvic disease (chronic)	658
26. Menopause	663
27. Menstrual disorder	664
28. Other female genital	666
29. Psoriasis	715
30. Other skin conditions	719
31. Curvature of spine	735
32. Sacro-iliac disease	736
33. Lumbago	782
34. Neuralgia	784
35. Headache (chronic)	785