THE SEVERITY OF ILLNESS AMONG MALES AND FEMALES[1]

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VARIOUS surveys have shown that the average incidence of illness is higher among females than among males. In the Hagerstown study, Sydenstricker[2] found that males had an illness rate from all causes of 970 per 1,000 and that females had a rate from all causes, exclusive of puerperal conditions, of 1,215 per 1,000 per year. Rates of 720 per 1,000 males and 833 per 1,000 females for all causes except female genital and puerperal diseases, were reported by Collins[3] in a study of illness made by the Committee on the Costs of Medical Care and the United States Public Health Service among 9,000 families in eighteen states. Although there were some differences in the methods used in these studies and also differences in the level of illness observed, the female illness rate was found consistently to be higher than the male rate. Collins pointed out that the females had a higher rate than the males for bed illness as well as for total illness, and he raised the question as to "whether this indicates more frequent illness among females, a greater severity of illness, or better care of the illness that occurs."[4] In another report on the frequency and volume of doctors' calls in the same group of families, Collins[5] furnished additional information on this subject. He found that although females had more doctors' calls per

[1] From the Division of Public Health Methods of the National Institute of Health and the Milbank Memorial Fund.

[2] Sydenstricker, Edgar: The Illness Rate Among Males and Females. *Public Health Reports,* United States Public Health Service, July 29, 1927, 42, No. 30, pp. 1939-1957.

[3] Collins, Selwyn D.: Cases and Days of Illness Among Males and Females With Special Reference to Confinement to Bed. *Public Health Reports,* United States Public Health Service, January 12, 1940, 55, No. 2, pp. 47-93.

[4] *Op. cit.*

[5] Collins, Selwyn D.: Frequency and Volume of Doctors' Calls Among Males and Females in 9,000 Families Based on Nation-Wide Periodic Canvasses, 1928-31. *Public Health Reports,* United States Public Health Service, November 1, 1940, 55, No. 44, pp. 1977-2020.

1,000 population than males, the higher rate of calls for females was a reflection of the higher incidence of illness. Very little difference was noted between calls per attended case for each sex. Apparently, females did not have a greater amount of medical care in relation to illness than males.

In view of the findings reported above, it is of interest to analyze in some detail the data from a special study of morbidity now being conducted among a sample of white families in the Eastern Health District of Baltimore. This paper presents a further study of some of the implications of the sex difference in morbidity with special reference to severity of illness. Is the sex difference in incidence of illness among males and females accompanied by a difference in severity of illness? An excellent opportunity to study this question is presented in the records of illness collected from a relatively small population such as that which is being surveyed in the Eastern Health District of Baltimore.

When the special study was initiated, the Eastern Health District of Baltimore consisted of two city wards containing 11,896 white families or households, including 43,377 persons, and 3,413 colored households, including 13,784 persons.[6] As far as the white population is concerned, the district is considered fairly representative of the localities in the City in which the wage-earning population lives; that is, it contains some families in relatively poor economic circumstances, wage-earning families in moderate circumstances, relatively few families in the professional class, and no families that can be classed as wealthy. Consequently, the district cannot be considered as representative of Baltimore as a whole, but it is probably representative of the population which forms the majority in the City.

There are three hospitals within the Eastern Health District and

[6] A few months after the special study of illness was started, the Eastern Health District was enlarged so that it now includes a population of approximately 100,000. Any reference to the Eastern Health District in this paper, however, is to the former district composed of Wards 6 and 7.

two adjacent to it. Each of these hospitals has an outpatient department. Approximately 150 private physicians practice regularly within the district. However, during the first and second years' study, from 300 to 400 different private physicians served the observed population.

Data and Method of Study

The method of sampling in this particular study has been described in detail in a previous report.[7] It is sufficient here to say that the white families living in thirty-five city blocks scattered throughout the two wards formed the sample population. The plan of the study was to follow families that live 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 that 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. Monthly visiting was employed in this study in order to secure accuracy in the reporting of illness. The record of illness started with the first visit to the family; no attempt was made to secure a report of illnesses which had occurred during a period preceding the first visit except illness existing on the day of the visit.

In the studies of illness conducted by periodic canvasses of families, "illness" may be considered to include any affection or disturbance of health which persists for a considerable part of one or more days. In this study, as in other family surveys, no specific definition of illness was formulated. The records of "illness" are of sicknesses reported by the household informant (usually the housewife), either as experienced by herself or as she observed them in her family.[8] Physical defects or deformities, even though disabling, were excluded from this analysis.

[7] Downes, Jean and Collins, Selwyn D.: A Study of Illness Among Families in the Eastern Health District of Baltimore. The Milbank Memorial Fund *Quarterly*, January, 1940, xviii, No. 1, pp. 5-26.

[8] The causes of illness as reported by the family informants were submitted to the

(Continued on page 224)

Studies of illness conducted by periodic canvasses of families afford two expressions of morbidity rates, namely, prevalence and incidence. By prevalence is meant the ratio of persons ill at a given time to the total persons in the population at that time. Incidence of illness expresses the rate of occurrence of illness in a population observed over a period of time. Since prevalence of illness is composed chiefly of cases of chronic illness and incidence is greatly weighted by acute (short duration) illnesses, data of prevalence and incidence are discussed separately. The section based on prevalence data will deal largely with observations secured by following chronic conditions present among members of 1,757 white families at the time of the first visit. The section based on incidence will deal with observations made on illnesses arising in the population during the twelve-month period ending June, 1940. No family observed less than two months has been included.

Severity of illness, both chronic and acute illnesses, may be described in various ways: (1) according to degree of disability; (2) if disabling, the duration of disability; and (3) the amount of medical care. It is of interest to examine sex differences with respect to these categories.

It has been shown in a previous report[9] that the sample population in the morbidity study was found to be representative of the white population of the district from which it was drawn with respect to age and size of household.

In this report the analysis has been based on illnesses for all ages. The age distribution of the population for males and females is shown in Table 1. It is evident that no important differences existed between the age composition of the male population and that of the female. Consequently, it has not been considered necessary to make

attending physician for confirmation or correction. The causes of illness for clinic attendance and hospital admission were checked against the records of the clinic or hospital where the service was given.

[9] Downes, Jean: Illness in the Chronic Disease Family. *American Journal of Public Health*, June, 1942, 32, No. 6, pp. 589-600.

Age Groups	Years of Life			
	Male	Female	Male	Female
	Per Cent		Number	
All Ages	100.0	100.0	2,713	2,770
0- 4	7.4	7.2	199	200
5-19	26.0	24.9	705	687
20-39	34.4	34.3	932	948
40-59	24.4	24.5	659	677
60+	7.8	9.1	211	251
Unknown Age			7	7

Table 1. Sex and age distribution of sample population observed during twelve consecutive months in the Eastern Health District of Baltimore, 1939-1940.

any adjustment for differences in age in making comparisons between rates for males and females.

Prevalence of Illness

In this study, prevalence indicates the number of persons for whom an illness was reported on the first visit to the family during the year ending June, 1940.

Table 2 shows the prevalence of illness for each sex, classified

Table 2. Prevalence of illness, by sex, in the Eastern Health District of Baltimore, 1939-1940.[1]

Classification of Illness	Ratio per 1,000		Ratio of Prevalence for Females to That for Males
	Males (3,314)	Females (3,336)	
Total Cases	142.7	231.7	1.62
Acute Illness	44.3	69.8	1.58
Chronic Illness[2]	98.4	161.9	1.65
Major Chronic	52.5	92.3	1.76
Minor Chronic	45.9	69.6	1.52
Institutional Illness	0.4	0.3	0.75

[1] Prevalence of illness as of the first visit to the family, 1939–1940. The population includes 1,757 white families observed two months or longer.

[2] Illnesses included in the classes, "major" and "minor," are enumerated on page 226 of the text.

according to acute and chronic and institutional illness. Chronic illnesses are subdivided into those which are here termed as "major" and as "minor" illnesses. The group designated as "major" includes: *Mental Disease* or *Mental Deficiency, Neurasthenia* or *Nervous Breakdown, Heart Disease, Hypertension* or *High Blood Pressure, Arthritis, Diabetes, Varicose Veins, Gall-Bladder Disease, Ulcer of the Stomach or Duodenum, Chronic Nephritis, Cancer, Rheumatic Disease, Tuberculosis, Syphilis, Anemia,* and chronic illness as a result of *Accidents.* "Minor" chronic illness, the second group, includes: *Neuralgia, Neuritis, Lumbago, Hemorrhoids, Hernia, Chronic Indigestion, Chronic Cold and Cough, Chronic Bronchitis, Sinusitis, Asthma,* chronic *Skin Conditions, Backache,* and other ill-defined complaints which were reported as chronic conditions.

Other studies have shown that chronic illness constitutes the majority of illnesses prevailing in the population at a given time. In this study approximately 70 per cent of the illnesses reported on the first visit to the family were chronic conditions or complaints. This proportion was true of both males and females. However, the rate of prevalence was considerably higher for females than for males, with

Table 3. Distribution of cases of chronic illness[1] by degree of disability and by sex in the Eastern Health District of Baltimore, 1939-1940.[2]

Classification of Illness	Per Cent		Number of Cases	
	Male	Female	Male	Female
Cases of Major Chronic Illness[3]	100.0	100.0	174	308
Nondisabling	61.0	69.2	106	213
Disabling but not Confined to Bed	24.1	18.5	42	57
Confined to Bed	14.9	12.3	26	38
Cases of Minor Chronic Illness[3]	100.0	100.0	152	232
Nondisabling	85.6	89.2	130	207
Disabling but not Confined to Bed	11.8	4.3	18	10
Confined to Bed	2.6	6.5	4	15

[1] Chronic illness present at the first visit to the family.
[2] The population includes 1,757 white families observed two months or longer.
[3] Illnesses included in the classes, "major" and "minor," are enumerated above in the text.

excesses of 52 to 76 per cent in the various classes of illness. Institutional illness, which included a small number of cases, was less frequent among females than among males.

Disability. Cases were grouped according to the following classifications: nondisabling; disabling at some time during observation, but not confined to bed; cases confined to bed for one or more days. A disabling illness was defined as one which caused loss of one or more days from work, school, or other usual activities during the period of observation.

The distribution of "major" and "minor" chronic illnesses by degree of disability is shown for each sex in Table 3. In the group of "major" chronic illnesses the proportion of cases which had some disability was higher among males than among females. This was true for both degrees of disability, (1) confined to bed and (2) disabling but not confined to bed. The same relationship between the sexes was noted for "minor" chronic illnesses, with one exception: the proportion classed as confined to bed was higher for females than for males. These differences between the sexes may be due in part to more complete reporting of nondisabling chronic conditions for females than for males, rather than to any true sex difference in disabling illness.

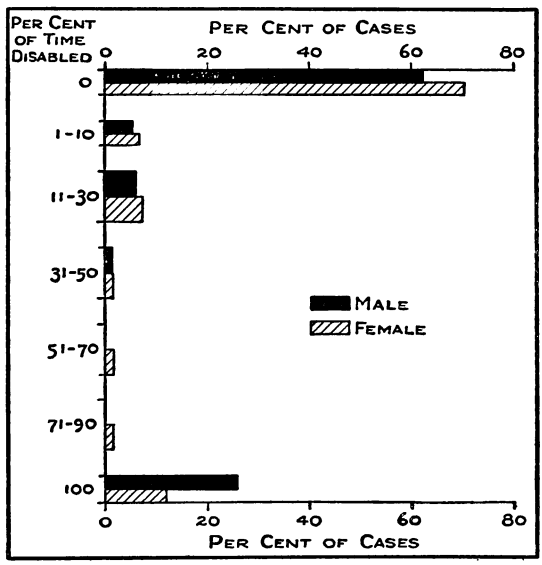

Fig. 1. Distribution of cases of "major" chronic illnesses according to the percentage of total days (duration of the case) that were disabled days.

Duration of disability for chronic illnesses may be expressed as a

frequency distribution of cases showing the proportion of the total time observed that the case was disabled because of the chronic illness itself. Figure 1 presents the data for "major" chronic illnesses for each sex. It is apparent that a large proportion of these illnesses caused no disability during the period of observation; 63 per cent of male cases and 70 per cent of female cases were in this class. There is a marked difference between the sexes when cases disabled throughout the period of observation are considered. Only 12 per cent of the female cases reported disability of such duration compared with 26 per cent of the male cases. Even though female cases which were disabled more than half of the time observed be added to this group, an excess of 50 per cent still remains in the number of male cases over female cases which were so severely disabled.

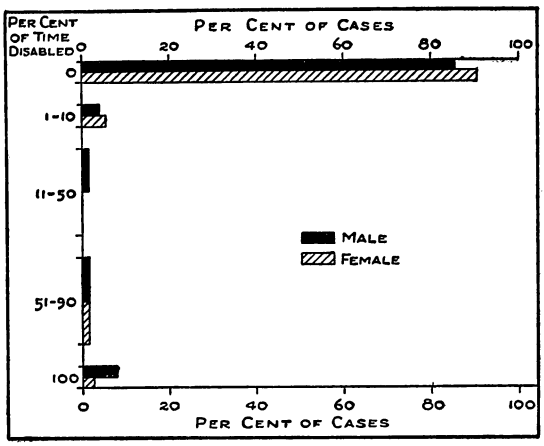

Fig. 2. Distribution of cases of "minor" chronic illnesses according to the percentage of total days (duration of the case) that were disabled days.

The chronic illnesses classed as "minor" caused less disability than did other chronic cases. Data for these "minor" cases are presented in Figure 2. In 86 per cent of the male cases and 91 per cent of the female cases the chronic condition caused no disability. Again the proportion of cases disabled throughout the period of observation was greater for males than for females.

Medical Care. Another index of severity is medical care in relation to illness. Table 4 shows the proportion of chronic illnesses which received medical care, private physician or clinic care. There was relatively little difference between the sexes; when "major"

Classification of Illness	Male	Female
Cases of Major Chronic Illness[2]		
Total Cases	174	308
Number Receiving Medical Care	86	138
Per Cent Receiving Medical Care	49.4	44.8
Cases of Minor Chronic Illness[2]		
Total Cases	152	232
Number Receiving Medical Care	37	66
Per Cent Receiving Medical Care	24.3	28.4

[1] The population includes 1,757 white families observed two months or longer.
[2] Illnesses included in the classes, "major" and "minor," are enumerated on page 226 of the text.

Table 4. Per cent of chronic illnesses which received medical care at some time during the study year by sex in the Eastern Health District of Baltimore, 1939-1940.[1]

chronic cases are considered, a slightly higher proportion of male cases had medical care; the reverse was true for "minor" cases of chronic illness.

When amount of care per attended case is considered, as shown in Table 5, females with a "major" chronic illness had considerably less care than did male cases in the same category. There was no difference in amount of medical care between the sexes for cases of chronic illnesses classified as "minor."

It may be concluded that both "major" and "minor" chronic illnesses were present in a considerably greater number of females than males in the population studied. On the whole, however, the

Table 5. Doctors' calls and clinic visits per attended case of chronic illness among males and females in the Eastern Health District of Baltimore, 1939-1940.[1]

Classification of Cases of Illness	Males	Females	Ratio of the Average for Females to That for Males
Total Cases of Illness[2]	9.1	6.8	0.74
Major Chronic	9.8	6.5	0.66
Minor Chronic	7.4	7.5	1.01

[1] The population includes 1,757 white families observed two months or longer.
[2] Illnesses included in the classes, "major" and "minor," are enumerated on page 226 of the text.

chronic illnesses reported for males were considerably more severe than those reported for females.

Incidence of Illness

Incidence in this report of morbidity expresses the rate at which attacks of illness occurred in the observed population over a period of twelve consecutive months and does not include illnesses present at the time of the first visit to the family. Acute attacks of chronic illness which occurred during the year of study are included. The attacks of illness have been classed into two broad diagnosis groups, respiratory and nonrespiratory. In order to insure a fair degree of comparability in the data for both sexes, female genital and puerperal diagnoses have been excluded from all tables, except appendix tables which are shown at the end of the report. The number of cases of male genital diseases was so small as to be negligible; such cases have not been excluded.

Table 6. Incidence of illness by sex during twelve consecutive months in the Eastern Health District of Baltimore, 1939-1940.

Causes of Illness and Classification of Disability	Rate per 1,000 Population[1]		Ratio of Rate for Females to Rate for Males
	Male	Female	
All Causes[2]	1,105.0	1,593.9	1.44
Nondisabling	623.7	984.8	1.58
Disabling but not Confined to Bed	234.4	276.2	1.18
Confined to Bed	247.0	332.9	1.35
Respiratory Illness	669.7	915.2	1.37
Nondisabling	384.8	569.7	1.48
Disabling but not Confined to Bed	123.1	135.0	1.10
Confined to Bed	161.8	210.5	1.30
All Other Illness	435.3	678.7	1.56
Nondisabling	238.8	415.2	1.74
Disabling but not Confined to Bed	111.3	141.2	1.27
Confined to Bed	85.1	122.4	1.44

[1] The population includes 2,713 years of life for males and 2,770 years of life for females in 1,757 white families observed two months or longer.

[2] Excluding female genital and puerperal diagnoses. Excluding also cases of illness with onset prior to the study year.

Disability. The incidence from all causes of illness for females, excluding female genital and puerperal diagnoses, was 44 per cent higher than that for males; the rate for males per 1,000 population was 1,105 and that for females was 1,594. When these rates were further subdivided according to severity of the cases of illness, there were some interesting differences which are shown in Table 6. The rate for females exceeded that for males for each severity category, but the amount of the excess varied. The excess was greatest for nondisabling cases of illness; the rate for nondisabling illnesses for females was 58 per cent greater than that for males. For illnesses which were disabling but did not cause confinement to bed, the female rate was only 18 per cent greater than that for males. For bed illnesses, however, the female rate was 35 per cent greater than the male rate.

Since more than half the illnesses were classed as respiratory, and, therefore, the total rate might be unduly weighted by any characteristics of respiratory illnesses, the rates have been shown also in Table 6 for respiratory illnesses and nonrespiratory illnesses. It can be seen that the excess of illness for females over that for males followed the same pattern for each group of causes; the incidence of illness was higher among females than among males for each severity category, and the excess was greatest for nondisabling cases of illness, second for bed cases, and least for disabling cases not confined to bed. It is evident that the females had a considerable excess of illness over the males and that, when disability was used as a criterion of severity, there was an excess both of severe and minor illnesses.

The proportions of cases of illness in each disability group are compared for each sex in Table 7. Of the total illnesses for males, the per cent accompanied by disability of one day or longer was 43.6 as compared with 38.2 for females. When the cases of illness were classified according to respiratory and nonrespiratory illness, the proportions in each disability group were very similar to those for all causes of illness. Although the females had a higher level of illness and also of bed illness, the proportion of illnesses graded accord-

ing to disability as severe was greater for males than for females.

The larger proportion of disabling illness among males as compared with females may have resulted in part from an underreporting of nondisabling illnesses among males. The excess of nondisabling illness among females suggests that there may have been a more complete reporting of minor illnesses for females than for males. It was found in the Hagerstown study[10] that females who reported their own illnesses had higher sickness rates than females who were not informants. However, it was also found that females who were not informants still had considerably higher sickness rates than males. In this study, as in the Hagerstown study, the housewife was usually the informant. Undoubtedly, some part of the excess in the nondisabling illnesses for females may have resulted from the fact that they reported their own illnesses more

Table 7. Distribution of cases of illness by degree of disability and by sex in the Eastern Health District of Baltimore, 1939-1940.[1]

Causes of Illness and Classification of Disability	Cases of Illness			
	Male	Female	Male	Female
	Per Cent		Number	
All Causes[2]	100.0	100.0	2,998	4,415
Nondisabling	56.4	61.8	1,692	2,728
Disabling but not Confined to Bed	21.2	17.3	636	765
Confined to Bed	22.4	20.9	670	922
Respiratory Illness	100.0	100.0	1,817	2,535
Nondisabling	57.4	62.2	1,044	1,578
Disabling but not Confined to Bed	18.4	14.8	334	374
Confined to Bed	24.2	23.0	439	583
All Other Illness	100.0	100.0	1,181	1,880
Nondisabling	54.9	61.2	648	1,150
Disabling but not Confined to Bed	25.6	20.8	302	391
Confined to Bed	19.5	18.0	231	339

[1] Based on 1,757 white families observed two months or longer during a period of twelve consecutive months.

[2] Excluding female genital and puerperal diagnoses. Excluding also cases of illness with onset prior to the study year.

[10] *Op. cit.*, footnote 2.

completely than those of males. However, it seems probable that the reporting of serious illness, especially cases resulting in confinement to bed, would be fairly similar for both sexes, regardless of the sex of the informant. The greater proportion of disabling illness for males than for females may result in part from an underreporting of minor illnesses, but it may also be indicative of greater severity of illness among males. In any case, no greater severity of illness among females as compared with males was evidenced.

Duration. In this study, another measure of severity which has been used is duration of illness. Table 8 shows the average duration of illness, disability, confinement to bed and to hospital for males and females according to each classification of disability. For nondisabling illnesses the average duration of each case was 21 days for males as compared with 23 days for females. For disabling illnesses not confined to bed, the average duration of illness for males was 24 days and that for females was 19 days. Of the total sick days for cases

Table 8. Average duration of sickness, disability, confinement to bed and to hospital for all causes[1] of illness by sex in the Eastern Health District of Baltimore, 1939-1940.[2]

Classification of Disability and Sick Days	Male	Female	Ratio of Average for Females to Average for Males
Nondisabling Illness			
Sick Days per Case	20.7	22.7	1.10
Disabling but not Confined to Bed			
Sick Days per Case	23.7	19.2	.81
Disabled Days per Case	12.9	9.1	.71
Confined to Bed			
Sick Days per Case	25.3	27.2	1.08
Disabled Days per Case	15.6	14.6	.94
Bed Days per Case	8.3	7.9	.95
Hospital Days per Hospital Case	12.2	15.6	1.28

[1] Excluding female genital and puerperal diagnoses. Excluding also cases of chronic illness with onset prior to the study year, but including sick days for all other illnesses with onset prior to the study year.

[2] Based on 1,757 white families observed two months or longer during a period of twelve consecutive months.

in this category, on the average there were 13 disabled days for males and 9 for females. The durations for bed cases were similar for males and females. There was an average of 25 sick days per bed case for males and 27 days for females. Each bed case incurred an average of 16 and 15 days' disability for males and females, respectively. The number of bed days per bed case was 8 for each sex. The average duration of hospitalization for each hospital case was 12 days for males and 16 days for females. The difference in the durations of illness for cases disabled but not confined to bed and especially the difference in the average duration of disability seem to indicate that the males may have suffered illness of greater severity than the females.

Medical Care. Severity of illness can be measured also by the medical care received, namely, by whether or not a doctor attended an illness, and if so, by the number of visits made. Table 9 shows for

Table 9. Per cent of illnesses receiving medical care by sex during twelve consecutive months in the Eastern Health District of Baltimore, 1939-1940.[1]

Causes of Illness and Classification of Disability	Per Cent of Illnesses Receiving Medical care	
	Male	Female
All Causes[2]	38.5	32.0
Nondisabling	22.3	18.7
Disabling but not Confined to Bed	48.1	39.7
Confined to Bed	70.3	65.0
Respiratory Illness	30.0	27.2
Nondisabling	12.1	12.1
Disabling but not Confined to Bed	40.1	36.1
Confined to Bed	64.9	62.3
All Other Illness	51.5	38.5
Nondisabling	38.7	27.7
Disabling but not Confined to Bed	57.0	43.2
Confined to Bed	80.4	69.6

[1] Based on 1,757 white families observed two months or longer.
[2] Excluding female genital and puerperal diagnoses. Excluding also cases of illness with onset prior to the study year.

males and females the proportion of illnesses which received medical care. The percentage of illnesses which received medical care among females was somewhat lower than that among males for each class of disability for all illnesses, whether respiratory or nonrespiratory, with the exception of nondisabling respiratory illnesses where the percentages were the same for both sexes. The difference between males and females in the proportion of illnesses receiving medical care was not large enough to be important for respiratory illnesses, but for nonrespiratory illnesses, the proportion among females which received medical care was 25 per cent less than among males.

When degree of disability is considered, the proportions receiving medical care followed the same general pattern for each sex, the highest percentage occurring for bed cases, the next highest for cases disabled but not confined to bed, and the lowest for nondis-

Table 10. Doctors' calls per case attended by a doctor by sex during twelve consecutive months, Eastern Health District of Baltimore, 1939-1940.[1]

Causes of Illness and Classification of Disability	Doctors' Calls per Case Attended		Ratio of Average for Females to Average for Males
	Male	Female	
All Causes[2]	3.4	3.0	0.88
Nondisabling	2.6	2.3	0.88
Disabling but not Confined to Bed	3.6	2.7	0.75
Confined to Bed	4.0	3.8	0.95
Respiratory Illness	2.9	2.5	0.86
Nondisabling	1.9	1.9	1.00
Disabling but not Confined to Bed	2.5	1.7	0.68
Confined to Bed	3.6	3.0	0.83
All Other Illness	3.9	3.6	0.92
Nondisabling	3.0	2.5	0.83
Disabling but not Confined to Bed	4.5	3.7	0.82
Confined to Bed	4.7	5.0	1.06

[1] Based on 1,757 white families observed two months or longer.
[2] Excluding female genital and puerperal diagnoses. Excluding also cases of chronic illness with onset prior to the study year, but including all other illness with onset prior to the study year.

abling cases. The fact that a greater proportion of nondisabling illnesses among males received medical care than among females might be the result of an underreporting for males of minor illnesses which would not be likely to receive medical care. However, the greater proportion of disabling illness which received medical care among males as compared with females seemed to indicate a slightly greater severity of illness for males over females.

When the volume of medical care was considered in relation to the number of attended cases, Table 10, the males appeared to have a slight excess also in the average number of calls made to each case attended. The difference between the number of calls per attended case for males and females was not relatively large, but the difference was present for each classification of disability for all causes of illness. The average number of calls per attended case was higher for males than for females for respiratory and nonrespiratory ill-

Table 11. Clinic visits per clinic case by sex during twelve consecutive months in the Eastern Health District of Baltimore, 1939-1940.[1]

Causes of Illness and Classification of Disability	Clinic Visits per Clinic Case		Ratio of Average for Females to Average for Males
	Male	Female	
All Causes[2]	3.5	3.7	1.06
Nondisabling	3.4	4.0	1.18
Disabling but not Confined to Bed	3.9	4.0	1.03
Confined to Bed	3.4	3.2	0.94
Respiratory Illness	2.9	3.4	1.17
Nondisabling	2.1	5.7	2.71
Disabling but not Confined to Bed	3.9	1.7	0.44
Confined to Bed	2.6	2.1	0.81
All Other Illness	3.8	3.8	1.00
Nondisabling	3.7	3.4	0.92
Disabling but not Confined to Bed	3.8	4.4	1.16
Confined to Bed	4.0	4.0	1.00

[1] Based on 1,757 white families observed two months or longer.
[2] Excluding female genital and puerperal diagnoses. Excluding also cases of chronic illness with onset prior to the study year, but including all other illness with onset prior to the study year.

nesses with the exception of nondisabling respiratory cases, where there was no difference between the sexes, and nonrespiratory bed cases where the difference was relatively small. The calls per attended case were highest for both sexes for cases confined to bed. The excess of calls per attended case for males as compared with females might have resulted partly from visits of males to company doctors for nondisabling illness while at work, but for disabling illness, the excess seemed to indicate a greater severity of illness among males than among females.

When clinic visits per clinic case were compared for males and females in Table 11, there was relatively little difference between the sexes for all illnesses. The females had a somewhat higher number of clinic visits per clinic case for nondisabling illnesses. For bed illness, the males had a slightly higher average number of clinic visits for each clinic case. The number of cases of respiratory illnesses attending clinics was 80 for males and 83 for females so that considerable fluctuation in the averages according to degree of disability may have resulted from the small numbers. Very little difference between the sexes was noted in the average number of clinic visits per clinic case for nonrespiratory illnesses.

Volume of Medical Care

Another expression of the amount of medical care is the rate of doctors' calls and clinic visits per 1,000 population. The rates for each sex shown in Table 12 are based on all doctors' calls and clinic visits made throughout the year on account of illness and regardless of the date of onset of the illness. Medical care received for reasons other than illness, such as well-baby care, was not included in this report. The majority of the medical care calls were doctors' calls. Clinic visits formed 33 per cent of the total visits for males and 28 per cent for females. The rate of medical care calls per 1,000 persons was 1,968 for males, 2,220 for females, excluding genital and puerperal diagnoses, and 2,454 for females including care for genital and

puerperal diagnoses. It is interesting to note the similarity between these rates and those observed in the study of illness by the Committee on the Costs of Medical Care and the United States Public Health Service. Collins[11] reported a rate of 2,225 per 1,000 males, 2,474 per 1,000 females, and 3,054 per 1,000 females when care for genital and puerperal diagnoses was included.

The hospitalization rates for males and females are compared in Table 13. When the hospital admissions for female genital and

Table 12. Rate of doctors' calls and clinic visits for all cases of illnesses by sex in the Eastern Health District of Baltimore, 1939-1940.[1]

Medical Care and Classification of Disability	Rate per 1,000 Population[2]			Ratio of Rate for Females to Rate for Males	
	Male	Female (Excluding Genital and Puerperal Diagnoses)	Female (Including Genital and Puerperal Diagnoses)	Female (Excluding Genital and Puerperal Diagnoses)	Female (Including Genital and Puerperal Diagnoses)
Doctors' Calls and Clinic Visits	1,967.9	2,219.5	2,454.2	1.13	1.25
Nondisabling	613.0	853.1	924.9	1.39	1.51
Disabling but not Confined to Bed	589.8	445.5	451.6	0.75	0.77
Confined to Bed	765.2	920.9	1,077.6	1.20	1.41
Doctors' Calls	1,322.2	1,602.9	1,805.1	1.21	1.37
Nondisabling	359.4	500.0	563.9	1.39	1.57
Disabling but not Confined to Bed	342.1	318.1	322.7	0.93	0.94
Confined to Bed	620.7	784.8	918.4	1.26	1.48
Clinic Visits	645.8	616.6	649.1	0.96	1.01
Nondisabling	253.6	353.1	361.0	1.39	1.42
Disabling but not Confined to Bed	247.7	127.4	128.9	0.51	0.52
Confined to Bed	144.5	136.1	159.2	0.94	1.10

[1] Includes all medical care given for illness during the study year.
[2] The population included 2,713 years of life for males and 2,770 years of life for females in 1,757 white families observed two months or longer during a period of twelve consecutive months.

[11] *Op. cit.*, footnote 5. The figures quoted exclude calls by nonmedical practitioners to agree with the Eastern Health District tabulation.

puerperal diagnoses are excluded, the female rate of 51 was found to be 25 per cent less than the male rate of 67 per 1,000. The total rate for females for all causes was 76 per 1,000. The institutional rates were 4.8 per 1,000 males and 4.0 per 1,000 females; the rate for females was 17 per cent less than that for males. If hospitalization may be considered a criterion of severity, the males again appear to have suffered more serious illness than the females. It should be pointed out, however, that hospitalization may not be an indication of the severity of illness so much as of the nature of the illness and of the treatment required; for example, a tonsillectomy with no complications may be hospitalized regardless of severity while, on the other hand, a relatively severe heart case may not be hospitalized because of an expected long duration and because of the type of

Table 13. Rate of hospitalization by sex during twelve consecutive months in the Eastern Health District of Baltimore, 1939-1940.[1]

Classification of Hospital Cases	Male	Female	Ratio of Rate for Females to Rate for Males
	Rate per 1,000 Years of Life		
Hospitalized Illness[2]			
Excluding Female Genital and Puerperal Diagnoses	67.1	50.5	0.75
Including Female Genital and Puerperal Diagnoses	67.1	75.8	1.13
Institutionalized Illness[3]	4.8	4.0	0.83
	Number		
Years of Life	2,713	2,770	
Number of Hospital Admissions Excluding Female Genital and Puerperal Diagnoses	182	140	
Number of Hospital Admissions Including Female Genital and Puerperal Diagnoses	182	210	
Number of Institutional Cases[3]	13	11	

[1] Based on 1,757 white families observed two months or longer.
[2] Includes all cases of illness which had hospital care hospitalized at any time during the study year.
[3] Included also in "Hospitalized Illness."

treatment involved. In view of the evidence already noted indicating greater severity of illness among males than among females, it is interesting that the rate of hospitalization for males exceeded that for females.

Summary

The findings of the study may be briefly summarized as follows:

(1) The prevalence of illness was 62 per cent higher for females than for males.

(2) Chronic illness formed approximately 70 per cent of the total cases of illness present at any given time for both males and females.

(3) The proportion of cases of chronic illness which caused disability was higher among males than among females, and the proportion disabled throughout the period of observation was considerably greater among males than among females.

(4) There was no difference in the amount of medical care for "minor" chronic illnesses, but for "major" chronic illnesses attended cases among males received on the average 50 per cent more care per case than did female cases.

(5) The incidence of illness during the study year was 44 per cent higher for females than for males. The excess was greatest for nondisabling illness but was relatively high for bed illness.

(6) The proportion of attacks of illness which caused disability was greater for males than for females.

(7) The average duration of attacks of illness was similar for bed cases and for nondisabling cases for both sexes, but for cases disabled but not confined to bed, males had an excess over females both in total sick days and disabled days per case.

(8) A somewhat higher proportion of attacks of illness among males received medical care than among females, and the attended male cases received on the average more doctors' calls than did the females.

(9) Medical care expressed in relation to the total population indicated that there were 1.9 visits per male and 2.4 per female per year. Two-thirds of the total medical services were doctors' calls; clinic visits formed slightly less than one-third of the visits for both sexes.

(10) The hospitalization rate for males was considerably in excess of the rate for females when genital and puerperal diagnoses were excluded.

Acknowledgments are made:

To the Johns Hopkins School of Hygiene and Public Health, especially to the Departments of Epidemiology, Biostatistics, and Public Health Administration, for generous assistance and cooperation which have greatly facilitated the carrying on of the study of illness in the Eastern Health District of Baltimore.

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Appendix tables will be found on pages 242-244.

Appendix Table 1. Rate of al . the
Eastern Health District of Baltimore, 1939-1940.[1]

Classification of Disability	Rate per 1,000 Population[2]			Ratio of Rate for Females to Rate for Males	
	Male	Female (Excluding Genital and Puerperal Diagnoses)	Female (Including Genital and Puerperal Diagnoses)	Female (Excluding Genital and Puerperal Diagnoses)	Female (Including Genital and Puerperal Diagnoses)
All Causes	1,279.8	1,845.5	1,945.1	1.44	1.52
Nondisabling	753.8	1,189.5	1,228.9	1.58	1.63
Disabling but not Confined to Bed	262.8	303.6	313.4	1.16	1.19
Confined to Bed	263.2	352.3	402.9	1.34	1.53
	Number				
All Causes	3,472	5,112	5,388		
Nondisabling	2,045	3,295	3,404		
Disabling but not Confined to Bed	713	841	868		
Confined to Bed	714	976	1,116		

[1] All illness includes both prevalence and incidence during the year's observation.
[2] The population included 2,713 years of life for males and 2,770 years of life for females in 1,757 white families observed two months or longer during a period of twelve consecutive months.

Appendix Table 2. Number of days of sickness, disability, confinement to bed and to hospital, and number of illnesses (all causes[1]) by sex in the Eastern Health District of Baltimore, 1939-1940.[2]

Classification of Sick Days and Cases of Illness According to Degree of Disability	Male	Female (Excluding Genital and Puerperal Diagnoses)	Female (Including Genital and Puerperal Diagnoses)
Nondisabling			
Number of Sick Days	36,963	65,243	71,001
Number of Cases	1,785	2,874	2,938
Disabling but not Confined to Bed			
Number of Sick Days	15,805	15,304	15,818
Number of Disabled Days	8,586	7,292	7,398
Number of Cases	667	798	822
Confined to Bed			
Number of Sick Days	17,360	25,751	30,347
Number of Disabled Days	10,677	13,813	16,304
Number of Bed Days	5,702	7,518	8,828
Number of Cases	685	946	1,084
Hospital			
Number of Hospital Days	1,948	1,909	2,695
Number of Hospital Cases	160	122	191

[1] Excluding chronic cases of illness which had onset prior to the study year.
[2] Based on 1,757 white families observed two months or longer during a period of twelve consecutive months.

and number of male and female cases attended by a doctor during twelve consecutive months in the Eastern Health District of Baltimore, 1939-1940.[1]

Causes of Illness and Classification of Disability	Doctors' Calls			Attended Cases		
	Male	Female (Excluding Genital and Puerperal Diagnoses)	Female (Including Genital and Puerperal Diagnoses)	Male	Female (Excluding Genital and Puerperal Diagnoses)	Female (Including Genital and Puerperal Diagnoses)
All Causes[2]	3,201	3,755	4,279	940	1,237	1,347
Nondisabling	778	1,006	1,150	303	441	470
Disabling but not Confined to Bed	881	708	718	248	258	264
Confined to Bed	1,542	2,041	2,411	389	538	613
Respiratory Illness	1,399	1,550	1,550	479	627	627
Nondisabling	221	333	333	115	172	172
Disabling but not Confined to Bed	292	215	215	116	126	126
Confined to Bed	886	1,002	1,002	248	329	329
All Other Illness	1,802	2,205	2,729	461	610	720
Nondisabling	557	673	817	188	269	298
Disabling but not Confined to Bed	589	493	503	132	132	138
Confined to Bed	656	1,039	1,409	141	209	284

[1] Based on 1,757 white families observed two months or longer.
[2] Excluding cases of chronic illness with onset prior to the study year.

Appendix Table 4. Number of clinic visits and clinic cases by sex during twelve consecutive months in the Eastern Health District of Baltimore, 1939-1940.[1]

Causes of Illness and Classification of Disability	Clinic Visits			Clinic Cases		
	Male	Female (Excluding Genital and Puerperal Diagnoses)	Female (Including Genital and Puerperal Diagnoses)	Male	Female (Excluding Genital and Puerperal Diagnoses)	Female (Including Genital and Puerperal Diagnoses)
All Causes[2]	1,017	1,062	1,146	287	286	307
Nondisabling	375	485	505	111	122	131
Disabling but not Confined to Bed	374	293	297	97	74	76
Confined to Bed	268	284	344	79	90	100
Respiratory Illness	234	282	282	80	83	83
Nondisabling	42	182	182	20	32	32
Disabling but not Confined to Bed	106	22	22	27	13	13
Confined to Bed	86	78	78	33	38	38
All Other Illness	783	780	864	207	203	224
Nondisabling	333	303	323	91	90	99
Disabling but not Confined to Bed	268	271	275	70	61	63
Confined to Bed	182	206	266	46	52	62

[1] Based on 1,757 white families observed two months or longer.
[2] Excluding cases of chronic illness with onset prior to the study year.

Appendix Table 5. Number of doctors' calls and clinic visits of patients by sex with chronic conditions present at the time of the first visit to the family.[1]

Medical Care and Classification of Disability	Illnesses Present on the First Visit to the Family	
	Males	Females
Doctors' Calls and Clinic Visits	1,121	1,373
Nondisabling	510	907
Disabling but not Confined to Bed	345	236
Confined to Bed	266	230
Doctors' Calls	386	721
Nondisabling	197	412
Disabling but not Confined to Bed	47	176
Confined to Bed	142	133
Clinic Visits	735	652
Nondisabling	313	495
Disabling but not Confined to Bed	298	60
Confined to Bed	124	97

[1] The population includes 3,314 males and 3,336 females in 1,757 white families observed two months or longer during a period of twelve consecutive months.

Appendix Table 6. Number of doctors' calls and clinic visits for all causes of illness by sex in the Eastern Health District of Baltimore, 1939-1940.[1]

Medical Care and Classification of Disability	Male	Female (Excluding Genital and Puerperal Diagnoses)	Female (Including Genital and Puerperal Diagnoses)
Doctors' Calls and Clinic Visits[2]	5,339	6,148	6,798
Nondisabling	1,663	2,363	2,562
Disabling but not Confined to Bed	1,600	1,234	1,251
Confined to Bed	2,076	2,551	2,985
Doctors' Calls	3,587	4,440	5,000
Nondisabling	975	1,385	1,562
Disabling but not Confined to Bed	928	881	894
Confined to Bed	1,684	2,174	2,544
Clinic Visits	1,752	1,708	1,798
Nondisabling	688	978	1,000
Disabling but not Confined to Bed	672	353	357
Confined to Bed	392	377	441

[1] The population included 2,713 years of life for males and 2,770 years of life for females in 1,757 white families observed two months or longer during a period of twelve consecutive months.

[2] Includes all medical care given for illness during the study year.

A CONCEPT OF THE DEFICIENCY STATES[1,2]

H. D. KRUSE, M.D.

ALTHOUGH nation-wide dietary inadequacies have been revealed by surveys, the occurrence of deficiency diseases has not been generally noted except in city hospitals or endemic regions. Clinicians have asserted that they do not see deficiency diseases. This apparent discrepancy, despite much discussion, has remained baffling.

According to one explanation, many manifest cases are unrecognized. But even if these were detected, the figures on the prevalence of deficiency diseases would not match the data on the frequency of dietary inadequacies. Another explanation has been that deficiency diseases in an early or mild state are undetectable by ordinary clinical methods. This state was recognized in pellagra by Roussel who designated it incipient in preference to prodromal, latent, or larval (1). Recently it has been called subclinical.

This explanation raised two new questions. One was: By what means may deficiency diseases in this state be detected or recognized? Over the answer to this question there has been considerable division of opinion. The other was: What is the nature of deficiency diseases in this state? The views on this have been varied and vague. Yet it is a fundamental question, for its answer expresses a concept. Obviously, the prevalence of deficiency diseases that will be revealed depends on the methods of detection which are inseparably linked with the concept.

Study of the pathogenesis of deficiency diseases makes the existence of an early or mild state thoroughly understandable. A deficiency disease on a dietary basis develops in the following sequence: lowered concentration of the essential factor in the blood; depleted storage in the body's reservoirs; diminished excretion in

[1] From the Milbank Memorial Fund, New York.

[2] Presented at the Round Table on Nutrition, Twentieth Annual Conference of the Milbank Memorial Fund, May 7, 1942.

the urine; microscopic change in tissue; gross morphological and functional change. It is not to be inferred, however, that each step is completed before the next begins. The alteration in transport and storage and the microscopic change in tissue show that the disease does exist in a state which is undetectable by ordinary clinical methods. For most deficiency diseases these changes have been demonstrated by appropriate sensitive methods.

One line of evidence comes from biochemical methods in analyses of blood and urine. In avitaminosis C, for instance, low blood values for ascorbic acid have been found in a definite proportion of population samples (2, 3). True, some investigators have argued that such values for ascorbic acid in the absence of other signs do not constitute scurvy. Judged by clinical criteria, the condition is not scurvy. Not until it has advanced to macroscopic tissue changes and developed signs is it designated scurvy. But that view draws a purely arbitrary distinction. Its only justification is that it differentiates two states of severity in the process. One is the beginning or mild state; the other the fully-developed disease. But whatever the former is called, it is a step in the process. As a practical matter, it may call for therapy.

The other line of evidence on the existence of the early or mild state in deficiency diseases has been the demonstration of morphological changes. The early changes revealed by x-ray in scurvy have been described (4). Biomicroscopy has disclosed still more about the early and mild state of several deficiency diseases. Just as the microscope was highly useful to the pathologist in extending his range of vision to lesser changes in postmortem tissue, it has now proved highly informative to apply it in deficiency diseases to changes in living tissues. It is particularly revealing if the site showing very early changes is selected for observation. Kruse has found specific biomicroscopic changes for four deficiency diseases: avitaminosis A (5), ariboflavinosis (6, 7), aniacinosis (8), and avitaminosis C (9).

In this morphological study of these deficiency diseases, with biomicroscopic in conjunction with macroscopic examination, it was possible to see all gradations and to reconstruct the sequence of changes. These observations, combined with the results from administration of specific therapy, have clearly shown that the early or mild state has a deeper meaning than was previously recognized. While each of these four deficiency diseases was a separate and distinct entity and had its specific individuality in details, all showed a similarity in their general biological behavior. They seemed to reflect certain principles. Accordingly, they have formed the basis for a new concept of deficiency diseases, their evolution, the state in which they exist, how they may be recognized, and their response to specific therapy.

First, it should be stated, each avitaminosis shows a specificity and invariability of the particular tissue sites in which characteristic lesions appear. This point has been demonstrated over and over in animals and humans. For studying the evolution of each condition, a tissue site affected early and undergoing changes throughout the entire course yields most information. It is found that the pathological process manifests a definite sequence of changes in this tissue.

Whether developing or receding, a deficiency disease possesses certain properties. First, the pathological process in the tissue has velocity. In the beginning this is not a constant, but an increasing velocity, an acceleration. How rate behaves next cannot be definitely stated. Probably the process, having achieved its potential maximum velocity, moves ahead for a time with little change in it. Naturally, this rate would not be absolutely constant. These velocities are determined by the causal force[3] which in turn is a function of causal degree and rate. The causal force increases or decreases

[3] To many persons the term "deficiency disease" connotes a disorder arising solely from a deficiency in the diet. But a deficiency disease may occur without any inadequacy in the diet. True, dietary inadequacy is the most common cause; but there are many others.

(Continued on page 248)

according to these two factors. As counteracting forces go into action, the velocity of the process is slowed. Or with therapy, the pathological process undergoes deceleration, arrest, and reversal. But the maximum rate at which the curative force can act is governed by the rate at which the tissue process developed. The possible time schedules on which the process may evolve will be arbitrarily classified here into two main kinds, which are subdivided.

In the one, the pathological process in tissue is rapid in onset, in running its course, and in responding to therapy. For the process to have marked acceleration the immediate causal force must be considerable. Its magnitude depends on the degree and rate of the cause. For maximum effect this may be brought about by a sudden change from an optimum diet to one markedly deficient in an essential. Such a deficient diet, applied abruptly, causes the body to draw steadily on its reserves to compensate for deficit in intake. As the reserves increasingly fail to meet the demands, there is rapidly increasing deficiency in the body. Thus, there is increase in its intensity and its rate, an acceleration, which is reflected in its force. At the start, the tissue to be affected had a pathological rate of zero, or perhaps a negative value. Markedly increasing the force of the deficiency accelerates greatly and imparts a rapid velocity to the pathological process. It appears and progresses at a rapid rate. It

More properly, the term "deficiency disease" should connote a deficiency in the bodily tissues rather than in the diet. Indeed, its meaning should be even broader; it should include not only a deficiency but also any metabolic disturbance of the essential in the tissues. The causes of such a deficiency or disturbance are numerous and may be complex. They may be conveniently classified as external and internal. Dietary deficiency is the most common external cause. Any bodily condition interfering with digestion, transport or utilization, promoting destruction or excessive excretion, or raising the requirements of the dietary essential is an example of an internal cause. Almost every nonnutritional disease affects nutrition. A cause comes about through a combination of circumstances. For example, assuming a satisfactory internal mechanism, a deficiency disease may arise from insufficient intake relative to age, activity, exposure to light, storage, state of tissue, and probably other factors.

The innumerable chemical reactions and complex relationships in which the vitamins participate are just beginning to be appreciated. In full cognizance of their biological importance, it would nevertheless be inappropriate to attempt to bring into the present discussion these intermediate details. Rather, the broad aspects are sufficient for the present purpose, a consideration of the development of the deficiency states as manifested in tissue.

has characteristic manifestations reflecting this swift velocity. This is an acute process, an acute deficiency disease. With application of therapy in sufficient amount, the velocity changes similarly but in the reverse direction. The pathological process is decelerated and stopped; then the restorative process is accelerated. Pathological changes which have developed rapidly recede quickly. This acute process is rapid in development, progress, and recession.

There is another form in this acute category. Here the bodily deficiency occurs rapidly but becomes only slight or moderate in degree. Thus, it acquires a marked increase in rate but only slight intensity. This resultant is reflected in its force which is somewhat less than in the acute form. The pathological process is rapid but less rapid than in the acute form. It might be called subacute. Or, since it is mild in intensity, it might be designated mild acute.

The second main form of the process is slow in onset, progress, and response to therapy. Its development might be conceived as follows: For the process to have only slight acceleration the immediate causal force must be slight. This state may be brought about by a very slow change from an optimum to a moderately or markedly deficient diet. Such a deficient diet, applied very slowly, causes the body to draw very slowly on its reserves to compensate for the deficit in intake. As the reserves steadily fail to meet the demands, there is a slowly increasing deficiency in the body. Thus, there is an increase in its intensity, but at such a slow rate, over such a long period, that its force never becomes marked. Slightly increasing the force of the deficiency slowly accelerates and imparts only a slow velocity to the pathological process. It develops and advances at a slow rate. It has characteristic manifestations reflecting this slow velocity. This is a chronic process, a chronic deficiency disease. With application of therapy in sufficient amount and for a sufficient period, it gradually but completely recedes. The chronic form is slow in development, progress, and recession. The acute and chronic processes differ fundamentally in velocity.

Another form belongs in the chronic category. In this the bodily deficiency occurs very slowly and becomes only slight or moderate in degree. Its slight increase in rate and intensity is reflected in its force which is very slight and somewhat less than in the chronic form. The pathological process, more gradual than in the chronic form, is very slow. We have designated it mild chronic.

Time, a much neglected factor in malnutrition, operates in another way, namely duration. Here again the acute and chronic processes differ. Just as the acute process is rapid in rate, it is relatively short in duration. A few weeks out of a lifetime is almost infinitesimal. In these instances, time is almost zero. If uninterrupted, the acute process runs through a definite sequence of manifestations in a rather short time. It may, therefore, be divided into stages. Naturally, it may be interrupted at any stage and reversed to normal if the therapy is complete.

The chronic process, if uninterrupted, will run at its slow rate for a long period, in fact probably for life. During this time it progresses in a definite sequence. Therefore, it too may be divided into stages. In the past it may have been thought that a slight dietary deficiency prevailing even for years produced no tissue change. On the contrary, with persistence of a slightly deficient diet over years, the chronic process progresses with mild intensity in a definite course. This chronic process may be interrupted at any stage by therapy; but only adequate dosage and time bring complete reversal.

Besides its rate and duration, the pathological process also has intensity. The intensity of the cause leads to a corresponding intensity of the lesion. Just as there may be all degrees of intensity in causation—for example, all degrees of a deficiency in the diet—so there are all degrees of resulting lesions. Actually, the number of degrees which would be expressed would depend on the units and scale arbitrarily adopted. For present purposes, it is sufficient to divide the gradient levels into two groups: (1) severe, which is suf-

ficiently marked to produce gross lesions, from the just perceptible to the most pronounced; (2) mild, which is of so low intensity as to produce changes perceptible only by microscopy.[4] These two categories, mild and severe, it will be noted, refer to actual tissue change, not to symptoms. They apply to both the acute and chronic processes.

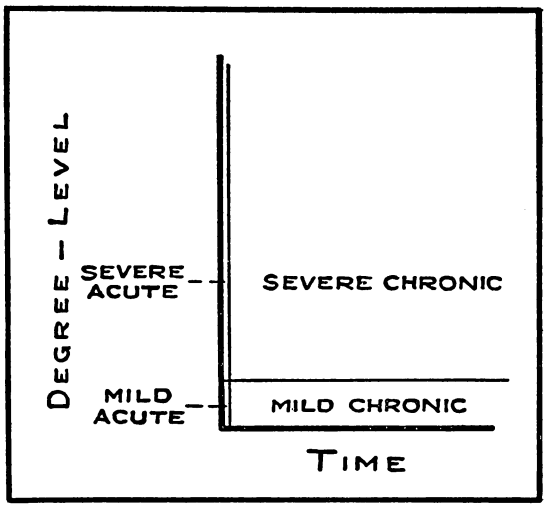

Fig. 1. States of a deficiency disease according to form, intensity, and stage. Divisions representing stages have not been indicated. From this chart the action of degree, rate, and duration of the cause in determining the tissue state may be visualized.

In considering the deficiency diseases in relation to intensity and time, it is evident that the acute and chronic states may be either mild or severe. Therefore, the simplest classification provides the categories: mild acute, mild chronic, severe acute, and severe chronic, with each divided into stages. The action of intensity, rate, and duration in determining the tissue state may be visualized from Figure 1. Divisions representing stages have not been indicated. Under this classification such a term as latent or subclinical state is no longer necessary. It is seen to be a broad state comprising the mild acute and mild chronic conditions. It is preferable to use the more specific designation corresponding to the actual condition.

Thus far we have presented the evolution and recession of the acute and chronic states in their simplest course: as if they arose in normal tissue and with therapy their cure was always complete.

[4] Actually, our system of rating now in use provides for four degrees of intensity for each stage in both the chronic and acute process.

But actually, in life, events are somewhat more complex. In the acute form there are several eventualities. It may run its acute course. With an untreated severe process, the patient either succumbs, or becomes inactive and has a poor appetite, both being protective mechanisms. In the latter event the process then advances at a slower rate. Or this first acute episode may be relieved by improvement in diet. But complete recovery, based on tissue restoration rather than symptomatic relief, would at best be slow because of the limited potency of food. If therapy is terminated upon relief of distressing symptoms or disappearance of late signs, response would be rapid but recovery incomplete. It is clear that as a result of any of these procedures, cure of the acute process would not always be finished. The recession in intensity, stage, and rate would not be complete. Consequently, the process would be brought to a new state with subsequent developments depending on circumstances.

With lapse from an optimum to a moderately deficient diet before recession was complete, the pathological process would resume at a slow rate. With a good diet following incomplete therapy, the process would remain stationary; with a slightly or moderately deficient diet, the pathological process would renew its advance at a slow rate. Also, an untreated mild acute process, running its course, would continue at a slower rate. As the result of any of these circumstances, the pathological lesion does not return to normal but persists on a lower level in the chronic state. Here it may be in equilibrium or progressing as a chronic process at a slow rate. In addition to arising from normal tissue, a chronic process may be seen to arise from an acute. Circumstances would again determine further developments.

By appropriate intervention this chronic process may be interrupted at any stage. But only by adequate therapy for sufficient time is its recession complete. In the event that a previously unsatisfactory diet is corrected, the chronic process becomes static or recedes very little and extremely slowly. Or with therapy for an in-

sufficient period, the process will recede incompletely. Thereafter, if the diet is slightly deficient, the slowly receding process may turn to a progressing chronic process. Or with a deficient diet and no therapy, the chronic process will continue its advance. Under these various unfavorable circumstances the chronic process, once contracted, may recede slightly, become stationary, or progress, depending on the diet.

The person with an arrested or chronic process may shift his diet from bad to worse and vice versa, but seldom to good. It is common knowledge that moderate or marked dietary deficiencies are apt to occur seasonally. They set up a mild or severe acute process, emerging usually in the spring. Other causes may act more infrequently but similarly from time to time. The arrested or chronic process constitutes a base on which this acute change is superimposed. To attain the same velocity, it takes less force to speed up an existing arrested or slowly moving process than to establish and then accelerate a process. Or, expressed in another way, a degree of dietary deficiency that would not produce an acute process in a well-nourished body would produce it in an already deficient body with a chronic process. Thus, an acute process may arise more easily from a chronic base. Under incomplete treatment the acute process disappears and leaves the chronic base, which may again undergo exacerbation. Repeated every year, this cycle is known as seasonal recurrence.

These do not represent all the possible changes in rate, stage, and intensity which a process may undergo. The diagram presenting the field suggests many more possible movements. The result is much more complex than was originally presented. But in sum, a mild or severe acute process in any stage may be seen on a mild or severe chronic form in any stage. These combined states add to the number of categories which must be borne in mind. It cannot be overemphasized that these combined states are very prevalent, perhaps the most prevalent.

The severe acute state is the form on which almost all clinical attention to deficiency diseases has hitherto been focused. Historically, this form, presenting a grave problem, was the first to be recognized; consequently, the recorded knowledge on the symptoms, signs, and pathology of this form predominate in the literature. Similarly, in experimental work, where the objective was to demonstrate the existence of new vitamins or to assay foods, animals were suddenly shifted from an optimum natural to a deficient "purified" diet in which every trace of an essential had been as far as possible removed. Naturally, the severe acute form of deficiency ensued.

In the past the mild and chronic states have received only sporadic and scant notice. By nature they have not been likely to attract attention. The mild are not conspicuous; indeed, they are below the level of unaided perception. Their associated symptoms, though often troublesome, are not so intense as to be unbearable or to necessitate medical consultation. Often the patient is unaware of symptoms until therapy has brought relief. The grossly perceptible chronic process comes on so gradually and insidiously as not for a long time to be obtrusive. Only in the advanced stages is it likely to draw complaint. Though noted often, little significance has been attached to it. Its relation to nutrition has been unrecognized.

Since the chronic state of deficiency diseases has not been commonly recognized, it is worth while to mention some of its characteristics. Its essence is time. For persons this is age. The longer persons live, the more chance they have to incur changes and to have them develop to an advanced state. Consequently, chronic changes are seen with greater frequency and in the latest stages with increasing age. This I have noted for avitaminosis A, ariboflavinosis, aniacinosis, and avitaminosis C.

In the past these chronic alterations have been called senile changes with the implication that senility causes them. But senility *per se* is not responsible for them. That has never been a satisfactory

explanation. Not all elderly persons show the changes. On the other hand, they occur in children. Time, not senility, is the essential point. And time does not start the changes, it simply is a dimension over which they progress. They are specific avitaminoses in a state of chronicity, due usually to respective dietary deficiencies running over a period of years. Their prevalence and severity vary with the number and degree of deficient diets and therefore with economic level. Most important of all, they are reversible, yielding slowly but completely to appropriate therapy.

This rate of response is another characteristic peculiar to chronic changes. Whereas acute changes respond with considerable promptness, chronic changes recede very slowly. In acute changes we are accustomed to expect improvement with dramatic rapidity. Actually, some of the rapidity is more apparent than real. For one thing, it is a relative matter; the more pronounced the acute, the more spectacular is a given degree of improvement. Often, removal of late signs constitutes supposedly rapid cure of an acute deficiency. Obviously, this is far from complete cure. But it is mainly because the relief of symptoms, the first event, is so prompt as to be striking. If judged solely by freedom from symptoms, the therapeutic response of acute is rapid. But when judged by complete restoration of all tissue changes, as seen by the biomicroscope, response in the acute condition is not quite so spectacularly quick as it is reputed. Nevertheless, response is very much more rapid in the acute than in the chronic state. The reason lies in the differential nature of their pathology. The tissue changes in the acute form of a deficiency disease are of a kind that appears rather rapidly and disappears just as readily. Those in the chronic form, with time allowing progression, are of a kind that progresses slowly and insidiously and recedes just as gradually.

Scattered observations in the literature on deficiency diseases are in accord with the concept presented here. The states are designated in terms identical with or similar to our nomenclature. In describ-

ing various forms of rickets, Eliot and Park mentioned: early mild, florid, and mild chronic (10). Their description of the course of these respective states may be interpreted in terms of intensity and time.

Furthermore, the literature records the characteristic difference between the acute and chronic forms in response to treatment. Eliot and Park remark that in one form of rickets the complete cure is slow (10). It has also been noted that in treatment of polyneuritis in animals, the acute fulminating type disappeared very speedily in a few days, the chronic type very slowly, in fact only after many months (11).

Even more significant has been the experimental production of scurvy in four states, depending on varying degrees of deficiency in vitamin C and the length of the experimental period (12). Tozer differentiated the chronic from the acute state on a time basis. She stated that the chronic form varies in severity according to the degree of deprivation of vitamin C. Indeed, using a different nomenclature to express intensity, she described mild and severe degrees for both the acute and chronic forms. Similar results have been reported on experimental vitamin B_1 deficiency (13, 14, 15).

Some broad generalizations can be drawn about these states in relation to factors affecting them. Like prevalence, the status of a deficiency disease is influenced by economic level, geographical region, and age, as well as by lesser environmental factors. Of these three it may be seen that the first two are indices of the number, nature, and degree of dietary deficiencies. Age is again the time factor. In the lower economic groups, deficiency diseases tend to be more numerous, more severe, and more advanced than in the higher economic groups. In geographical regions where a particular deficiency disease is endemic, the severe acute form is common; in other regions, it is rarely seen. If the disease is present in the latter, it is mostly in the chronic form. At younger ages, deficiency diseases are likely to be less prevalent and mostly in the mild acute or begin-

ning chronic state; at older ages they are apt to be more frequent and largely in the chronic form.

These influences are not invariable, absolute or completely decisive. Economic level and geographic region are far from perfect correlates of deficient diets; age does not initiate a deficiency disease. Nor are these influences of equal weight. Perhaps the most influential is economic level. But many persons in the higher economic groups do have severe deficiencies; while some in the lower miraculously escape. Only a small proportion of persons in an endemic region come down with an acute deficiency disease; almost all of these are in the low-income group. As for the influence of age, adults may be normal; whereas children, particularly if they are from low-income families, may exhibit a chronic process. We have seen numerous children from 8 to 11 years old with chronic changes similar to those most frequent in the middle-age group. But all these children were in the low economic group.

Obviously, the recorded prevalence of malnutrition depends on the concept, criteria, and means of recognizing it. In the recent past it has been judged by physical measurements or by presence of signs, including those of the acute severe type of deficiency disease. Neither method has revealed any considerable prevalence of malnutrition. It is very misleading to rely solely on them and to accept data only from them as evidence of malnutrition. Simple inspection is not sufficiently sensitive to detect very mild changes, whether acute or chronic. Most of the chronic changes, even when severe, have not been recognized as specific characteristics of deficiency diseases. These mild acute and mild or severe chronic conditions constitute the largest part of malnutrition.

As a means of appraising nutritional status, various new methods have been proposed for recognizing deficiency diseases. It is now plain that a method should detect and grade such a disease, whatever its state. The method should apply to both the acute and chronic forms, in all their stages and degrees. At once it should be stated

that the various new methods pertain to different aspects of a deficiency disease, yield dissimilar kinds of information, and are unequal in meeting the requisites.

For the appraisal of nutritional status, the biochemical determination of the concentration of a vitamin in the blood or urine, with or without a test dose, has very definite and narrow limitations beyond which it is misleading. In the evolution or recession of a deficiency disease, the blood and tissue changes are not synchronous. They are on different time schedules; they do not start simultaneously, nor do they proceed at the same rate. A shift in the blood value constitutes the first bodily change. The concentration of the vitamin in the blood changes much more rapidly than does the tissue process.

Values on the concentration of a vitamin in the blood reflect very sensitively the recent dietary habit (16) as well as other conditioning factors. They may change not only with season (17) but also within shorter periods; they may fluctuate. Hence, the blood values may temporarily be moderate or high without demonstrable improvement in an existing chronic tissue lesion (9). Indeed, there is much to indicate that sustained satisfactory blood levels resulting from conversion and adherence to a satisfactory diet are not accompanied by an appreciable recession in the tissue pathology.

Potent therapy will produce maximum blood levels and entirely restore bodily saturation in several weeks but will completely repair the slightest chronic tissue lesion only in months (9). Hence, the blood value may be high while the tissue pathology has yet shown little recession; the high blood level will be maintained over the many months while the tissue lesion is receding but is, of course, still abnormal.

In any of these events, the blood value would indicate a satisfactory nutritional status while the tissue would be pathological, a rather common occurrence. Manifestly, an assessment based on blood data alone would be erroneous.

It should be clear that there is no necessarily high correlation be-

tween data derived by different methods on the same deficiency disease. They provide information on different aspects and states of the disorder. Unfortunately, this fact has not been appreciated. Rather, it has been thought that various methods applied to the same deficiency disease should yield similar data. On this basis it has become the practice to test the validity of a method by comparing its results with blood values. This procedure is entirely unsound. When it is remembered that blood values shift rapidly and may fluctuate intermittently, while tissue changes very slowly, there should be no expectation of identical results.

The limitations of the blood methods for the evaluation of nutritional status cast no discredit. Used appropriately, they have their value. For following of dietary habits in the body, for secondary screening of persons without avitaminotic tissue changes, for specific metabolic studies, the blood technics are the methods of election.

The methods which embody gross and biomicroscopic examination of specific tissues for characteristic morphological changes—the eyes for avitaminosis A and ariboflavinosis, the gums for avitaminosis C, and the tongue for aniacinosis—meet most requirements for appraising nutritional status. Particularly, they permit both the acute and chronic forms in any stage and degree of tissue change to be detected. True, if the tissue is normal, it is possible that the blood values may be low. This situation, however, is the least frequent in the general population. Such a circumstance would be most frequently encountered in infants and preschool children. But tissue change is so prevalent over all age groups, and the biomicroscopic system as a primary screen is so sensitive in detecting its very early or mild form, that practically blood values as a secondary screen would add information in only a comparatively small number of instances.

Already the gross and biomicroscopic methods of examining tissue have yielded results indicating a high prevalence of malnutrition. Even in high economic groups, there are few people in abso-

lutely perfect nutrition. Yet these results are not surprising. Very few persons have consistently followed throughout life a diet satisfactory in all essentials, escaped the many other causes of malnutrition, or had complete recovery from any impairment of their nutrition. The older the person, the more opportunity he has had for some dietary lapse or adverse influence. Then too, the standard of perfection in the tissue is very exacting. And the biomicroscopic method is so sensitive that it is capable of detecting slight abnormalities. From all these considerations, the high prevalence of deficiency diseases is not unexpected.

Taken by and large, most of the malnutrition is chronic, with or without mild acute; some of it is mild, but much is rather severe. This condition too is understandable. Much malnutrition, with incomplete or no treatment, passes into the chronic form either as an arrested or slowly progressive process. The latter is not uncommon. Often faulty diets persist for long periods, even years.

This concept of the deficiency states has further applications. In all treatment of deficiency diseases, it shows the need to recognize the chronic state and to carry on therapy for a sufficiently long time. Otherwise, seemingly disappointing results may lead to erroneous and misleading conclusions.

Finally, it furnishes a plausible basis for the interpretation of any relation that may be found between nutrition and health and resistance to disease.

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