# A SHORT-TERM LONGITUDINAL MORBIDITY **INVESTIGATION**

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N the epidemiological study of sickness, the trend has been to classify the population at the to classify the population at risk in terms of socio-economic variables. Recently, with the development of longitudinal morbidity studies, there has been an attempt to classify the population in terms of its previous illness experience. This development introduces two major problems. The first, which arises in any morbidity study but is particularly serious in this new approach, is the question of the accuracy of the diagnosis available for analysis. It is certain that the diagnosis of illness, even when made by a physician and supported by all the modern laboratory aids, is less precise than the diagnosis of cause of death. To what extent the errors made in individual cases influence the validity of data for a large group of patients has still to be determined.

The second problem involved in the longitudinal type of study is that of classification. The existing diagnostic classifications were designed to group together illnesses which have some common basis. In the longitudinal study it is desired to group together patients who have in common a certain pattern of morbidity and who may, on this account, differ in their future illness experience. A classification which attempted to identify psychoneurotic patients would appear to hold considerable promise. A beginning in this direction has already been made by Downes and Simon (2) who compared the illness experience of psychoneurotic persons with that of their total sample population.

This Department, with access to records of a pre-paid medical care plan,<sup>2</sup> has been interested in this aspect of morbidity

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research for some time and has proceeded with a short-term pilot investigation in which the illness experience for one month was analysed in terms of the sickness experience of the population in a previous month. The comparison of the two primary groups, those ill and those not-ill in the previous month, forms the subject of this paper. Therefore, in this preliminary analysis the problem of accurately classifying the patients is not involved.

#### METHODS

Because, as mentioned in a previous paper (5), our morbidity data were derived from the W.M.S. monthly medical account cards (Hollerith card), it was difficult to obtain a continuous record of the medical experience of one group of subscribers over any appreciable time-period. The difficulty was partially solved by collating, with I.B.M. equipment, the account cards of separate months in such a way as to draw together all the cards for one subscriber. Four months spaced at quarterly intervals through the year 1951 were chosen for this study, the first two of which, January and April, have been completed. The medical data from each card for each subscriber were transferred to a summary Hollerith card. By a single listing of these cards it was possible to observe the illness experience for patients ill in both January and April, and for those ill in January or in April alone. In this manner, two cross-sectional morbidity studies were converted into a short-term longitudinal study.

The subscriber population of January, 1951, was classified according to illness experience in that month. This paper is confined to a comparison of the two primary classes, the Ill and the Not-Ill in January, in terms of their illness experience in April.<sup>3</sup> The January data were thus used solely for the purpose of classification of the population and the April data, for comparison of morbidity experience.

which is a medical care plan in Windsor, Ontario, Canada, owned and operated by physicians who practice on a fee-for-service basis. The subscriber population of over 90,000 members works in industry and business primarily. <sup>3</sup> Illness experience is expressed as monthly prevalence, not incidence. April con-

finements are excluded.

In dividing the W.M.S. population of January, 1951, into two classes, the III and the Not-III, a patient who received only preventive services in January was assigned to the Not-III class. Females who were confined in that month were excluded. Unfortunately, it was not possible to recognize among the persons ill in April, 1951, those who joined the scheme after January 31, 1951. Since the W.M.S. subscriber population increased by some nine per cent during the three-month interval, there were illnesses recorded in April which were improperly ascribed to the Not-III class. This inaccuracy could not be avoided, but at least it provided a bias against the hypothesis that the III would have higher rates of new illnesses in April than the Not-III.

Within the III class our attention was restricted to illnesses of a different nature in the same patient in April. The term "new illness" is used in this same sense throughout this paper. Thus, all diagnoses in April which suggested continuation of an illness experienced in January were excluded. In both the III and the Not-III classes, obvious variations of the same diagnosis in April were treated as one illness. For example, if a patient were treated in April for dyspepsia and peptic ulcer, the latter diagnosis was taken and only one illness recorded. As a result, there may have been an under-estimation of the true number of illnesses in April, particularly for the III class.

The comparison of April illness rates was made in terms of two diagnostic morbidity codes which were developed during previous studies,<sup>4</sup> the Psychosomatic Code (P-Code) and the System Code (S-Code), both of which have been related to the International Statistical Classification<sup>4</sup> in terms of its threedigit code numbers.

The Psychosomatic or P-Code divides the illnesses into six broad categories: P-1, Definite Psychosomatic; P-2, Probable Psychosomatic; P-3, Possible Psychosomatic; P-4, Definite Organic; P-5, Accidents; and P-0, Indefinite Psychosomatic.<sup>5</sup>

<sup>&</sup>lt;sup>4</sup> By a panel of five physicians.

<sup>&</sup>lt;sup>5</sup> Called Indefinite Etiology in Figures 2a. and 2b.

1 Definite Psycho- somatic	2 Probable Psycho- somatic	3 Possible Psycho- somatic	4 Organic	5 Accident	0 Indefinite Psycho- somatic
300–326 790	354 369 541 552 573 577 708 784 791	240-245 293 395 402 433 444 467 585-586 605 616 632 634-635 725-726 780 782 786	All other code numbers	800–996	779 788 793 795

Table 1. Summary of the distribution of international three-digit code numbers by psychosomatic code groups.

P-1 comprises illnesses for which the physician, rightly or wrongly, made a definite diagnosis of psychoneurosis. P-4 includes illnesses with clear-cut organic diagnoses. In P-0 were placed those illnesses given such a vague description that classification was not justified. Thus in these three groups of the P-Code and in P-5 (Accidents) little in the way of difficult judgement was involved. The question of the accuracy of the original diagnoses has already been discussed.

Needless to say, all the diagnoses did not fall into such straightforward categories. There were many conditions which could not be placed in the two extremes of the organic-functional spectrum. In some, the diagnosis represented a disease considered to have emotional factors in its development, e.g.: duodenal ulcer. In others, the diagnosis was one which is frequently used to label ill-defined symptoms which may have an emotional basis, e.g.: hypotension. Where it was felt that emotional factors were probably significant, the diagnosis was allocated to P-2 (Probable Psychosomatic). Where this was still possible, but less certain, the diagnosis was allocated to P-3

Int. Code	Diagnosis	
790 310 318 317 316	P-Code 1: Definite Psychosomatic Nervousness and Debility Anxiety Reactions without Mention of Somatic Symptoms Psychoneurotic Disorders, Other, Mixed and Unspecified Types Psychoneurosis with Symptoms Affecting Other Systems Psychoneurosis with Symptoms Affecting the Digestive System	168 137 68 14 13
544 784 573 543 354 708	P-Code 2: Probable Psychosomatic Disorders of Function of Stomach Symptoms Referable to Upper Gastro-Intestinal Tract Functional Disorders of Intestines Gastritis and Duodenitis Migraine Pruritis and Related Conditions	104 95 85 82 44 14
293 444 634 726 240 635 241 605 243 782	P-Code 3: Possible Psychosomatic Anemia Unspecified Essential Benign Hypertension without Mention of Heart Disorders of Menstruation Muscular Rheumatism Hayfever Menopausal Symptoms Angioneurotic Oedema Cystitis Urticaria Symptoms Referable to Cardiovascular and Lymphatic System	297 243 236 232 209 205 199 145 101 64
793 788 795	P-Code 0: Indefinite Psychosomatic Observation without Need for Further Medical Care Other General Symptoms Ill-Defined and Unknown Causes	323 70 20

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Table 2. Principal diagnoses assigned to each P-code diagnostic group, showing the international three-digit code number, together with the diagnosis and the number of cases which were observed in the tabulations for July, 1951.

(Possible Psychosomatic). This grouping was arbitrary and undoubtedly many physicians would be inclined to shift certain diagnoses from one category to another. It was our opinion that with all its limitations this classification was sufficiently accurate for the immediate purpose and that it was preferable to include the debatable diagnoses in our analysis rather than to reject material of potential interest.

The International 3-digit code numbers included in each of the P-Code groups are shown in Table 1. Of these, the prin-

	P-Code S-Code	Ob- served	Ex- pected	Dif- ference	P Per Cent
1	Definite Psychosomatic	25	13.25	11.75	0.1
	Psychoneuroses	22	11.15	10.85	0.1
	Residual	3	2.10	0.90	53.5
2	Probable Psychosomatic	43	35.39	7.61	20.1
3	Possible Psychosomatic	68	54.75	13.25	7.3
	Anemias	9	4.36	4.64	2.6
	Other Circulatory Disorders	6	2.63	3.37	3.8
	Disorders of Gall Bladder, Pancreas & Liver	5	1.81	3.19	1.8
	Residual	48	45.95	2.05	76.4
4	Organic	413	358.59	54.41	0.4
	Benign Neoplasms	6	2.18	3.82	5.6
	Thyroid Disorders	5	2.39	2.61	9.1
	Nutritional Deficiency	5	1.29	3.71	0.1
	Anemias	5	1.77	3.23	1.5
	Organic Nervous Disorders	7	2.47	4.53	0.4
	Respiratory Infections-Mild	76	47.00	29.00	0.0
	Respiratory Infections-Severe	12	28.51	-16.51	0.2
	Other Gastro-Intestinal Disorders	10	5.58	4.42	6.1
	Genital Infections-Male	6	3.01	2.99	8.5
	Urinary Disorders	12	5.12	6.88	0.2
	Other Bone & Joint Disorders	4	1.70	2.30	7.8
	Residual	265	257.57	7.43	64.6
5	Accident	41	41.29	-0.29	96.0
0	Indefinite Psychosomatic	20	11.55	8.45	1.3
т	DTAL	610	514.82	95.18	0.0

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Table 3a. Numbers of new April illnesses of various diagnoses for those ill in January 1951 compared with the numbers expected based on April prevalence among the not-ill, for male subscribers of W.M.S. aged 20 years and over.

cipal diagnoses encountered in a previous analysis are shown in Table 2 for P-Code groups 1, 2, 3, 0.

The System Code<sup>6</sup> represents an attempt to obtain reasonably homogeneous diagnostic groups intermediary in refinement between the three-digit diagnostic categories and the main sections of the International Statistical Classification. Altogether, there are sixty-six clinical groups in the S-Code. Anatomic system has been the principal unit, but, within it etiology and severity, in the clinical sense, have also been taken into consideration. The creation of a specific clinical group was

<sup>&</sup>lt;sup>6</sup> The development of the S-Code together with tables setting forth the relationship between it and the International Statistical Classification have been presented in Reference 6.

_	P-Code S-Code	Ob- served	Ex- pected	Dif- ference	P Per Cent
1	Definite Psychosomatic	74	50,10	23.90	0.1
	Psychoneuroses	64	45.59	18.41	0.6
	Other Psychiatric Problems	8	1.54	6.46	0.0
	Residual	2	2.97	-0.97	58.5
2	Probable Psychosomatic	65	46.12	18.88	0.6
	Headaches	25	13.79	11.21	0.3
	Peptic Ulcers	15	6.87	8.13	0.2
	Residual	25	25.46	-0.46	92.8
3	Possible Psychosomatic	259	229.63	29.37	5.2
	Anemias	51	37.27	13.73	2.4
	Organic Nervous Disorders	9	5.13	3.87	8.7
	Degenerative Cardiovascular Disorders	26	40.60	-14.60	2.2
	Vague Urinary Symptoms	6	1.84	4.16	0.2
	The Myalgias	29	14.05	14.95	0.0
	Residual	138	130.74	7.26	53.9
4	Organic	851	714.34	136.66	0.0
	Malignant Neoplasms	11	6.38	4.62	6.7
	Nutritional Deficiency	21	9.19	11.81	0.0
	Anemias	17	9.16	7.84	1.0
	Nasal Infections	21	13.15	7.85	3.0
	Rheumatic Infections	5	0.96	4.04	0.0
	Respiratory Infections-Mild	138	98.71	39.29	0.0
	Gastro-Intestinal Infections	31	17.69	13.31	0.1
	Anal Disorders	13	7.50	5.50	4.4
	Vague Gastro-Intestinal Symptoms	4	9.08	-5.08	9.3
	The Arthritides	35	25.17	9.83	5.0
	Residual	555	517.35	37.65	9.7
5	Accident	62	50.55	11.45	10.7
0	Indefinite Psychosomatic	- 33	22.01	10.99	1.9
Т	OTAL	1,344	1,112.75	231.25	0.0

Table 3b. Numbers of new April illnesses of various diagnoses for those ill in January 1951 compared with the numbers expected based on April prevalence among the not-ill, for female subscribers of W.M.S. aged 20 years and over.

dependent upon the frequency of cases assigned to it as determined from observations made during an earlier study.

Because of the relatively low illness rates involved, statistical analysis of differences between rates was carried out according to the formula used by Stocks: (3)

$$t = \frac{O - E}{\sqrt{E}}$$

where O is the total number of observed illnesses and E is the



Fig. 1. New illnesses in April among persons not-ill and those ill in January. Sex and age-specific monthly prevalence rate per 1,000 for all diagnoses. Semilog scale.

total number of expected illnesses in the population. The formula was inevitably applied to the smaller population, the Ill class in this instance. Their expected total of illnesses was determined by applying to their population the age-sex specific rates of illnesses per 1,000 Not-Ill subscribers and summing the resultant age-sex specific expected illnesses. Because the Not-Ill population was considerably in excess of the Ill population, this was found to be equivalent to using pooled Ill and Not-Ill rates for calculating the expected illnesses.

The description of results will be confined to those for adults 20 years of age and over, although the graphs of age-sex specific illness rates presented in this paper do show the rates for ages under 20.

### Results

A. Rates for All Illnesses Combined. The age-sex specific rates of illness for all diagnoses combined for the Ill and Not-Ill are shown in Figure 1. For each sex, the Ill group have significantly higher rates of new illness in April as revealed at the bottom of Tables 3a and 3b. In Figure 1 it can be seen that the pattern of relative differences by age-groups is the same for both sexes although females tended to have greater differences between the Ill and Not-Ill January subscribers at all ages after age group 5-9. In both sexes, peak differences occurred in age groups 10-14, 40-49 and 60 +.

B. Rates by P-Code. In Figure 2a the age-sex specific April prevalence rates of illnesses by P-Code diagnostic groups have been compared for males of the III and of the Not-III classes. The two groups were undifferentiated in Probable Psychosomatic illnesses and in Accidents. Elsewhere, the males of the III group had rates of illness in excess of the Not-III. Statistically, the elevation of their rates of new April illnesses was only of borderline significance for Possible Psychosomatic illnesses (p = 7.3 per cent), but was highly significant for Definite Psychosomatic illnesses (p = 0.1 per cent) and for Organic illnesses (p = 0.4 per cent) as shown in Table 3a.

In Figure 2b are shown the corresponding rates for females. Although the January III had higher rates of Accidents in April, the excess in the III was not significant (p = 10.7 per cent, Table 3b.). The excess of Possible Psychosomatic illnesses was barely significant (p = 5.2 per cent, Table 3b.), while the remaining three, Definite Psychosomatic, Probable Psychososomatic, and Definite Organic illnesses gave rise to highly significant excesses in the III class.

C. Rates by S-Code within P-Code Groups. The Illnesses



Fig 2a. New illnesses in April classified in and those ill in January. Age-specific monthl



P-Code diagnostic groups among females ly prevalence rate per 1,000. Semilog scale.

were classified within each P-Code diagnostic group according to the S-Code. The S-Code clinical groups which gave rise to differences of borderline significance or better between the Ill and the Not-Ill classes have been set forth in Tables 3a and 3b. immediately under the data for each appropriate P-Code diagnostic group. The remaining clinical groups within each P-Code group have been combined under the heading Residual.

1. Definite Psychosomatic (P-1). The principal S-Code group within the category, Definite Psychosomatic illnesses, is that of Psychoneuroses which accounted for the significantly high rates of both males and females of the January III subscribers. Females of the January III, in addition, had higher rates of 'Other Psychiatric Problems.'

2. Probable Psychosomatic (P-2). Within Probable Psychomatic illnesses, males of the January III and Not-III did not differ in their rates of new April illnesses for any one of the four S-Code clinical groups which constitute this psychosomatic category. Females of the III class had significantly higher rates in two clinical groups, Headaches and Peptic Ulcers.

3. Possible Psychosomatic (P-3). Altogether the Possible Psychosomatic diagnoses fell into 11 S-Code clinical groups for males and 13 for females. Both males and females of the January III had significantly higher rates of Anemias classified as Possible Psychosomatic. These were the unspecified anemias. The Organic Nervous Disorders classified as P-3 which gave rise to an excess in the January III females were principally vertigo and dizziness. Females of the January III, compared with the Not-III, had a significant *deficit* of those Degenerative Cardiovascular Disorders which fell into P-3, namely, hypertension and heart block.

4. Organic (P-4). Organic diagnoses of P-4 fell into 51 clinical groups for males and 53 for females (confinements are excluded). Differences of borderline significance or better arose between the III and Not-III in 11 clinical groups for males and 10 for females. Both sexes of the III had significantly higher rates of Anemias (specified as 'secondary,' 'pernicious,' etc. in this instance). Two other groups gave rise to significant differences for both sexes: The III had excesses of Nutritional

Deficiencies and Mild Respiratory Infections. Males of the Ill had a significant *deficit* of Severe Respiratory Infections. In certain clinical groups of the S-Code no differences arose; for males these were Circulatory and Skin diseases; for females, Genito-Urinary and Skin diseases.

#### Discussion

In general, the data point to an increased liability to medically treated illness among those who were ill from some other cause in a previous month. To put the matter differently, there is some evidence of "illness proneness" over this short period. One must remember, of course, that only medically treated illnesses are being considered. The increased liability to illness could be explained in several ways. First, a person who has suffered an illness in one month may, through lowered resistance (admittedly an ill-defined concept), be more susceptible to further disease. Partial support of this comes from Downes' reports (1, 2) where it would appear that the chronically ill are liable to higher rates of new illness. Second, a person living under physical or social conditions conducive to the development of illness may, for that reason, have a greater liability to illness in both the periods studied. Support for this view is derived from the frequently made observation that living standards are negatively correlated with illness experience. Another explanation, that of increased liability among certain persons to seek medical care, must also be considered. However, with the present data it is not feasible to advance any one hypothesis in preference to another. A long-term study of the illness experience of individuals which took cognizance of their environmental conditions as well, could throw further light upon these observations.

Two of the P-Code groups, Accidents and Indefinite Psychosomatic, will be dealt with separately because of their relative segregation from the psychosomatic continuum.

In neither sex did the Ill and the Not-Ill differ significantly in their April rates for accidents, so that there is no evidence in the short run of a greater liability to accidents among persons who have recently suffered an illness. Such an increased liability could, however, be obscured by the fact that some persons ill in January might still be convalescent in April and thereby less exposed to environmental hazards.

The latter P-Code group, Indefinite Psychosomatic, cannot be discussed because of the very nature of the diagnoses which make up the group. Nevertheless, it may be pointed out that this group was not responsible for the differences observed in the remaining groups. That is, differences arising in this group of diseases did not oppose or offset differences arising in the other diagnostic components of the P-Code. In passing, it may be noted that over 90 per cent of the services rendered for these indefinite illnesses were diagnostic services.

Since the remaining components of the P-Code contributed almost equally to the excess of April illness among the Ill, one may conclude that the increased liability to illness among the January Ill as a whole is not a selective one with regard to the Psychosomatic continuum.

When the higher April illness rates of the January III were examined in terms of the specific disease groups of the S-Code it was found that the excesses were more marked for certain types of illness. For example, in both sexes, the III group had higher rates for Anemias, Nutritional Deficiencies, and for Mild Respiratory Infections. These findings suggest that the increased short-term sickness liability of certain subscribers is specific in nature. The question of whether the January III group represents persons with temporarily lowered resistance, a generally unfavourable environment or a greater interest in receiving medical treatment is not answered by this analysis but it does become clear that the operative factors may best be sought in terms of the specific diseases whose prevalence is increased among the III class.

For the two significant deficits among the January III mentioned above, namely, Severe Respiratory Infections in males and Possible Psychosomatic Degenerative Cardiovascular Disorders in females, no explanation can be offered. In neither in-

stance could the deficit be attributed to overly strict deletion of April illnesses which might have been related to medically treated January illness. If such were the case both sexes might be expected to have a deficit whereas females had a non-significant excess of Severe Respiratory Infection and males had a non-significant excess of Psychosomatic Degenerative Cardiovascular diseases.

An attempt was made to discover associations between the S-Code clinical groups in which the Ill and Not-Ill differed significantly. The only meaningful result which emerged was that obtained from an analysis in which illnesses were classified according to chronicity. Those clinical groups of the S-Code which were essentially acute in nature were amalgamated as were those which were essentially chronic. Adults of both sexes of the Ill class had excesses of chronic illness while only females had an excess of acute illnesses compared with the Not-Ill class of subscribers.

Having observed that the two primary classes, the Ill and the Not-Ill, differ in their subsequent illness experience, one then wishes to know whether the increased sickness liability of the former is a non-specific phenomenon or whether it arises from specific associations between particular diseases in the same person. Before the data were collected, it had been decided to classify the Ill by applying the Psychosomatic Code to their January illnesses. This phase has been completed. Other classifications suggested by the foregoing analysis are the division of patients according to whether their January illnesses were chronic, sub-acute, or purely acute in nature; and the division of patients according to the clinical classification of their January illnesses in terms of the System Code, paying special attention to those clinical groups which were responsible for significant differences in April between the Ill and Not-Ill classes of W.M.S. subscribers.

#### Summary

1. Adult subscribers to a pre-paid medical care plan who

were ill in January, 1951, when compared with those subscribers who were not ill in January, 1951, had significantly higher illness prevalence rates in April, 1951. Only medically treated illnesses are considered. The April illness rates exclude all illnesses for which treatment was given in January.

2. The January Ill had significantly higher rates of new illnesses for both the Definite Psychosomatic and Definite Organic groups of the Psychosomatic Code. They did not have significantly higher rates for Accidents in April.

3. The higher rates of the January Ill were not uniform throughout the clinical groups of the System Code. No pattern of selectivity was discernible, other than a tendency for the excess to be more marked for Chronic than for Acute illnesses, especially among males.

4. In certain clinical groups of the System Code no differences arose. For males, these were Circulatory and Skin diseases; for females, Genito-Urinary and Skin diseases. The January Ill had two inexplicable deficits compared with the Not-Ill subscribers, namely, for Severe Respiratory Infections in males and for Degenerative Cardiovascular Disorders (hypertension and heart block only) in females.

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