

# Wheat "Consumption" and Hospital Admissions for Schizophrenia During World War II

## A Preliminary Report

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THE possibility of a positive correlation between changes in wheat consumption and changes in the number of hospital admissions for schizophrenia was investigated because of (1) the reported decrease in the number of admissions to mental hospitals during some wars,<sup>1-3</sup> (2) the common experience of changes in kinds and quantities of food consumed during wartime, and (3) the possible relationship between schizophrenia and celiac disease. The latter disease is probably hereditary, occurs in adults and in children, and usually becomes asymptomatic in a period of weeks or months after the elimination of wheat, rye, barley, buckwheat and, possibly, oats from the diet.

Slisenger<sup>4</sup> found three schizophrenics among a group of thirty-two adults with celiac disease ("nontropical sprue," "gluten enteropathy"). Bossak, Wang and Adlersberg<sup>5</sup> discovered five psychotic patients (type unspecified) among

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NOTE: The word "consumption" may indicate either the amount available at the consumer level or some other measure such as that used by the Scandinavian countries (see footnotes to Table 1). When the term is used herein in the fashions employed by the original reporters, it appears in quotation marks.

ninety-four patients with nontropical sprue. The emotional disturbances which occur so frequently in patients with celiac disease are alleviated after the institution of a "gluten-free" diet<sup>6</sup> and have been reported to be the first symptoms to disappear.<sup>7</sup> Furthermore, Graff and Handford<sup>8</sup> have reported that in four of the thirty-seven men admitted to the Institute of the Pennsylvania Hospital for the first time with schizophrenia, during a one year period, there was a history of celiac disease in childhood. The possibilities of a patient having such a history may be assessed by its paucity in clinical practice and by the report of Black<sup>9</sup> of about three to eight cases of celiac disease per 10,000 live births in Glasgow.

### METHODS

The number of women admitted to the mental hospitals of Finland,<sup>10</sup> Norway,<sup>11</sup> Sweden,<sup>12</sup> Canada<sup>13</sup> and the United States<sup>14</sup> before and during World War II and the "consumption" of wheat and rye<sup>15-18</sup> during these periods were collected from the sources indicated (Table 1).

The per cent change in the mean annual number of first admissions for schizophrenia to the hospital in each of the five countries from the respective pre-war mean was compared to the per cent change in the "consumption" of wheat and wheat plus rye (Fig. 1).

### RESULTS

The data are summarized in Table 1 and Figure 1.

Available data on Norway, Sweden and

Canada indicated that there were fewer changes in the number of patients readmitted for schizophrenia than in those admitted for the first time. The official reports listed only first admissions for the United States and the

TABLE I

Wheat "Consumption" Data and Hospital Admissions for Schizophrenia  
*Summary of Original Data*

Country and Period	Mean Annual No. of First Admissions for Schizophrenia*	Mean Annual "Consumption" of Wheat†
Finland*		
1936-1939 (prewar)	1,217	69.5
1940-1942	1,107	60.9
1943-1945	832	48.0
Norway*		
1936-1940	332	(299.6)
1941-1945	201	(123.4)
Sweden		
1937-1939	938	(737.2)
1940-1942	654	(481.3)
1943-1945	608	(458.5)
Canada		
1937-1939	814	84.0
1942-1942	721	75.0
1943-1945	871	84.6
U. S. A.		
1939	9,557	70.5
1940-1942	10,230	70.1
1943-1945	10,943	74.6

\* Admission statistics were reported by the calendar year. All the data available for the prewar period (1936-1939) were used in calculating the means for that period. Admission statistics for Finland were published as the sum of first admissions plus readmissions and are used here. Admission statistics for Norway were reported as total first admissions during the two five-year periods 1936-1940 and 1941-1945.

† Wheat "consumption" for Finland is expressed as grain in kilogram per caput per harvest year; that for Norway and for Sweden as grain in ten million kilograms per country per harvest year (figures in parentheses). The statistics for these countries are gross, are reported by the harvest year and refer to the net value obtained from production plus imports, minus seed and exports. The harvest year ended in Finland on August 31, in Norway on September 30 and in Sweden, July 31. The "consumption" data for Canada and the United States are for flour (kilograms per caput per year) at the consumer level. Rye flour, which composed less than 1.4 per cent of the total of wheat and rye flour (see text), is included.

sum of first admissions plus readmissions for Finland. Estimates from a plot (not shown) of the relationship of the per cent change in the number of first admissions plus readmissions for schizophrenia to per cent change in the number of first admissions in Norway, Sweden and Canada indicate that in Finland the mean annual decrease in the number of first admissions from the prewar mean was probably about 19 per cent in 1940-1942 and about 45 per cent in 1943-1945. These calculated values are shown in Figure 1, and the means of the original data for these periods are shown in Table I. The estimated decreases in the number of first admissions in Finland have also been employed in the statistical calculations which were kindly made by Dr. Johannes Ipsen, Professor of Medical Statistics, School of Medicine, University of Pennsylvania.

The correlation coefficient of the per cent change in the "consumption" of wheat with the per cent change in the number of first admissions for schizophrenia is  $r = 0.908$ , 7 d.f.,  $P < 0.01$ . The possibility that changes in the "consumption" of rye<sup>15-17</sup> (date not shown) might also be related statistically, but less strongly to changes in the number of first admissions for schizophrenia was considered. The amount of rye consumed constituted about 30 to 60 per cent of the combined "consumption" of wheat and rye during the prewar period in the three Scandinavian countries.<sup>19</sup> The changes in the "consumption" of rye in Canada and the United States have been assumed to be zero because of the small amount of rye flour consumed in these countries (see footnote†, Table I).<sup>19</sup>

The multiple regression equation for the per cent change in the number of first admissions of women with schizophrenia ( $\Delta S$ ) as related to the per cent change in the "consumption" of wheat ( $\Delta W$ ) and of rye ( $\Delta R$ ) may be expressed as  $\Delta S = +5 \text{ per cent} + 1.04 (\Delta W) + 0.48 (\Delta R)$ .

The correlation coefficient of per cent change in the number of first admissions with the per cent change in the consumption of wheat and of rye is  $r = 0.961$ , 6 d.f.,  $P < 0.01$ . The analysis assumes homogeneity of material. The validity of this assumption is impossible to estimate.



## COMMENTS

The internal evidence in the statistical reports on the number of admissions to mental hospitals in the five countries (bed capacity, number of physicians, the time relationships of increases in admissions for "psychogenic psychoses," etc.); the lack of a relationship between the degree of change in the number of admissions for schizophrenia and the wartime status of the country (occupied, active combat on home soil; at war but not invaded, and neutral); the clear evidence that decreases in the number of admissions are not due to increased employment during wartime (unpublished data); all are in accord with the concept that the changes in the number of first admissions were primarily due to changes in incidence. The approximate increase in the female population at major risk of schizophrenia (women from fifteen to forty-five years of age) during the six years of World War II was less than 1 per cent in Norway and Sweden, 3.5 per cent in the United States, 5 per cent in Finland and 8 per cent in Canada.

Psychotic service personnel in the Scandinavian countries were hospitalized in civilian hospitals, thus these patients are included in the statistics. However, in Canada and the United States, these patients were hospitalized at military installations initially; thus these patients were not included in the statistics unless they were transferred to civilian or Veterans Administration hospitals. Changes in the number of men admitted to the hospitals with schizophrenia during wartime were similar to those in women; we used the data on women in this report because distortion of statistics due to hospitalization in military installations was far less.

Although the data on the annual "consumption" of wheat are crude and subject to misinterpretation,<sup>20</sup> the changes reported are large enough to be a fairly accurate index of the degree of change in the amounts available for human consumption; particularly since the data for three year periods (five year periods for Norway) were compared. The statistical correlations between the per cent change in the number of first admissions for

schizophrenia and the per cent change in the amount of wheat and of wheat plus rye consumed are high. Nevertheless, implications concerning a role of these cereals in the pathogenesis of schizophrenia should be considered speculative, as with any epidemiologic correlation unsupported by other data.

In addition, schizophrenia is *not* confined to those populations which eat large amounts of wheat. For example, the thorough study of Rin and Lin<sup>21</sup> of the aborigines in Taiwan demonstrated four active, plus six inactive cases of schizophrenia among 11,442 individuals. These tribes were reported to eat mainly "sweet potatoes" and millet with some corn and upland rice.<sup>22</sup> The estimated "morbidity risk for schizophrenia" (<0.27 per cent) in these subjects is one-third or less than that in northern Europeans who consume wheat and rye.<sup>23</sup>

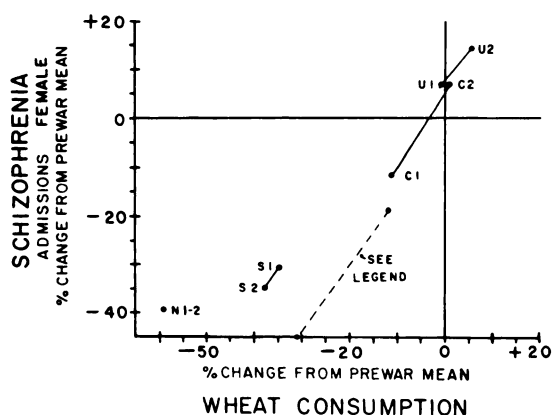


FIG. 1. Per cent change in the "consumption" of wheat versus per cent change in the number of first admissions to mental hospitals for schizophrenia. The changes in the amount of wheat "consumed" and in the number of women with schizophrenia admitted to mental hospitals in five countries during World War II have been expressed as the per cent change from the respective prewar means. These values (derived from Table 1) have been plotted for the means of the two periods: Period 1 = 1940-1942 and Period 2 = 1943-1945, except in the case of Norway the period is Period 1-2 = 1941-1945 (see footnote, \* Table 1). The per cent change in the number of first admissions is plotted for Norway (N), Sweden (S), Canada (C) and United States (U) and for the estimated number of first admissions for Finland (dashed line). See text for method of estimating changes in the number of first admissions from the original data for Finland.

## SUMMARY AND CONCLUSION

The per cent change from prewar values during World War II in the number of women admitted to hospitals for the first time with schizophrenia in five countries was found to be significantly correlated with the per cent change in the amount of wheat and wheat plus rye "consumed."

This, in association with the possible relationship between schizophrenia and celiac disease (gluten enteropathy) briefly discussed herein, suggests that further investigation of a possible relationship between schizophrenia and the kind and quantity of foods ingested is warranted.

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