

# Glycosuria, Family History of Diabetes, and Life Insurance

## Recent Insurance Mortality Experience

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Detection of diabetes has been a primary aim of this Association ever since its founding. The life insurance business has had a similar interest, and for a much longer time. Although the objective has been different, the detection of diabetes as a result of examination for life insurance has served in some degree a major objective of this Association, namely, to bring diabetics under treatment soon after onset and before the development of symptoms. These diabetics otherwise might have gone undetected until their condition had greatly deteriorated and serious complications ensued. This is by no means a matter of purely academic interest. Urinary examinations in connection with life insurance are very common, and until the rapid expansion of industrial medical examinations in the past decade, they probably constituted the largest proportion of such examinations in apparently healthy people. In the experience of the Joslin Clinic, more than one-fifth of the male patients at ages 35-54 prior to 1930 had their disease disclosed originally as a result of life insurance examination. Even within the last decade, the proportion has been still sizable.<sup>1</sup> Moreover, early discovery of diabetes in this manner has been of benefit. This is shown by the lower mortality among such cases as compared with the general mortality of diabetics of corresponding ages.<sup>2</sup>

The interest of the life insurance business in detecting diabetes has been of significance to clinical medicine in other ways. It has been an important factor in the development and standardization of tests for urinary glucose and blood sugar.<sup>3</sup>

Over the years, a very considerable literature has accumulated on glycosuria among applicants for life insurance. Studies of the mortality among such persons have been made on both individual company<sup>3a</sup> and intercompany experiences.<sup>4, 5, 6</sup> The latter appear in reports of

investigations which include a large number of impairment classes. The purposes, characteristics and limitations of these life insurance studies of impaired lives have been summarized by Lew,<sup>7</sup> and only the salient features will be presented here. Most of the present paper relates to the findings of the "1951 Impairment Study,"<sup>6</sup> the latest intercompany investigation. This study was prepared by the Society of Actuaries in consultation with The Association of Life Insurance Medical Directors of America. It covered the experience of 27 life insurance companies in the United States and Canada which have about 70 per cent of all the "Ordinary" insurance outstanding in the two countries. The study relates to persons insured between 1935 and 1949, who were traced to their policy anniversary in 1950. Applicants with serious unrelated impairments, or histories of disease, were excluded to eliminate these extraneous factors. The study was based on applicants accepted for "Ordinary" insurance (insurance issued to individuals in amounts of \$1,000 or more), either at regular rates of premium (standard risks) or with some increase over the regular premium rate (substandard risks). These applicants were all medically examined. In some instances, there was more than one examination, or supplementary information was obtained from the applicant's physician.

The findings in these studies are presented in the form of mortality ratios, which are expressed as a percentage of actual to expected deaths. This ratio relates the number of deaths that occurred in a specific category to the number that would have occurred if the mortality had been the same by age at issue and duration of insurance as that experienced by all persons insured, after medical examination, under standard "Ordinary" policies during the same period. Thus, a ratio of 100 per cent means that the mortality experienced is equal to that among standard "Ordinary" risks of the same age who had been medically examined, and observed over the same period of time. For convenience, the term "normal" will be used in this sense.

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These mortality ratios are subject to the same limitation as most statistical observations which are based on samples of limited size. Consequently, the range of probable deviation of the "true" mortality ratio from the observed mortality ratio was calculated in each instance. The range of probable deviation in these cases means that there is an even chance that the "true" value of the mortality ratio lies within the range indicated. The statements made with regard to the significance of the ratios take into account their range of probable deviation.

In interpreting the findings, certain facts should be kept in mind. The death rates of all persons insured under standard "Ordinary" policies during the period covered by the investigation were quite low. Consequently, the mortality standard used to measure the results is quite rigorous. For example, even in the sixth to tenth policy years, the death rates were between only one and slightly over two per 1,000 a year at issue ages under 35, and were at about this level in the eleventh to the fifteenth policy years at issue ages under 30. These death rates thus apply to attained ages up to 45.

Also, during the period covered by the investigation the diseases of the heart and circulatory system came to dominate the mortality picture, followed by malignant neoplasms and accidents in that order. The death rates from diabetes, tuberculosis, pneumonia and influenza, and nephritis were very low, so that a significant excess mortality from any of these causes was generally limited to impairment classifications with a large volume of material. For example, more than 5 deaths from diabetes could be expected only in impairment classifications with more than 500 expected deaths from all causes.

These studies based upon insured lives have certain limitations. For example, applicants are selected on the basis of their acceptability for "Ordinary" life insurance, which presumes a reasonably good state of health when the insurance is issued. On the other hand, the examinations for life insurance are not as thorough as in clinical practice, and the statements of an applicant for life insurance regarding his medical history may not be as complete and frank as those given to his private physician.

PERSONS WITH GLYCOSURIA

The cases included in the "1951 Impairment Study" because of glycosuria totaled close to 10,000. These were subdivided according to the amount and persistency of sugar in the urine, separately for those in which a blood sugar test was made and for those in which this test was not made or was not known to have been made. The experience on cases insured at standard premium

rates and on those at substandard premium rates were studied separately. In some classifications the contributing companies were asked to furnish data on substandard cases only. Contrary to what might have been expected, more than 90 per cent of the cases of glycosuria were males. This proportion is significantly larger than in the study as a whole, which averaged approximately 80 per cent males and 20 per cent females. The larger proportion of males in the glycosuria classifications may reflect the higher average age of male applicants and perhaps also the greater frequency with which more than one urine specimen is required on males because they apply more frequently for insurance in large amounts. Some indication of this is seen in the fact that males accounted for more than 95 per cent of the cases with blood sugar tests.

The classifications of glycosuria used in the investigation are shown in table 1. They are affected by the differences between companies in laboratory technics for the determination of the amount of sugar in the urine and in recording its amount. The differences in technics affected both the amount and the persistency of sugar reported. Thus, in the combined experience under the standard section of the glycosuria classifications, more than one-half of the volume of data was contributed by the companies reporting the average amount of sugar in all specimens examined. Most of the remainder was equally divided between companies reporting the average amount in positive specimens only and those reporting the largest amount. In the combined experience under the substandard section, more than half of the volume of data was contributed by companies reporting the average amount in all specimens and about a third by companies reporting the average amount in positive specimens only. Consequently, these classifications by amount and persistency are not so significant as they

TABLE 1  
Class of cases with glycosuria used in  
1951 Impairment Study

Accidental.....	{ 1 test only or no details 1 out of 3 or 4 tests 2 out of 6 or 7 tests
Less than 1%	
Intermittent.....	{ 1 out of 2 tests 2 out of 3-5 tests 3 out of 6 or 7 tests
Less than 1/2%	
From 1/2% to 1%	
Persistent.....	{ 2 out of 2 tests 3 out of 3-5 tests
Less than 1/2%	
From 1/2% to 1%	
Over 1%, or history of diet or treatment	

otherwise might have been.

The volume of data in the several classifications varied considerably. In part this reflects the differences in technics described above and differences in the underwriting rules of the individual companies as regards the number of specimens required for rating risks with glycosuria. The number might be less if the applicant had a prior history of glycosuria; perhaps only one specimen would be asked for in the circumstances and the case would be classified as accidental by some companies.

The cases with blood sugar tests were not analyzed according to the levels of blood sugar found, but the blood sugar level would be reflected in the rating of the individual risk. However, in the period covered by this study only those with borderline elevated blood sugar were accepted for substandard insurance, and those with definitely high levels, in the probable diabetic range, were rejected altogether.

The mortality data are shown in table 2 for the larger experience on cases in which blood sugar tests were not made, or were not known to have been made. In the cases insured at standard premium rates, the experience is limited to those with accidental glycosuria or with intermittent glycosuria of 1 per cent or less. The mortality in those with accidental glycosuria was virtually normal. In those with intermittent glycosuria of less than 0.5 per cent, it was slightly elevated. The experience on cases with intermittent glycosuria of larger amount was too small to yield information of value.

In the experience on substandard cases the mortality was significantly elevated over normal in every classifi-

cation. When account is taken of the size of the experience in the several classifications, by amount and persistency of glycosuria, the differences in the mortality ratios are, for the most part, not statistically significant.

Table 3 gives the facts on cases in which a blood sugar test was made. Those with accidental glycosuria insured at standard premium rates had a mortality virtually equal to the expected. The mortality was only slightly elevated in those with intermittent glycosuria of less than 0.5 per cent.

TABLE 3

Mortality ratios among cases with glycosuria who were given blood sugar test  
By persistency and amount of glycosuria  
(1951 Impairment Study)

Classification of glycosuria	Standard Risks		Substandard Risks	
	Claims (no.)	Mortality ratio	Claims (no.)	Mortality ratio
"Accidental"	35	95% <sup>+13</sup> <sub>-11</sub>	29	155% <sup>+24</sup> <sub>-20</sub>
Intermittent				
Less than 1/2%	22	115% <sup>+21</sup> <sub>-17</sub>	—	—
1/2% to 1%	—	—	12	168% <sup>+45</sup> <sub>-35</sub>
Over 1%	—	—	37	134% <sup>+18</sup> <sub>-15</sub>

In the substandard cases there was a sizable experience only for those with accidental glycosuria, and for those with over 1 per cent of glycosuria. In both instances, the mortality was moderately in excess of the average for all standard risks. The smaller experience on cases with intermittent glycosuria of 0.5 to 1 per cent showed an even higher mortality. While at a casual glance these findings appear to be contradictory, this reflects primarily the technical differences in determining and recording the amount of sugar in the urine, referred to earlier in the paper.

The results are next considered for certain combinations of the data, namely, cases with 1 per cent or less glycosuria, classified according to persistency (table 4). In the experience with cases where a blood sugar test was not made or not known to be made, the mortality was slightly elevated among standard risks with intermittent glycosuria. The mortality in the corresponding substandard experience was more than 1½ times normal. In cases with persistent glycosuria, for which only data on substandard risks are available, the mortality was still higher—twice the expected.

In cases with a blood sugar test, the mortality was also

TABLE 2

Mortality ratios among cases with glycosuria who were not given blood sugar test  
By persistency and amount of glycosuria  
(1951 Impairment Study)

Classification of glycosuria	Standard Risks		Substandard Risks	
	Claims (no.)	Mortality ratio	Claims (no.)	Mortality ratio
"Accidental"	68	108% ± 9	51	165% ± 15
Intermittent				
Less than 1/2%	69	126% ± 10	22	159% <sup>-24</sup> <sub>+29</sub>
1/2% to 1%	—	—	12	173% <sup>+46</sup> <sub>-36</sub>
Persistent				
Less than 1/2%	—	—	20	191% <sup>+37</sup> <sub>-30</sub>
1/2% to 1%	—	—	11	229% <sup>+65</sup> <sub>-49</sub>
Over 1%	—	—	8	159% <sup>+56</sup> <sub>-41</sub>

TABLE 4  
Mortality ratios among cases with intermittent or persistent glycosuria of 1% or less  
*Experience on cases with no blood sugar test and with blood sugar test separately (1951 Impairment Study)*

Classification	Standard Risks		Substandard Risks	
	Claims (no.)	Mortality ratio	Claims (no.)	Mortality ratio
No Blood Sugar Test				
Intermittent glycosuria	75	121% ±9	34	163% <sup>+23</sup> / <sub>-20</sub>
Persistent glycosuria	—	—	31	203% <sup>+30</sup> / <sub>-25</sub>
Blood Sugar Test				
Intermittent glycosuria	26	116% <sup>+19</sup> / <sub>-16</sub>	16	133% <sup>+30</sup> / <sub>-24</sub>

slightly elevated in standard risks with intermittent glycosuria. The ratio was a little, but not significantly higher in the corresponding group of substandard risks.

Certain consistent findings emerge from these figures. The experience on cases with a blood sugar test was slightly but consistently better than in those where the test was not done or there was no information on the matter. On the whole there is indication that the blood sugar test was effective in detecting cases with hyperglycemia. Another factor is that cases given a blood sugar test include an above-normal proportion of applicants for larger amounts of insurance among whom the level of mortality has been found to be generally somewhat lower than among persons insured for smaller amounts.<sup>8</sup>

There is also indication that the mortality is higher in those with larger amounts of sugar in the urine or with more persistent glycosuria as compared with those with accidental or smaller amounts of glycosuria, although results are obscured partly by the differences in technics and recording, and also as would be expected, by the more rigorous selection of the cases with persistent glycosuria of large amount.

The volume of the experience in the individual classifications was not sufficient to disclose significant variations in the mortality ratios by age at issue or by duration. In the combined classifications under the standard sections there was no distinct trend in the ratios, either by age or duration. In the combined experience under the substandard sections, the mortality ratio for issue ages under 40 was virtually normal—103 per cent, but for issue ages 40 and over it was significantly higher—172 per cent. There was no distinct trend in the mortality by duration.

Analysis was made of the causes of death among these

glycosurics, but the number of deaths in detailed classifications by amount and persistency of glycosuria was generally small. Accordingly, the facts are presented only for broad combinations of the glycosuria classifications. In the entire standard experience, diabetes accounted for 5 death claims on 4 lives, where only 1.45 claims were expected. This is significantly above normal. The contrast is even greater in the substandard experience where there were 11 death claims from diabetes on 8 lives as against only .88 claims expected. Deaths charged to diabetes comprise a minor fraction of the total mortality—about 3 per cent of all the deaths in the standard experience, and 5 per cent in the substandard experience. However, in view of the association between diabetes and early onset of arteriosclerosis, it may be noteworthy that the mortality from disease of the heart and circulatory system was significantly above normal in several of the substandard classifications.

#### GLYCOSURIA IN RELATION TO BLOOD SUGAR LEVEL

Mortality data among persons with glycosuria who were given a blood sugar tolerance test are available from an earlier study of the Metropolitan's experience reported by Jimenis, Marks, Finegan and Blatherwick<sup>9</sup> in 1947, which was concerned mainly with the variations in mortality according to blood sugar level. Not all the persons had glycosuria on the examination which brought them into the study, although most of them did or else had a history of glycosuria. Table 5 shows the classification of the cases according to the 1/2-hour and 2-hour blood sugar levels, based upon determinations of samples of capillary blood by the Folin-Malmros method. Table 6 shows the mortality experience in three broad blood sugar groups according to the amount of sugar in the urine. From this it can be seen at a glance that the mortality was primarily influenced by the blood sugar level. The findings with respect to glycosuria were rather

TABLE 5  
Classifications by blood sugar levels of cases given glucose tolerance test  
*Experience of Metropolitan Life Insurance Company, 1927-1946*

	Blood Sugar (Mg. per 100 cc.)	
	1/2 hour	2 hour
Normal	200 or less	120 or less
Borderline	201 or more 200 or less	120 or less 121 to 140
High	201 or more Any amount	121 to 140 141 or over

Note: The 1/2-hour and 2-hour blood sugar values are considered together in classifying the results of the test.

TABLE 6

Mortality ratios among cases given glucose tolerance test according to level of blood sugar and amount of glycosuria  
*Experience of Metropolitan Life Insurance Company, Ordinary Department Cases examined in 1927 to 1944, traced to anniversary in 1946*

Blood sugar group	Amount of Glycosuria					
	Less than 0.4%		0.4% but less than 1%		1% or over	
	Actual deaths	Per cent actual of expected	Actual deaths	Per cent actual of expected	Actual deaths	Per cent actual of expected
Normal	95	108	30	122	21	95
Borderline	23	166	10	127	7	80
High	15	152	6	87	37	189

inconsistent, except where the blood sugar level also was distinctly high.

The findings with respect to hyperglycemia with no or slight glycosuria are in accord with those reported recently by McCullagh and his associates<sup>10</sup> on a follow-up of patients of the Cleveland Clinic who were suspected of having diabetes by virtue of an abnormally elevated blood sugar only, and who otherwise would not have been suspected, since glycosuria was absent. They found that the proportion of patients developing overt diabetes was definitely related to the level of the blood sugar at initial observation. Despite the marked differences between the two studies in the type and source of material and the methods of analysis, they supplement each other well.

FAMILY HISTORY OF DIABETES, ONE OR MORE CASES IN THE FAMILY

From the point of view of volume of experience this is the largest classification in the "1951 Impairment Study." It consisted of those insured who had at least one close relative with diabetes. There were nearly 90,000 cases in this classification, 98 per cent of them in the standard section. The distribution by sex was almost exactly that found among all classes combined in the "1951 Impairment Study"—81 per cent were males, 19 per cent females.

Table 7 shows the mortality experience in the standard section according to age at issue and according to the duration of insurance. There are no significant deviations from the mortality experience among standard risks in general among these cases either by age or by time elapsed from the time insurance was issued. There was a slight downward trend in the mortality ratios with advancing age at issue, but despite the large experience this was not statistically significant.

Further breakdown of the figures among standard risks according to age and duration of insurance from

TABLE 7

Mortality ratios among cases with a family history of diabetes  
(One or more immediate relatives)  
*Experience by age at issue and by duration of insurance separately*  
(1951 Impairment Study)

Ages at issue	Standard Risks				
	Claims (no.)	Mortality ratio	Policy year durations	Claims (no.)	Mortality ratio
15-64	2,095	100%	1-15	2,095	100%
15-29	184	107%	1- 2	305	103%
30-39	540	105%	3- 5	517	94%
40-49	810	100%	6-10	836	102%
50-64	561	96%	11-15	437	105%

issue was also made. The mortality ratios in these divisions are shown in table 8. By and large the deviations from normal mortality are no greater than might be expected in an experience of this kind. It will be observed that the mortality ratios show a moderate excess over normal in the 11th to 15th policy years among those under 40 when insured. Not much stress can be put on this finding, although the attained ages of these persons lie in the period of life in which diabetes is of sizable frequency.

The mortality from diabetes was significantly high—more than twice the expected at issue ages under 40 and one and two-thirds the expected at ages 40 and over. The total number of claims from the disease was 28, (on 26 lives) or only about 1.5 per cent of the total from all causes. Mortality from nephritis and from diseases of the heart and circulatory system were all significantly high at ages under 40—almost twice the expected from nephritis, and one and one-fifth the ex-

TABLE 8

Mortality ratios among cases with a family history of diabetes  
(One or more immediate relatives)  
*By age at issue according to duration of insurance*  
(1951 Impairment Study)

Ages at issue	Standard Risks			
	Mortality Ratio			
	1-2	3-5	6-10	11-15
15-29	89%	117%	99%	127%
30-39	92%	98%	106%	118%
40-49	118%	97%	100%	91%
50-64	97%	83%	99%	107%
	Number of Claims			
15-29	29	55	63	37
30-39	65	121	220	134
40-49	127	200	324	159
50-64	85	143	227	106

pected from diseases of the heart and circulatory system. Mortality for these conditions at ages 40 and over, however, was normal.

Earlier insurance studies have included the mortality experience among persons who reported at least two diabetic relatives at the time insurance was applied for. The number of cases included in two intercompany investigations—the Impairment Study—1938<sup>11</sup> and the Medical Impairment Study—1929<sup>5</sup> was not large, but in both the mortality among such insured persons was about  $\frac{1}{3}$  higher than normal. The total number of deaths in these two studies was too few to show any significant difference in the mortality from diabetes as compared with average risks.

#### SUMMARY

A. Long-term follow-up experience on a large number of persons with glycosuria accepted for "Ordinary" insurance shows that: (1) Cases found acceptable for standard insurance have a mortality little different from normal; (2) those limited to substandard insurance because of this impairment have a mortality significantly above normal. This difference primarily reflects the higher proportion in the substandard group of cases with a persistent glycosuria or with large amounts of sugar in the urine; (3) glucose tolerance tests serve to screen out some diabetics, with the result that the mortality among glycosurics having this test was uniformly somewhat lower than among those not having the test; and (4) hyperglycemia is of greater significance than glycosuria in relation to the mortality experienced.

B. A very extensive experience on persons who reported one close relative with diabetes at the time they were insured, showed normal mortality from all causes combined. There was some increase in mortality from diabetes, and, in those under 40, increased mortality from cardiovascular-renal diseases. Earlier studies, based upon applicants with at least two diabetic relatives, showed that they had a moderate increase in mortality above normal from all causes combined.

#### CONCLUSION

The results of a long-term study of glycosuria in insured persons indicate that generally those with "accidental" glycosuria—that is, found on an occasional specimen—have a favorable prognosis, and even in those with more persistent glycosuria, not clearly diabetic, longevity is not greatly affected. The proportion progressing to diabetes apparently is not large, as judged either by the total mortality or that from diabetes. It is likely that some of these were diabetic at time of application for insurance, but were not detected by the

examination for life insurance.

Taken as a whole, persons who are themselves not diabetic but who have a close relative with diabetes, showed no significant diminution of longevity although the frequency with which diabetes subsequently developed among them is above normal.

#### SUMMARIO IN INTERLINGUA

*Glycosuria e Historia Familial de Diabete in Relation al Assecurantia de Vita: Recente Datos de Mortalitate in le Statistica del Assecurantia*

A. Le sequente observationes se basa super le analyse statistic del historia assecurantial de grande numeros de individuos con glycosuria a qui polissas "ordinari" habeva essite accordate in le curso de longe periodos de tempore. (1) Individuos classificate como assecurabile sub conditiones standard ha un mortalitate non multo differente ab le norma. (2) Individuos restringite a conditiones substandard de assecurantia a causa de lor glycosuria ha un mortalitate significativamente supranormal. Iste differentia reflecte principalmente le facto que le gruppo a conditiones substandard de assecurantia include un plus alte proportion de individuos con formas persistente de glycosuria o con grande quantitates de sucro in le urina. (3) Tests de tolerantia a glucosa servi a eliminar un certe numero de diabeticos. Isto explica le observation constante que le mortalitate es levemente plus basse inter glycosuricos pro qui tests del tolerantia a glucosa esseva executate que inter glycosuricos pro qui ille tests habeva essite omittite. (4) In relation al mortalitate del gruppo de individuos studiate, le presentia de hyperglycemia es plus significative que le presentia de glycosuria.

B. Le analyse statistic de multo extense numeros de personas reportante al tempore de lor application que illes habeva un consanguineo immediate con diabete, revelava un mortalitate normal pro omne causas de morte in combination. Il habeva in iste gruppo un certe augmento de mortalitate ab diabete e etiam, inter individuos infra 40 annos de etate, un augmentate mortalitate ab morbos cardiovascular-renal. Previe studios del casos de applicantes con al minus duo consanguineos diabetic revelava un moderate augmento del mortalitate in comparation con le norma pro omne causas de morte in combination.

Le resultados del studio de glycosuria in personas assecurate in le curso de un longe periodo de tempore indica como regula general que individuos con glycosuria "accidental"—i.e. un glycosuria de occurrentia sporadic in certe specimens—ha un prognose favorable, e mesmo inter individuos con glycosuria persistente que non es clarmente diabetic, il non ha un grave reduction del

longevitate. Le proportio del casos que progredere verso diabete non pare esser grande, secundo lo que es indicate per le mortalitate total o per le mortalitate ab diabete. Il es probabile que le mortes ab diabete in iste gruppo include un certe numero de individuos qui haveva diabete al tempore de lor application sed in qui ille condition non esseva detegite per le examine medical pre-assescurantial.

In general, individuos non personalmente diabetic sed possedente un consanguineo immediate con diabete non monstrava un diminution significative de lor longevitate ben que le frequentia del subsequente disvelopamento de diabete es supra le norma inter illes.

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<sup>10</sup> McCullagh, E. P., Fawell, W. N., and Lane, F. J.: Significance of hyperglycemia without glycosuria. *Journal of the American Medical Association* 156:925-29, Nov. 6, 1954.

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## The Effects of Vegetarianism

Vegetarians are usually classified as (1) lacto-ovo-vegetarians, or (2) "pure" vegetarians (vegans). Lacto-ovo-vegetarians shun animal flesh (meat, poultry and fish), but eat such foods as milk and eggs, or products made from or containing these. "Pure" vegetarians (vegans) exclude from their diets all foods of animal origin.

M. G. Hardinge and F. J. Stare [*J. Clin. Nutrition* 2:73, 83 (1954)] reported nutritional, physical and laboratory studies on 112 vegetarian (86 lacto-ovo-vegetarians and 26 vegans) and 88 nonvegetarian adults, adolescents and pregnant women. With the exception of the adolescent vegan, the average dietary intake of all groups "approximated or exceeded" the National Research Council recommended allowances. There were no significant differences in the heights, weights and blood pressures of these groups, but the vegan averaged 20 pounds less than the others. Total protein, albumin and globulin values did not differ statistically in the groups, and hematologic studies were similarly negative. As regards pregnancy, the lacto-ovo-vegetarian diet appeared to provide adequate nutrition.

These observations suggest that vegetarianism is es-

entially harmless, but some recent studies by F. Wokes, J. Badenoch, and H. M. Sinclair [*Voeding* 16:590 (1955)] indicate that definite illnesses may appear in some vegans of long standing. The group of vegans studied by these British workers consisted of 32 children (13 male, 19 female) of ages up to 18 years, and 117 adults (54 male, 63 female). The commonest and earliest symptoms were in the mouth, particularly sore tongue, but these usually disappeared after a month or two. Paresthesia, amenorrhea and menstrual disturbances, and nonspecific subjective "nervous symptoms" were also noted. Some 20 per cent of the subjects complained of pains in the back and spine, and some had such characteristic stiff "poker" backs that Wokes *et al.* use the term "vegan back" to describe it. These workers emphasize that even slight symptoms did not become manifest until the individual had been on the vegan diet for several years, that more serious symptoms took still longer to develop, and that "quite a number" were apparently symptomless even after more than five years on the diet.

From "Vitamin B<sub>12</sub> Deficiency in Vegetarians" in *Nutrition Reviews* 14:73-74, March 1956.