

AN EXPERIMENT IN THE CONTROL OF TUBERCULOSIS AMONG NEGROES

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THE most important tuberculosis problem at present is the control of the disease among Negroes. In 1939-1941 the death rate among nonwhite persons in New York City was 208 per 100,000 population, compared with a rate of 41 among white persons (7). It is generally recognized that most of the Negro population in any given community are living on the lowest economic level. This implies environmental conditions associated with poverty, poor housing, and inadequate income for food, clothing, and other necessities.

Since tuberculosis mortality does vary with the level of living of groups of the population, and since nutrition is an important environmental factor determined to a considerable extent by the level of living, it seemed important to conduct an experiment to learn whether an improved nutritional status and by implication a higher level of living will affect the incidence of tuberculosis among persons at risk of attack because of exposure in the family. This particular experiment was conducted in Negro families in Harlem.

The importance of environment when considering tuberculosis has been brought out by various persons interested in the subject. Frost (8) said: "Probably nothing has been more influential in bringing about the decline of tuberculosis than progressive improvement in the social order as a whole; and nothing, perhaps, is more essential to the further effective control of the disease than to hold up, and so far as possible to improve the standards of living of the lower economic strata. . . . It is probable that one of the most important factors in the decline of tuberculosis has been progressively increasing human resistance, due to the influence of selective mortality and to environmental improvements such as better nutrition and relief from

¹ From the Milbank Memorial Fund, the Community Service Society, and the Bureau of Tuberculosis of the New York City Department of Health.

physical stress, tending to raise what may be called nonspecific resistance.”

The marked increase in tuberculosis which followed World War I and again after World War II has demonstrated that populations forced to live on the border of starvation are especially susceptible to the spread of the disease among them. It is recognized that malnutrition is not the only cause of the increase in tuberculosis. Holm (9) indicates the causes of the great increase in tuberculosis in Europe after World War II as: greater opportunity for the spread of tubercle bacilli because of the disorganization of the whole anti-tuberculosis program in many European countries, overcrowded living conditions in the large cities, malnutrition, the low standard of every-day hygiene, because of the nonexistence of facilities for hygiene, and the psychic pressure under which the population has lived.

The experience of Great Britain during and after World War II has demonstrated that an environmental factor, good nutrition, is a most important factor in building up and preserving general resistance to disease and death. There the government took measures to ensure an adequate amount of food for everyone without regard to income.

Magee (10) in a discussion of some lessons of the war in the application of nutrition to public health describes the effect upon tuberculosis as follows: “In regard to tuberculosis, the circumstances altered appreciably for the worse in the early part of the war. Many patients who in peacetime would have remained in sanatoria were sent home to make room for anticipated air-raid casualties. Many of these tuberculous people may have become infective after discharge, and the increase in the incidence of, and death rate from, tuberculosis in 1940–1941 was not surprising. The death rate was 635 per million in 1938; it had risen to 699 in 1940, but had reached the lowest level ever—583 per million—in 1944. The incidence was 50,689 in 1938, 54,300 in 1943, and practically the same in 1944. The increased incidence is unquestionably, to some extent, a measure of improvement in ascertainment rather than in real incidence. As-

certainment was improved by the medical examination of large numbers of young people for military service, and by the introduction of mass radiography.

“Tuberculosis has always flourished where there is poverty or famine, and it is generally believed that poor food is the dominant factor. . . . During the First World War the death rate from tuberculosis rose from 1,340 per million in 1913 to 1,694 in 1918, whereas it decreased during the Second World War. In a recent review Leitch has brought forward evidence indicating that diet plays a dominant part in maintaining the body’s resistance against tuberculosis. There is therefore good reason to believe that the well-balanced diet during the war did a great deal to prevent increased mortality from tuberculosis.”

In a recent animal experiment Dubos (11) has shown that “Both in the susceptible and in the more resistant strains, the course and outcome of the disease are markedly affected by the environmental conditions under which the animals are kept during the infectious process. Thus, the susceptibility of mice to tuberculosis can be greatly modified by changing the composition of the diet fed the animal during, or before, initiation of the infectious process.”

DATA AND METHOD OF STUDY

The special nutrition experiment was set up in an area of upper Harlem, comprised of some thirty-five city blocks, extending north from 142nd Street to 156th Street, and west from the Harlem River to Eighth Avenue. Thirty-two thousand Negroes in 9,116 household units lived in this area (12).

Improvement of nutritional status was to be achieved by increasing the daily intake of nutrients; that is, by giving needed vitamins and minerals as a supplement to the usual diet. This experiment required that two groups of families or populations be studied, one in which supplements were given and the other a control for comparison with the experimental group.

It is relatively easy to set up a control for comparison with an experimental group. However, there are certain rigid re-

quirements which must be met if the experiment is to have validity. The requirements are as follows:

1. The control population must be similar in all essential respects to the experimental population except for the specific factor introduced into the latter.
2. The observation of results must be comparable for the control and experimental populations.
3. Relevant data capable of evaluation and statistical analysis must be obtained for both populations with equal care and exactness.

A consistent effort was made throughout the period of study to meet the requirements which have been described.

Sampling. Eligibility of the families considered for the study was carefully defined. 1. Exposure to active reinfection tuberculosis in the family was essential for admission to the study. To reduce variations in the factor of familial exposure, the index or active tuberculous case must be a related member of the family unit. 2. One or more of the family members must have an examination for objective rating of nutritional status.

In December, 1941, there were 218 families under public health supervision which met the first requirement of the special study. Members of these families were invited to have a nutrition examination. One or more members of 194 families were examined at the nutrition clinic.

The 194 families were divided into two groups of equal size; one, the vitamin group in which nutrients in the form of vitamins and minerals were given as a supplement to the diet; the other, a control group in which no supplements were to be dispensed.

In the selection of the families for the two groups, age constitution of the population was considered a factor of importance because the incidence of tuberculosis is known to vary with age. To control the factor of age, the families were matched according to size and allocated alternately to the control and vitamin groups. This method of matching the families by size and plac-

ing them alternately into the two groups excluded personal judgment.

At the beginning of the study (early in 1942), the two groups of families were examined for comparability with respect to sputum status of the index case and the age distribution of the population at risk of developing tuberculosis.

There had been exposure to known positive sputum in a similar proportion of the families in both groups; namely, 84 per cent of the vitamin families and 83 per cent of the control families.

The two groups of families were found to be homogeneous also with regard to age constitution. More than half the number in each group had children under 16 years of age in them. Families with only adults, 25 years of age or older, formed about one-fourth of each group.

Data of the Study. Throughout the five years of the special study both groups of families were visited with the same frequency; that is, once a month for the first three years and once every three months thereafter. Detailed records concerning the social and economic condition of each family were obtained and at later visits any changes in these conditions were noted. The data collected were as follows: The individuals who made up the household were listed. The place and date of birth, length of residence in New York City, present employment status, and relationship to the head of the household were indicated for each person in the household. Cause of death, place of death, and date of death were listed for all deceased members of the family. Non-resident members of the family living in institutions were also listed. Nature of employment was obtained for all employed persons. Data were obtained also as to the amount and source of income, and the amount paid for rent. At monthly intervals information was obtained concerning the amount spent for food and the types of food eaten by the family during the preceding week.

Attention was given to all known health problems in the family. Persons suffering with chronic disease other than tu-

berculosis were listed and a record was obtained of medical care, both clinic and hospital care, received by these persons.

Abstracts of the tuberculosis clinic examinations were obtained for all members of the tuberculous families who had such examinations.

A study of the incidence of all illness during a twelve-month period was conducted in the tuberculous families included in the experimental group. Sickness records were collected at monthly intervals. The onset and duration of illness, the onset and duration of disability, the number of days confined to bed, and the number of days in the hospital were recorded on a special form on a calendar basis.

In addition to the record of illness, the families were asked to report all preventive medical care, such as immunizations and vaccinations, check-up examinations for chronic disease, prenatal and well-baby care. Also a record of all eye care and of all dental care was obtained.

Records of all types of medical service rendered to members of the families were checked against the records of the clinic or hospital where the service was given. The records for the few cases attended by private physicians were submitted to them for confirmation or correction only when this was necessary in order to permit the best public health nursing supervision of the case.

PUBLIC HEALTH TEACHING IN THE FAMILIES

It was thought best not to alter the usual program of public health instruction given to the families by the nurses. Rather, throughout the period of study a consistent effort was made to maintain the same standard of teaching in both groups of families.

The teaching program included the following points: The need for improved food habits for the entire family, attention to acute or chronic illness and the need for medical care for such illness, and the importance of the tuberculosis chest clinic examinations. The nurses also gave attention to the social and

economic problems of the family because their aim was to assist when needed any family in its efforts to maintain the family unit.

A most important part of the supervision of the tuberculous families was that given by the Upper Harlem Chest Clinic. Dr. Neville C. Whiteman was chief of the medical staff of the clinic throughout the period of the study. The diagnosis for essentially every examination of persons in the special study was reviewed and verified by Dr. Whiteman. Consequently, the data on tuberculosis are not subject to variations between different examiners.

EXAMINATION OF IMPORTANT ENVIRONMENTAL FACTORS
PRESENT AT THE BEGINNING OF THE SPECIAL EXPERIMENT

Tuberculosis as an Environmental Factor. In a study of the incidence of tuberculosis in a population exposed to special risk of the disease, the tuberculous environment both past and present must be scrutinized with care. Table 1 shows the annual

Table 1. Annual attack rate from tuberculosis among persons exposed to special risk in Negro families.

SPECIFIED STUDY	RATE PER 100 PERSON YEARS	NUMBER OF PERSON YEARS
Harlem (1938-1941)		
Vitamin Group	2.14	468
Control Group	2.32	431
Philadelphia (1924-1929) ¹	2.71	2,767
Williamson County, Tennessee (1931-1941) ²	2.05	1,315
Lee County, Alabama (1920-1937) ³	1.10	3,897
Kingston, Jamaica, B.W.I. ⁴	2.3	3,166

¹ Putnam, Persis: Tuberculosis Incidence Among White Persons and Negroes Following Exposure to the Disease. *The American Journal of Hygiene*, November, 1936, Vol. 24, No. 4.

² Puffer, Ruth R.; Murphy, W. J.; and Williams, W. C.: Tuberculosis Studies in Tennessee. *The American Journal of Hygiene*, May, 1942, Vol. 35, No. 3.

³ Graham, A. H.; Auston, P. W.; and Putnam, Persis: The Fate of Persons Exposed to Tuberculosis in White and Negro Families in a Rural Area of East Alabama. *The American Journal of Hygiene*, February, 1941, Monographic Series No. 16.

⁴ Opie, Eugene L.; Putnam, Persis; and Seward, E. Joyce: The Fate of Negro Persons of a Tropical Country, Jamaica, B.W.I., After Contact with Tuberculosis. *The American Journal of Hygiene*, February, 1941, Monographic Series No. 16.

FAMILY GROUP	TOTAL DEATHS PRIOR TO 1942	NUMBER OF DEATHS	
		1939-1941	Prior to 1939
Vitamin	46	34	12
Control	42	29	13

Table 2. Tuberculosis deaths before January, 1942—upper Harlem area of New York City.

attack rate from tuberculosis among persons at risk in Negro families. The attack rates for the Harlem families, shown first in the table, are for the period 1938-1941; that is, before the beginning of the experiment being reported upon. The rates for the control and vitamin groups were fairly similar. Therefore it may be concluded that they were comparable with respect to past exposure to infection in the family.

Annual attack rates among persons exposed to risk of infection in Negro families are shown also in Table 1 for a study made at the Henry Phipps Institute in Philadelphia (13), for rural areas in Tennessee (14), Alabama (15), and for Kingston, Jamaica, in the British West Indies (16).² It should be noted that, excepting Lee County, Alabama, the rates are on the same general level and are similar to those recorded for the Harlem families. From the epidemiological point of view these data indicate that familial aggregation of tuberculosis among Negroes has been approximately the same over a period of time and that urbanization has not greatly affected the level of the attack rates. This point has special significance when considered in relation to the objective of the Harlem experiment; that is, to see if a change in the environment will modify a familial risk of disease, a risk which was not unique for the Harlem families.

Table 2 shows the tuberculosis deaths which had occurred in

² There are differences in the method of analysis of the various studies. In Philadelphia, in Lee County, and in Jamaica, the experience begins with the first known exposure to sputum positive tuberculosis within the household and contains events ascertained by inquiry and those noted while the households were under observation. In Harlem and in Williamson County, exposure to a given type of index case is considered and experience includes only those events occurring during the period of observation.

In spite of the differences in the character of the material and the method used, the data are sufficiently similar to warrant the general comparison presented in Table 1.

FAMILY GROUP	PER CENT	NUMBER OF CASES	POPULATION
	REINFECTION TUBERCULOSIS (PERSONS AGED 10+)		
Vitamin	22.6	68	301
Control	21.2	62	293
	PRIMARY INFECTION (PERSONS AGED 0-24)		
Vitamin	25.5	40	157
Control	26.2	39	149

Table 3. Prevalence of living cases of tuberculosis, 1942—families in upper Harlem area of New York City.

the vitamin and control families before 1942. These data afford another indication that the intensity of exposure to tuberculous infection in the family was similar for both groups.

Table 3 shows the prevalence of living cases of reinfection tuberculosis and primary infection demonstrable by x-ray among family members at the beginning of the special study. The two groups of families had comparable rates for both types of cases.

Position of the index case in the family may be considered as an indication of possible variations in the intensity of exposure to infection in the family; that is, the tuberculous mother in the family may be supposed to have had more intimate contact with her children than the father. Figure 1 (Appendix Table 1) shows the position of the index case in the family. The differences between the two groups are not great; in 89 per cent of the vitamin and 81 per cent of the control families the index case was the husband, wife, or child.

It may be concluded from the data presented—familial attack rates, number of tuberculosis deaths, prevalence of living cases, and position of the index case in the family—that prior to the beginning of the nutrition experiment the families were comparable with respect to a most important environmental factor, opportunity for exposure to familial tuberculosis.

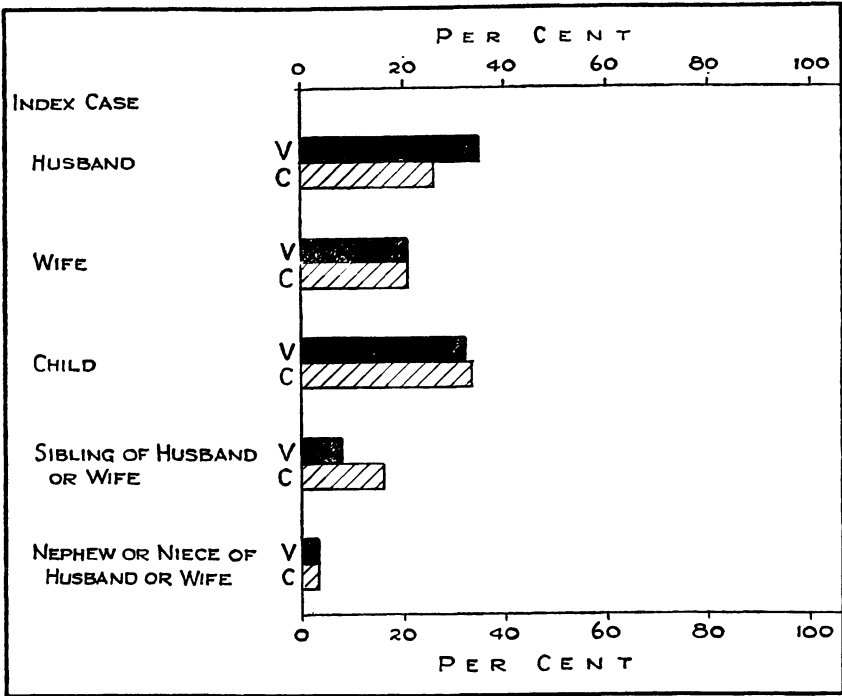


Fig. 1. Distribution of vitamin and control families according to position of the index case in the family—upper Harlem area of New York City.

Socio-Economic Environmental Factors. Individual resistance to progressive tuberculosis is believed to be affected by the socio-economic environment of the individual or the family. It is important, therefore, to examine the two groups of study families to ascertain their comparability with respect to important environmental factors.

Figure 2 (Appendix Table 2) shows the source of income for the vitamin and control families at the beginning of 1942. From 61 to 65 per cent in both groups were dependent on public assistance which is indicative of a low level of living.

Figure 3 (Appendix Table 3) shows the distribution of the families according to a composite rating on food habits at the beginning of the study.³ From 40 to 50 per cent of the families had food habits rated as marginal or unsatisfactory. It should

³ The rating on food habits was based on the standards recommended by the Food and Nutrition Board of the National Research Council. See Appendix 2.

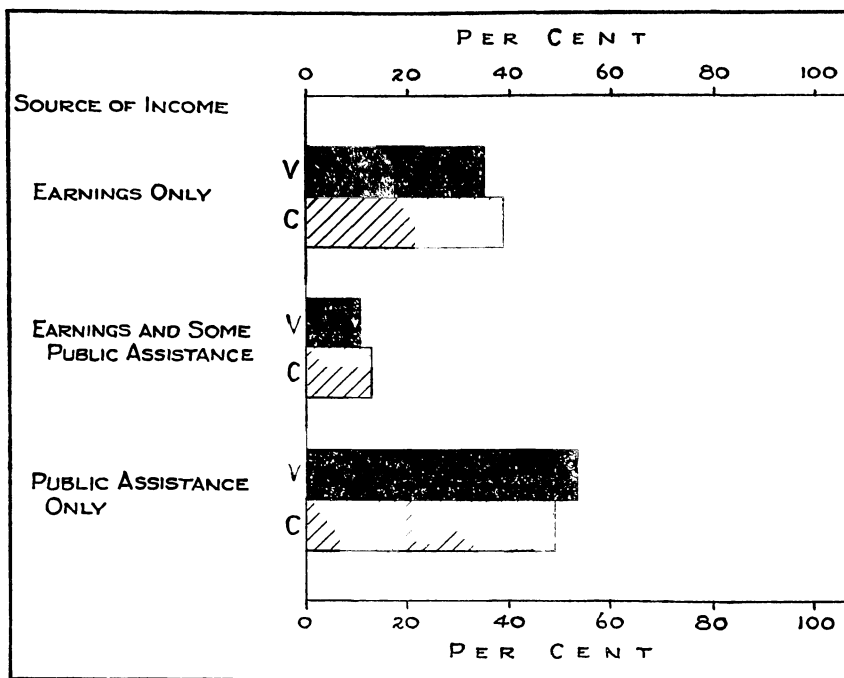


Fig. 2. Distribution of families according to source of income, 1942—upper Harlem area of New York City.

be explained that teaching good food habits had since 1939 been an important part of the public health nursing program in tuberculous families in the study area of upper Harlem (1-6).

The distribution of the families according to the degree of crowding is shown in Figure 4 (Appendix Table 4). The crowding rating for the family takes into consideration the number of rooms in the living quarters in relation to the age and sex content of the family.⁴ From 50 to 54 per cent of the families in the two groups were living in very crowded quarters; they were rated unsatisfactory or very unsatisfactory.

It may be concluded that at the beginning of the nutrition experiment the vitamin and control families were generally similar with regard to source of income, food habits, and crowding, all socio-economic factors which may have a bearing upon the spread of tuberculosis among their members.

⁴ The crowding rating is described in detail in Appendix 2.

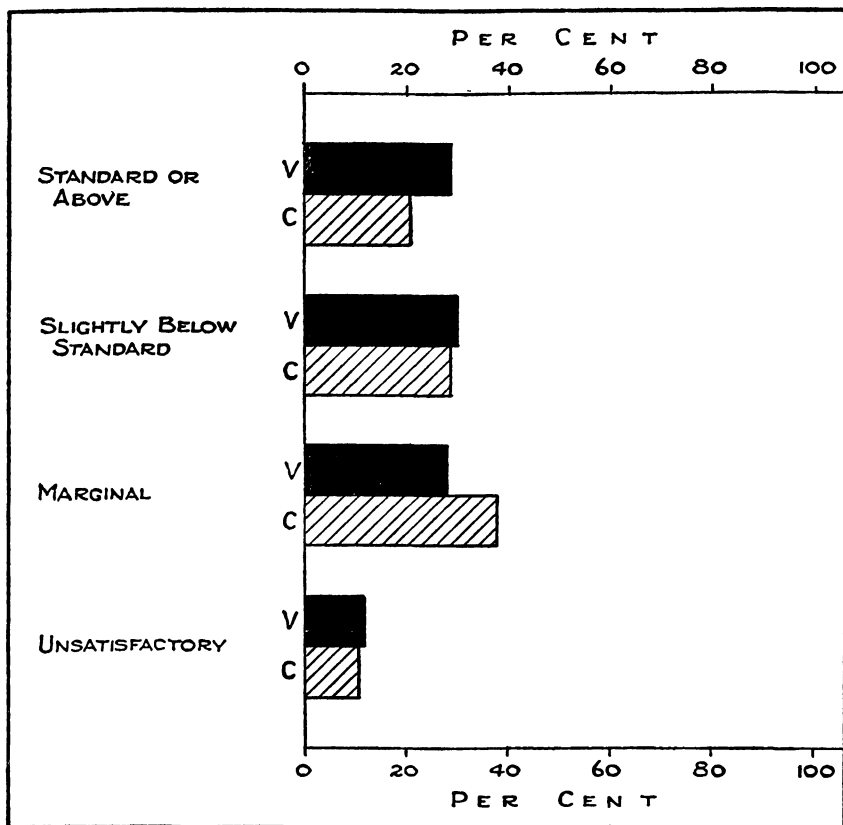


Fig. 3. Distribution of families according to composite ratings on food habits, 1942—upper Harlem area of New York City.

The presence of chronic illness other than reinfection tuberculosis among family members is of interest. Table 4 shows the number of cases of specific chronic conditions in each group of families. In each, these persons with chronic illness constitute about one-fourth of the population at risk of developing tuberculosis. These cases were reported to the nurses who asked routinely about chronic illness in the family and all were substantiated by medical records.⁵ Examination of the diagnostic categories reveals that the degenerative diseases and venereal disease formed the majority in both groups. There were four

⁵ It should be emphasized that the data in Table 4 comprise only cases known to the family. Examination of the total population would no doubt reveal more cases. Cases of "old syphilis" where the medical record stated that no further treatment was needed have been excluded.

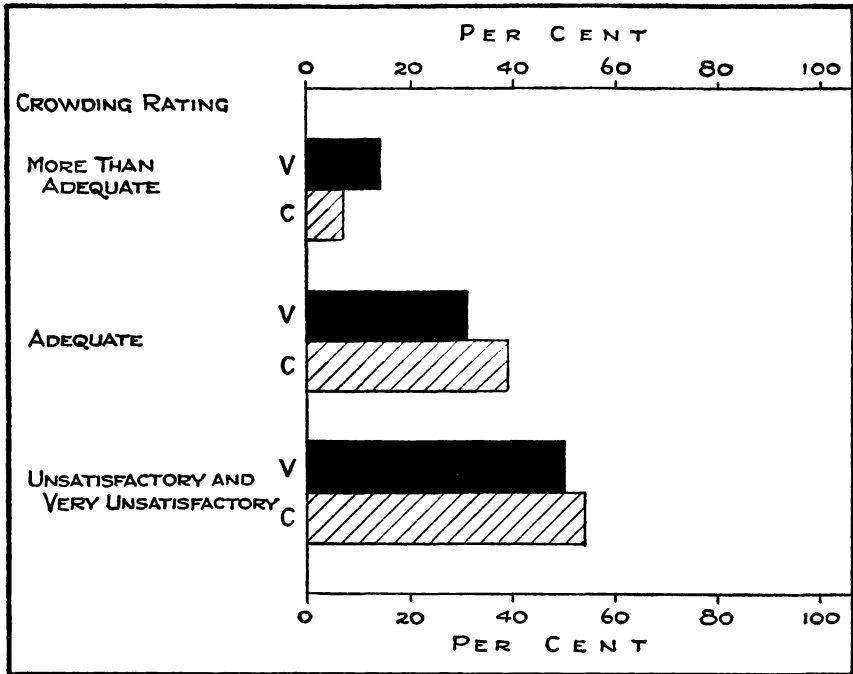


Fig. 4. Distribution of families according to degree of crowding, 1942—upper Harlem area of New York City.

persons in each group of families who were permanently disabled with a chronic condition.

Attack Rate from Tuberculosis, 1942–1947. Before a discussion of the attack rates during the five-year period of study, a

Table 4. Number of cases of chronic disease, 1942—families in upper Harlem area of New York City.

DIAGNOSIS	NUMBER OF CASES	
	Vitamin Families	Control Families
TOTAL	60	54
Heart Disease	12	11
Hypertensive Vascular Disease	10	6
Venereal Disease	9	6
Arthritis	6	5
Diabetes	1	4
Psychoses	6	5
Psychoneurosis	3	3
Rheumatic Fever	0	2
Other Causes	13	12

statement concerning the amount of vitamins given to members of the families in that group is appropriate. Table 5 shows the daily amount of vitamins and minerals given to persons in each of three age groups: 6 months to 4 years, 5-12 years, and 13 years of age or older. The amounts were determined by Dr. H. D. Kruse. The first column of Table 5 shows the amounts given for the first year of the special study; the level of dosage during that year was considered a therapeutic one. The amounts given in subsequent years, shown in the second column of Table 5, were considered those needed for daily requirements or maintenance.^{6, 7}

The vitamins and minerals were dispensed at the nutrition clinic; a month's supply for each member of the family was given to the housewife or another responsible member of the family each month. All instructions concerning the taking of

Table 5. Daily amount of vitamin and mineral supplements—families in upper Harlem area of New York City.

VITAMINS AND MINERALS	FIRST YEAR	SUBSEQUENT YEARS
CHILDREN 6 MONTHS TO AGE 4		
Niacin	30 mg.	4.0 mg.
Thiamin	3 mg.	.5 mg.
Flavin	3 mg.	.5 mg.
Vitamin A	10,000 I.U.	1,500 I.U.
Ascorbic Acid	75 mg.	20 mg.
Calcium	100 mg.	500 mg.
Iron	9 mg.	3 mg.
5-12 YEARS OF AGE		
Niacin	75 mg.	15 mg.
Thiamin	6 mg.	1 mg.
Flavin	6 mg.	1 mg.
Vitamin A	20,000 I.U.	3,000 I.U.
Ascorbic Acid	225 mg.	50 mg.
Calcium	250 mg.	500 mg.
Iron	21 mg.	6 mg.
13 YEARS AND OVER		
Niacin	150 mg.	20 mg.
Thiamin	9.9 mg.	2 mg.
Flavin	9.9 mg.	3 mg.
Vitamin A	50,000 I.U.	5,000 I.U.
Ascorbic Acid	375 mg.	75 mg.
Calcium	500 mg.	500 mg.
Iron	45 mg.	6 mg.

⁶ All new-born infants in the vitamin families were given vitamins at the therapeutic level for one year without regard to the amounts being taken by other members of the family at the time of the infants' birth.

⁷ The vitamins and minerals used during the first year of the special study were purchased from Mead Johnson and Company, Evansville, Indiana. Those for the four subsequent years were purchased from E. R. Squibb and Sons, New York, N. Y. Both companies furnished the material at lower-than-usual cost and thus made a contribution to the study.

FAMILY GROUP	RATE PER 100 PERSON YEARS	NUMBER OF CASES	NUMBER OF PERSON YEARS
<i>Vitamin</i>			
(1) Took Vitamins	0.16	1	644.5
(2) Took no Vitamins	0.50	3	598.5
Control	0.91	10	1,096.5
	DIFFERENCE	STANDARD ERROR	PROBABILITY
C and V1	0.75	± 0.396	.05 to .06
C and V2	0.41	± 0.446	.35 to .36

Table 6. Annual attack rate from tuberculosis, 1942-1947—families in upper Harlem area of New York City.

the vitamins were given by the supervising nurse of the nutrition clinic. Follow-up teaching with respect to the supplements was done by the field nurses who made home visits.

All members of the families in the vitamin group were urged to supplement their usual diet by the addition of vitamins. However, 27 per cent of persons in these families were unwilling to take any vitamins; in the second year the proportion not taking vitamins rose to 46 per cent, and by the end of the fifth year 60 per cent were not taking vitamins. Consequently, to study the incidence of new cases of tuberculosis in these families it is necessary to separate the population at risk into two groups—those who did take vitamins and those who did not. The transfer of persons from the vitamin group to the no-vitamin group was made on what was believed to be a conservative basis. Transfer was made only after an interval of six months from the time that the person had stopped taking vitamins.⁸

The number of new cases of tuberculosis which occurred in the three populations as risk are shown in Table 6⁹. One case occurred among persons taking vitamins. This case was a widowed female aged 23 whose husband died of tuberculosis in April, 1942. The patient had a chest x-ray in May, 1942, which was considered negative for tuberculosis. In March, 1943, after

⁸ No persons who stopped taking vitamins and minerals resumed the taking of them.

⁹ The method of analysis and the formula for the calculations in Table 6 follows that formulated and presented by Frost in 1933 (17).

ten months of observation, she was found to have active reinfection tuberculosis. During the ten months of observation the patient took a five months' supply of vitamins.

There were three new cases among the persons in the vitamin group of families who either took no vitamins or ceased taking them after a relatively short period of time. One of the cases in this group was a male aged 17 at the beginning of observation. He had three negative examinations including an x-ray of the chest. In December, 1943, he entered the Navy and was discharged two years later. At that time he was still negative for tuberculosis. A year later, in December, 1946, he was found on x-ray examination to have active pulmonary tuberculosis. This patient took vitamins for a period of six months before going into the Navy and refused to take them when he returned from the Navy.

The second case occurred in a male aged 48. This patient had four routine x-ray examinations, all of which were negative for tuberculosis. In February, 1946, he died of acute military tuberculosis. He took vitamins during the first twelve months of the study and was observed for three years while not taking vitamins.

The third case occurred in a male aged 19 at the beginning of observation. This patient took no vitamins. During the first year of observation he had three chest x-ray examinations all of which were negative for tuberculosis. He was out of the household for three years; on his return his x-ray examination was negative for tuberculosis. Seven months later he was re-examined and found to have minimal pulmonary tuberculosis.

In the control families there were ten new cases during the period of observation; four were males and six were females. One male was aged 27; two were in the age group 35-39; and one was aged 56. The females were generally younger than the males; three were under 25 years of age; one was 30; and the remaining two were over 45 years of age.

Two of ten cases were diagnosed as active pulmonary tuberculosis on their first x-ray examination during the period of ob-

ervation. The remaining eight were negative on their first examination; three were diagnosed on second examinations; three on a third examination; and one had a total of four negative chest x-rays before a diagnosis of tuberculosis was made. The last case was diagnosed as healed primary infection when first observed. The diagnosis remained the same for five subsequent examinations; on the sixth examination there was evidence of an active minimal lesion of reinfection type tuberculosis. The new cases all occurred in different families.

The lower section of Table 6 shows the difference between the rates in the vitamin families and the control group. The difference between the rates for the controls and for persons who took vitamins is of borderline significance; that is, the chances of such a difference being due to sampling are from 5 to 6 out of 100. On the other hand, the difference between the rates for persons who took no vitamins and for the control population was definitely nonsignificant.

CHANGES IN ENVIRONMENTAL FACTORS DURING OBSERVATION

Both the vitamin and the control families were found to be generally similar at the beginning of the nutrition experiment with respect to the tuberculous environment and to socio-economic conditions of the family. In view of the difference in the attack rates of new cases of tuberculosis in the two groups of families, it is proper to present data which reveal changes in environmental conditions which took place during the period of observation. It is also most necessary to learn whether measures for the detection of new cases were applied with equal force in the populations of the two groups of families.

Continued clinic supervision of the study group, including periodic x-rays of the chest, was considered of the utmost importance. Table 7 shows the frequency of these examinations. Sixty per cent of the persons in the vitamin families were examined at least once in each year compared with 52 per cent in the control families. Twenty-one and 31 per cent, respectively, were examined at least twice during the five years. The

FREQUENCY OF CHEST X-RAY	PER CENT	
	Vitamin Families (293 Persons)	Control Families (286 Persons)
TOTAL	100.0	100.0
Every 6 or 7 Months	20.9	23.3
Every 8 or 9 Months	15.3	11.5
Every 10-12 Months	23.4	16.7
Every 13-18 Months	8.9	11.5
Every 19-24 Months	10.6	6.2
Every 25+ Months	20.9	30.8
Not Examined	11.3	15.0

Table 7. Frequency of chest x-ray examinations among persons at risk, 1942-1946—families in upper Harlem area of New York City.

proportions unexamined during that period were 11 per cent of persons in one group compared with 15 per cent in the other group. About one-third of the unexamined in each group had negative chest x-rays before the beginning of the special study.

Familial Exposure to Tuberculosis. Familial exposure to tuberculosis during observation may be modified by hospitalization of active cases and deaths among these cases. Table 8 shows that there were 40 active cases in each group of families. Most of these cases had some hospital care; the mean months of care per case was similar for patients in both groups of families. The number of deaths were 23 in the vitamin families compared with 28 in the controls. Admittedly, these data afford only a crude measure of opportunities for exposure to infection in the

Table 8. Cases of active reinfection tuberculosis classified according to hospital care and mortality, 1942-1946—families in upper Harlem area of New York City.

CLASSIFICATION	VITAMIN FAMILIES	CONTROL FAMILIES
TOTAL CASES	40	40
Hospital Care	37	39
Months of Hospital Care	394	403
Months Per Case	10.6	10.3
Deaths	23	28

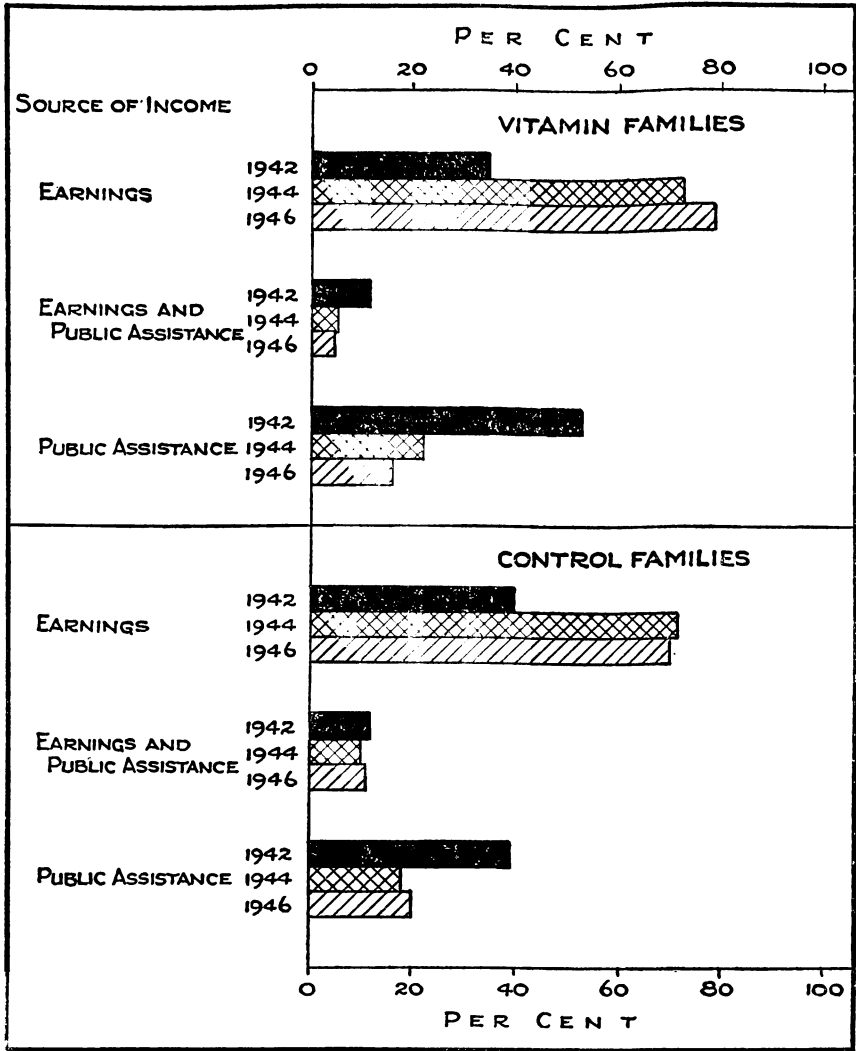


Fig. 5. Change in source of family income, 1942-1946—upper Harlem area of New York City.

family. However, the data are of the same order for both groups and they do suggest that there were no important differences between the two groups.

Socio-Economic Environment. There were marked changes in the socio-economic environment of the families. This was not surprising since the period of observation, 1942-1946, coin-

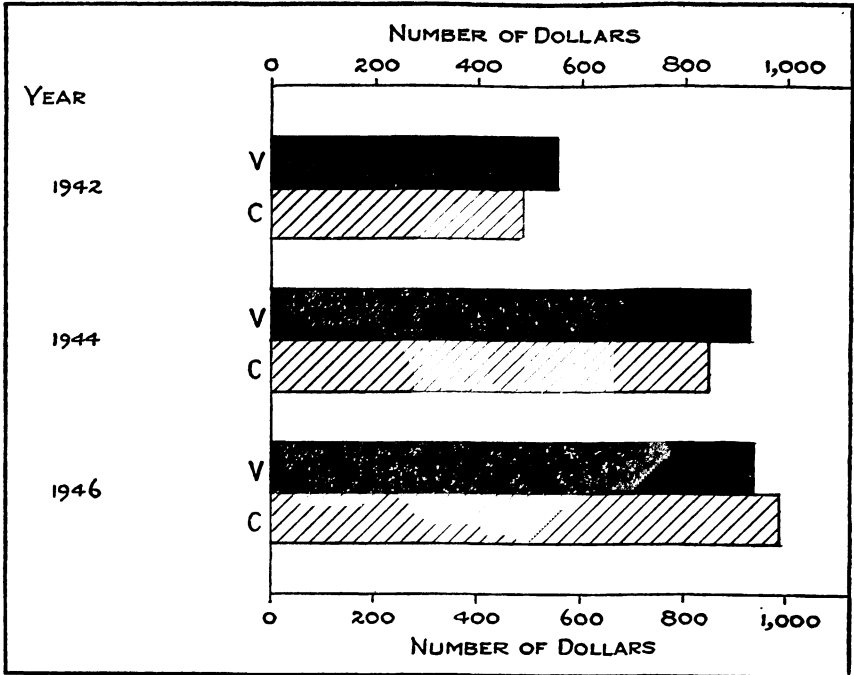


Fig. 6. Change in mean annual income per cost unit, 1942-1946—upper Harlem area of New York City.

cided with the war period. It is important to note whether one group of families was affected more by change in conditions than was the other group.

Figure 5 (Appendix Table 5) shows the change in source of family income. There was a striking increase in the proportion of families living on earnings and a corresponding decrease in the per cent dependent upon public assistance. This was due to increased opportunities for employment. The two groups of families were similar with respect to change in source of income.

As would be expected, the change in mean annual income per cost unit was equally as striking for the two groups of families.¹⁰ These data are shown in Figure 6 (Appendix Table 6). Here again the two groups of families were fairly similar. The increase in the mean annual income, from 73 to 89 per cent, in

¹⁰ Income is expressed in cost units because this method allows for the relative cost of maintenance of children and adults.

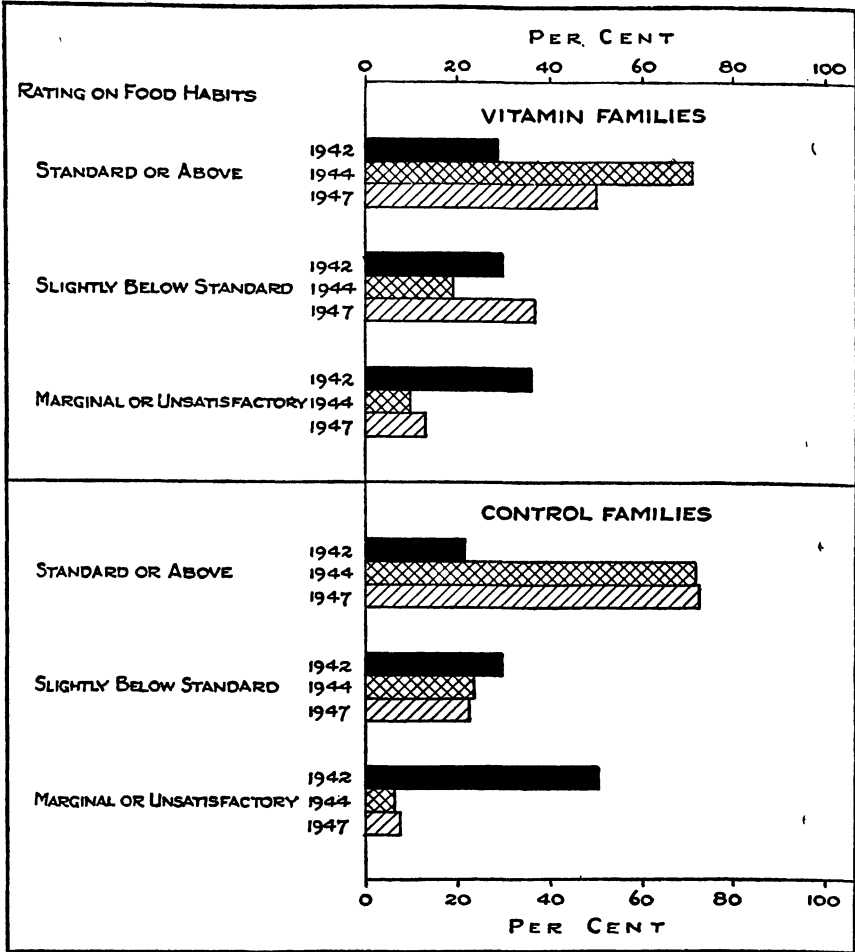


Fig. 7. Change in rating on food habits, 1942-1947—upper Harlem area of New York City.

these families was considerably greater than the increase in the cost of living during the period 1942-1946.¹¹

There was also a marked change in the families with respect to their rating on food habits. These data are shown in Figure 7 (Appendix Table 7). The ratings refer to the spring months of 1942, 1944, and 1947. Both vitamin and control families showed an increase in food patterns classed as "standard or

¹¹ According to the Consumer Price Index for New York City (United States Bureau of Labor Statistics), the cost of living determined from retail store prices rose 46 per cent during the period under consideration.

above" in 1944 and 1947 compared with 1942; there was a very marked decrease in the proportions where food habits were considered "marginal or unsatisfactory." Teaching of good food habits was stressed by the nurses throughout the period of study. This teaching was supposed to be equally emphasized in both groups of families. However, expenditure for food increased greatly during the period and the decisive factor in attaining the results presented in Figure 7 was without doubt the increase in family income.

CHANGES IN CONSTITUTION OF THE FAMILY

It should be emphasized that throughout the five years of the nutrition experiment both groups of families were visited with equal frequency by the public health nurses. The families were visited once a month for the first three years and in the last two years visits were made once every three months. On each visit, records were obtained concerning the make-up of the family; persons entering the family were recorded and inquiry was made concerning family members who had left the household.

Preliminary study of the tuberculous families in Area 8 of upper Harlem indicated that they were a mobile group (4). In a twelve-month period the average moving rate for household units was 30 per 100 observed. Consequently, it was recognized that the movement of family units would complicate close supervision of them. However, all families in the nutrition experiment were followed regardless of any change in place of residence unless the family moved away from New York City.

The annual moving rate of the vitamin and control families was 25.4 and 26.1 per 100, respectively. Figure 8 (Appendix Table 8) shows the proportion of families in each group according to the number of family moves. The two groups were quite similar with respect to moving. About 40 per cent in each group did not move during observation and 34 per cent moved two or more times. The families moved chiefly to Washington Heights and the Bronx. A few moved to lower Harlem, to Queens, and to Brooklyn.

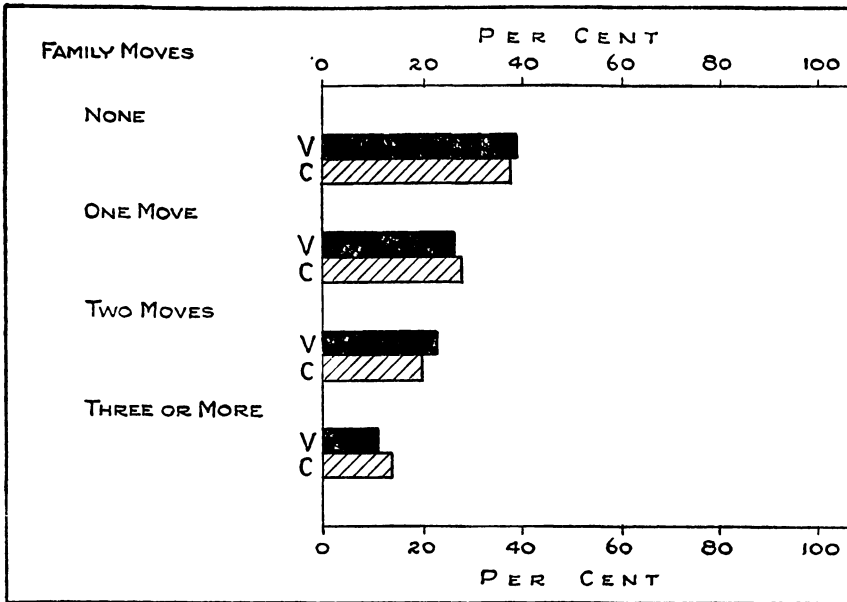


Fig. 8. Distribution of families according to number of moves of households during five years' observation, 1942-1946, 1947—upper Harlem area of New York City.

It was considered highly desirable to keep the members of the families who moved out of Area 8 of upper Harlem under the continued supervision of the Upper Harlem Chest Clinic and the Nutrition Clinic. Consequently, the cost of their transportation to and from the clinics was met by the special study budget.

During the five years' observation, eight of the vitamin families and ten of the control families moved away from New York City.

Family units do not remain constant with respect to their membership. Whenever a member who had been exposed to active tuberculosis in the home moved out of the family unit and established a household, this new household was also visited with regularity. A total of 128 different family units were supervised in the vitamin group; in the control group the total was 125.

Changes Within the Family. During the five years of observation there were, excluding infant deaths, ten deaths from

causes other than tuberculosis in each group of families. The causes of death were similar in the two groups—accidents, cancer, heart disease, cerebral hemorrhage, and diabetes.

There were sixteen births in each group of families. There were two infant deaths among those born in the control families. In one instance the mother was delivered while eclamptic and the infant survived only two days. The other infant death was due to a congenital heart condition. There were no deaths among the infants born in the vitamin families; none of these mothers took vitamins.

Births and deaths may be considered as expected events in families observed over a period of time. The vitamin and control families suffered absence of some of their members due to causes other than death. Some became institutional cases. Five persons from the vitamin families were sent to mental institutions and one was sent to a correctional institution because of delinquency. In the control families three persons were sent to mental institutions, one to prison, and one to a custodial institution. An effort was made to obtain reports at intervals concerning the health status relative to tuberculosis for all except those in penal institutions.

Entry into the armed forces meant a separation from the family unit for a period of time. Twenty-one young men from the vitamin families were admitted either to the Army or the Navy compared with twenty-four from the control families. One man in the control group entered the Merchant Marine service. There was only one medical discharge among those in both groups. After two years in the Army a member of one of the vitamin families was discharged with a diagnosis of dementia praecox.

In the vitamin families thirteen persons reentered observation upon discharge from the armed forces; the corresponding number in the control families was ten.

A relatively small number of persons in each group of families left observation permanently—seven in the vitamin families and ten in the control families. These were instances where

young men or women married and established homes outside of New York City.

It may be concluded that the two groups of families were generally similar at the beginning of the study with respect to environmental factors believed to be important in the production of tuberculosis. During the course of observation there were marked changes in the socio-economic environment. These changes appear to have occurred with about equal intensity in both groups. The only marked difference between the vitamin and control families was in the incidence of new cases of tuberculosis among their members; the incidence among those who took vitamins was appreciably lower than the rate in the control families but the difference does not have a probability below the 5 per cent level used generally as a limit for significance.

A sufficient number of studies have been made among both white families and Negro families in various localities to establish the attack rate among their members as an epidemiological fact. In subsequent years after familial exposure to tuberculosis in Negro families the attack rate has shown little variation. In those in Williamson County, Tennessee, there was no significant change over a period of six years. In the Philadelphia study and in the Kingston study there was no significant change during a period of fourteen years. In the Harlem families, however, there was a very significant change during a period of nine years. In the period before the beginning of the nutrition experiment the attack rate in the control families was 2.5 times the rate in the subsequent five years; in the vitamin families it was about 7 times the rate in the subsequent five years. These changes in the incidence coincided with marked changes in the socio-economic environment. The level of living of most of the families was raised. Could it be that an improved level of living affected the incidence of tuberculosis? The data from this study in Harlem certainly suggest that improvement in the level of living of tuberculous families in the very lowest economic group may act as a preventive measure.

Indeed, Frost suggested some years ago that such a measure might be effective.

Throughout the entire period of the special nutrition study, Dr. Herbert R. Edwards, at that time director of the Bureau of Tuberculosis, was medical director of the study program. Also, for the same period, Dr. Neville C. Whiteman was chief of the medical staff of the Upper Harlem Tuberculosis Clinic.

The home visiting was done by nurses of the Community Service Society. Miss Jean South, R.N., was the general supervisor of nurses until the end of 1945. After that time Miss Eleanor Cryan acted as supervisor.

At the beginning of the special experiment in nutrition, a nutrition clinic, financed by the Milbank Memorial Fund, was established. The nutrition clinic was under the direction of Dr. H. D. Kruse of the Milbank Memorial Fund. Miss Eleanor Cryan, R.N., of the Community Service Society, acted as supervisor of the clinic.

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An especial acknowledgment is made to the New York City Department of Hospitals and to the private hospitals and other agencies for permission to obtain for statistical purposes records of the services rendered to members of the families included in the special study. Records of medical care were obtained from the following local hospitals: Harlem, Morrisania, Willard Parker, Metropolitan, Bellevue, and Rikers Island Prison Hospital; New York Orthopedic, Woman's Hospital, Manhattan Eye, Ear, and Throat, Polyclinic, St. Luke's, St. Vincent's, Harlem Eye and Ear, Lutheran, and New York Hospital; Memorial, Roosevelt, Hospital for Joint Diseases, Sloan Hospital, and the Vanderbilt Clinic.

An especial acknowledgment is made to the families which formed the study group and whose cooperation was essential to the conduct of the study.

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APPENDIX 1

Appendix Table 1. Distribution of vitamin and control families according to position of the index case in the family—upper Harlem area of New York City.

POSITION IN THE FAMILY OF THE INDEX CASE	VITAMIN (97 FAMILIES)	CONTROL (97 FAMILIES)
	Per Cent	
TOTAL	100.0	100.0
Husband	35.5	26.1
Wife	21.0	21.6
Child	32.2	32.9
Sibling of Husband or Wife	8.0	15.9
Nephew or Niece	3.3	3.5

Appendix Table 2. Distribution of families according to source of income, 1942—upper Harlem area of New York City.

SOURCE OF INCOME	VITAMIN (97 FAMILIES)	CONTROL (97 FAMILIES)
	Per Cent	
TOTAL	100.0	100.0
Earnings	35.4	38.8
Earnings and Some Public Assistance	11.5	12.2
Public Assistance	53.1	49.0

Appendix Table 3. Distribution of families according to composite ratings on food habits, 1942—upper Harlem area of New York City.

CLASSIFICATION OF FOOD HABITS	VITAMIN (97 FAMILIES)	CONTROL (97 FAMILIES)
	Per Cent	
TOTAL	100.0	100.0
Standard or Above	29.2	21.1
Slightly Below Standard	30.3	28.9
Marginal	28.1	38.9
Unsatisfactory	12.4	11.1

Appendix Table 4. Distribution of families according to crowding rating—upper Harlem area of New York City.

CROWDING RATING	PER CENT		NUMBER OF FAMILIES	
	Vitamin	Control	Vitamin	Control
TOTAL	100.0	100.0	97	97
More Than Adequate	14.4	7.2	14	7
Adequate	36.1	39.2	35	38
Unsatisfactory	33.0	35.1	32	34
Very Unsatisfactory	16.5	18.5	16	18

Appendix Table 5. Change in source of family income, 1942-1946—upper Harlem area of New York City.

SOURCE OF INCOME	PER CENT		
	1942	1944	1946
	VITAMIN		
	(97 Families)	(92 Families)	(87 Families)
TOTAL	100.0	100.0	100.0
Earnings	35.4	72.8	79.3
Earnings and Some Public Assistance	11.5	5.4	4.6
Public Assistance	53.1	21.8	16.1
	CONTROL		
	(97 Families)	(82 Families)	(82 Families)
TOTAL	100.0	100.0	100.0
Earnings	38.8	71.9	69.5
Earnings and Some Public Assistance	12.2	9.8	11.0
Public Assistance	49.0	18.3	19.5

Appendix Table 6. Change in mean annual income per cost unit, 1942-1946—upper Harlem area of New York City.

FAMILY GROUP	MEAN AVERAGE ANNUAL INCOME PER COST UNIT	STANDARD ERROR OF MEAN	STANDARD DEVIATION
	1942		
Vitamin	\$559	± 47.31	328
Control	488	± 23.43	178
	1944		
Vitamin	\$931	± 62.79	416
Control	853	± 50.70	369
	1946		
Vitamin	\$942	± 68.79	440
Control	993	± 53.99	404

Appendix Table 7. Change in rating on food habits, 1942-1947—upper Harlem area of New York City.

CLASSIFICATION OF FOOD HABITS	PER CENT		
	1942	1944	1947
	VITAMIN		
	(97 Families)	(89 Families)	(80 Families)
TOTAL	100.0	100.0	100.0
Standard or Above	29.2	71.2	50.0
Slightly Below Standard	30.3	18.8	37.2
Marginal	28.1	5.0	10.2
Unsatisfactory	12.4	5.0	2.6
	CONTROL		
	(97 Families)	(90 Families)	(79 Families)
TOTAL	100.0	100.0	100.0
Standard or Above	21.1	70.9	71.6
Slightly Below Standard	28.9	22.8	21.6
Marginal	38.9	3.8	4.1
Unsatisfactory	11.1	2.5	2.7

Appendix Table 8. Distribution of families according to number of moves of households during five years' observation, 1942-1946, 1947—upper Harlem area of New York City.

NUMBER OF FAMILY MOVES	PER CENT		NUMBER OF FAMILIES	
	Vitamin	Control	Vitamin	Control
TOTAL FAMILIES	100.0	100.0	97	97
0	39.2	38.2	38	37
1	26.8	27.8	26	27
2	22.7	19.6	22	19
3	4.1	8.2	4	8
4	4.1	3.1	4	3
5	3.1	3.1	3	3

APPENDIX 2

Description of qualitative classes used in rating weekly food records:

1. *Rating for Milk Used Per Person Per Week*

Standard or Above	4 quarts or more
Slightly Below Standard	3 quarts
Marginal	2 quarts
Unsatisfactory	1 quart or less

- 2. *Rating for Eggs Used Per Person Per Week*
 - Standard or Above 5 eggs or more
 - Slightly Below Standard 3 or 4 eggs
 - Marginal 2 eggs
 - Unsatisfactory 1 or no eggs
- 3. *Rating for Times Citrus Fruits and Tomatoes Used Per Week*
 - Standard or Above 6 times or more
 - Slightly Below Standard 4 or 5 times
 - Marginal 3 times
 - Unsatisfactory 2, 1, or no times
- 4. *Rating for Times Green and Yellow Vegetables Used Per Week*
 - Standard or Above 7 times or more
 - Slightly Below Standard 5 or 6 times
 - Marginal 3 or 4 times
 - Unsatisfactory 2, 1, or no times
- 5. *Rating for Times Lean Meat, Fish, or Fowl Used Per Week*
 - Standard or Above 8 times or more
 - Slightly Below Standard 6 or 7 times
 - Marginal 4 or 5 times
 - Unsatisfactory 3, 2, 1, or no times
- 6. *Composite Rating for Five Food Groups*
 - Standard or Above 5 ratings standard or above
 - Slightly Below Standard 1 or more ratings slightly below standard, no rating marginal or unsatisfactory
 - Marginal 1 or more ratings marginal, no rating unsatisfactory
 - Unsatisfactory 1 or more ratings unsatisfactory

When cheese was needed to meet the recommended allowances for milk, it was considered as a milk substitute. When the milk requirement was met with some of the cheese used, the rest of the cheese was considered as a meat substitute. All of the cheese used was considered as a meat substitute when the milk requirement was met without the use of cheese.

Procedure for using cheese as a milk substitute (based on values for calcium):

- 1. 1 lb. of cottage cheese = 1 pint of milk
- 2. 5 ounces of cheese (other than cottage cheese) = 1 quart of milk

Procedure for using cheese as a meat substitute (based on protein values):

- 1. 2 ounces of cheese (other than cottage cheese) = 1 serving of meat
- 2. 3 or 4 ounces of cottage cheese = 1 serving of meat

Procedure for using dried peas or beans as a meat substitute:
1 serving of dried peas or beans = 1 serving of meat

The dietary pattern to meet recommended allowances outlined by the Food and Nutrition Board of the National Research Council is as follows:

Milk, adults: 1 pint daily; children 1 quart daily

Vegetables: 2 servings daily; 1 green or yellow

Fruit: 2 servings daily; 1 citrus or tomato and 1 other

Eggs: 3 or 4 times per week

Meat: 1 serving daily

Whole grain or "enriched" cereal and bread: at least half the intake

Butter or fortified oleomargarine (100-500 calories)

Potato: 1 or more servings daily

The description of the crowding rating is as follows:

1. More than adequate: More than one room for sleeping per person or per married couple plus two additional rooms (for living room and kitchen).

2. Adequate: One room for sleeping per person or for each two persons of suitable age and sex plus two additional rooms (for living room and kitchen).

3. Unsatisfactory: One room for sleeping for each two persons of suitable age and sex, plus one additional room for kitchen.

4. Very unsatisfactory: Less than one room for sleeping for each two persons of suitable age and sex, plus additional room for kitchen.

Instructions (crowding rating) given for determining suitable age and sex for sharing a sleeping room were as follows:

1. *Sex*: One sleeping room for two persons of opposite sex is considered suitable if the two persons are married or if both are under 6 years of age.

2. *Age*: (a) A separate sleeping room is to be allowed for infants under 2 years of age, except where there is more than one infant under 2.

(b) Two persons under 20 years of age who are of the same sex may share the same sleeping room if there is less than six years difference in their ages.

(c) Two adults who are 20 years of age or older and of the same sex may share the same sleeping room if there is less than fifteen years difference in their ages.

(d) An adult who is 20 to 25 years of age may share a room with a younger person of the same sex if there is less than six years difference in their ages.

3. *Lodgers:* A separate room is to be allowed for each lodger of different sex, unless a married couple. Related lodgers will be treated in the same way as family members, except that no allowance will be made for a separate living room and kitchen for lodgers.