Hemoglobin Patterns in Low-Income Families

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THE WIDESPREAD occurrence of anemia is well documented. This disorder has been observed frequently in both representative populations and categorical subgroups, in technologically advanced and in developing regions. However, little information is available concerning either the prevalence or the familial concentration of anemia that reasonably might be expected in special risk segments of large cities.

Brooklyn is a heterogeneous urban community in which knowledge concerning the frequency and distribution of anemia could contribute to improved health services for residents. To date only three limited studies have been described, each suggesting a serious prevalence of low hemoglobin levels in selected subpopulations. Among 2,729 nonpregnant patients observed at a health department nutrition clinic over a 5-year period, hemoglobin readings of less than 12.5 gms. per 100 ml. were recorded for more than a third; of the 1,729 patients who were under 20 years of age, 43 percent had readings below this level and 2.6 percent had readings of less than 10.0 gms. Among 560 pregnant women, 38 percent had levels under 10.0 gms. (*1*, *2*). Haughton (*3*) reported hemoglobin concentrations of less than 10 gms. per 100 ml. in 18.9 percent of 286 preschool children in a health center serving a predominantly underprivileged population. Trice found a level below 10 gms. in 21.4 percent of 689 children attending another district clinic (personal communication, Dr. D. Trice, New York City Department of Health, July 17, 1964).

Although only small, selected samples were involved, the public health implications of these observations in scattered segments of the city warrant further efforts to determine the prevalence of anemia in adults as well as in children, notably within families among the vulnerable groups in this and similar communities.

This report describes the blood hemoglobin status of 5,597 persons from a predominantly low-income area. Data are provided concerning the relationship of substandard hemoglobin values to such variables as age, sex, ethnic group, tuberculin sensitivity, and welfare status. The familial concentration of low hemoglobin levels is demonstrated in households considered to be comprised largely of well persons.

Material and Methods

Data on blood hemoglobin levels were derived retrospectively from records for members of 1,342 or 97.5 percent of 1,376 families studied in depth by fourth-year medical students during the years 1956–65. Although most members of these families were not clinic patients, many were known to personnel of one or more out-

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patient departments, and access in all but 12 instances was through an index client of the New York City Department of Health or the Visiting Nurse Association of Brooklyn.

The composition of the study families is shown in table 1. Public health nurses selected 1,012 families or 75.4 percent of the sample for student evaluation from two of the borough's eight health districts, comprising a combined population of about 500,000 persons. Twelve families or 0.9 percent were selected by a medical social worker at an affiliated hospital (these families were considered nurse-selected families in the table). The remaining 318 families, 23.7 percent, chiefly from these same districts, were reached through one or more members who attended the health department nutrition clinic previously described (*1*, *2*). Of the total 1,342 families, 53.7 percent were Puerto Rican, 26.9 percent were Negro, and 19.4 percent were of mixed or unidentified ancestry, chiefly European. At the time of the study 49.9 percent were partially or completely supported by public assistance. However, since changes in welfare status were not uncommon in the study population, this distinction was neither sharp nor consistent.

Of the 8,186 persons involved, an average of 6.1 persons per household, 75.1 percent were in the families selected by the public health nurses and the medical social worker, and 24.9 percent were in those selected by the nutrition clinic staff. Sixty-four percent were below 15 years of age; 48.1 percent were males.

Hemoglobin levels were measured in all cooperating family members. The Sahli hemoglobinometer was used most frequently in the homes; only rarely were specimens transported to the laboratory for more precise determinations. Specific hemoglobin values were recorded for 5,597 persons, 68.4 percent of the 8,186 household members included in the study. Of these 5,597 persons, 67.8 percent or 4,166 were of the 6,148 in nurse-selected families, and 70.2 percent or 1,431 of the 2,038 in nutrition clinic families. Not included were 109 persons whose hemoglobin readings were recorded as normal and

Table 1. Composition of study sample by source of selection, ethnic group, and welfare status of family, Brooklyn, N.Y., 1956–65

Families	Means of support			
	Welfare	Non-welfare	Total	Percent of total
Nurse-selected	498	526	1,024	100.0
Puerto Rican	280	247	527	51.5
Negro	145	134	279	27.2
White and other	73	145	218	21.3
Nutrition clinic	172	146	318	100.0
Puerto Rican	106	88	194	61.0
Negro	48	34	82	25.8
White and other	18	24	42	13.2
All study	670	672	1,342	100.0
Puerto Rican	386	335	721	53.7
Negro	193	168	361	26.9
White and other	91	169	260	19.4

Table 2. Frequency of low hemoglobin levels by ethnic group, age, and sex, members of nurse-selected families, by percent, Brooklyn, N.Y., 1956–65

Ethnic group and age (years)	Number	Hemoglobin level in gms. per 100 ml.		
		Less than 11	Less than 10	Less than 9
Males				
Negro:				
0–4	187	56.1	30.5	18.2
5–9	158	50.0	17.7	7.6
10–14	59	28.8	3.4	1.7
15 and over	98	9.2	4.1	2.0
Puerto Rican:				
0–4	405	49.1	23.2	9.1
5–9	260	40.0	15.4	4.6
10–14	121	24.0	5.8	.8
15 and over	342	2.9	.3	0
White and other:				
0–4	104	40.4	24.0	6.7
5–9	81	37.0	16.0	3.7
10–14	31	19.4	0	0
15 and over	95	7.4	3.2	3.2
Females				
Negro:				
0–4	208	51.4	25.0	11.1
5–9	130	41.5	21.5	6.2
10–14	73	43.8	11.0	0
15 and over	237	40.1	16.9	4.6
Puerto Rican:				
0–4	346	52.3	28.0	11.4
5–9	256	38.3	10.9	3.5
10–14	121	27.3	10.7	0
15 and over	454	35.7	17.8	6.2
White and other:				
0–4	109	42.2	20.2	5.5
5–9	78	21.8	7.7	0
10–14	44	20.5	2.3	2.3
15 and over	169	20.1	8.9	1.8

eight identified only as anemic. In general, the proportions of persons for whom specific hemoglobin readings were not available were comparable for ethnic, age, and sex subgroups, except for an underrepresentation of adult males.

The results of the patch or tine tuberculin tests performed as part of the routine health evaluation of all subjects less than 15 years of age were recorded for 47.1 percent of the nurse-selected and 52.0 percent of the nutrition clinic group.

Results

Of the 5,597 hemoglobin values recorded, 34 percent were below 11 gms., 14.2 percent below 10 gms., and 5 percent below 9 gms. per 100 ml. Although some of the nutrition clinic families had been selected on the basis of anemia previously demonstrated in the index patients, those households selected by the public health nurses showed a greater overall frequency of substandard readings. This observation, also evident in each of the principal subgroups, appeared unattributable to differences in the ethnic, age, or sex representation within the respective samples.

The greatest frequencies of low hemoglobin levels were noted in the younger subjects, notably in Negroes and, to a lesser degree, in Puerto Ricans (tables 2 and 3; figs. 1 and 2). In males the greatest frequency of anemia was generally among children 0–9 years old. Women had a significantly greater ($P<0.0001$) frequency than men; a sex difference was also noted, albeit to a lesser degree, among pubescent subjects.

As seen in table 3 and figure 2, low hemoglobin readings were significantly ($P<0.0001$) more common in families receiving public assistance than in those not on welfare rolls. Although these groups differed significantly ($P<0.05$) in respect to ethnic and age composition, low readings also were more common in welfare-supported subjects within most major subgroups, notably Puerto Ricans under 15 years of age ($P<0.001$) and Negroes 15 years and older ($P<0.01$), as well as among all subjects less than 5 years of age ($P<0.0001$).

Among families selected through the nutrition clinic, hemoglobin concentrations were significantly lower ($P<0.0001$) where the readings of the index patients were below 11 gms. than where they were above this level (table 4). Although the composition of these subgroups also differed significantly ($P<0.01$) in respect to age and ethnic origin, differences between principal subsamples, such as Negroes and Puerto Ricans, matched for these variables were similar in direction, degree, and order of probability. Significantly fewer ($P<0.01$) persons in the families with members who were index clients with low hemoglobin readings were without hemoglobin readings, but the generally older age of subjects in this group operated against bias attributable to this factor. With-

Table 3. Frequency of anemia in members of nurse-selected families by ethnic group, age group, sex, and welfare status, Brooklyn, N.Y., 1956–65

Ethnic group and age (years)	Supported by public assistance	Number	Percent with hemoglobin level in gms. per 100 ml. of—		
			Less than 11	Less than 10	Less than 9
Negro:					
Under 15	Yes	438	47.5	18.3	7.3
	No	377	49.3	25.2	12.2
15 and over	Yes	170	38.8	14.1	4.1
	No	165	23.0	12.1	3.6
Puerto Rican:					
Under 15	Yes	908	46.5	21.5	8.1
	No	601	36.9	14.0	4.7
15 and over	Yes	383	23.0	9.7	3.7
	No	413	20.3	10.9	3.4
White and other:					
Under 15	Yes	156	37.2	17.9	3.2
	No	291	31.6	13.4	4.1
15 and over	Yes	88	18.2	9.1	3.4
	No	176	14.2	5.7	1.7

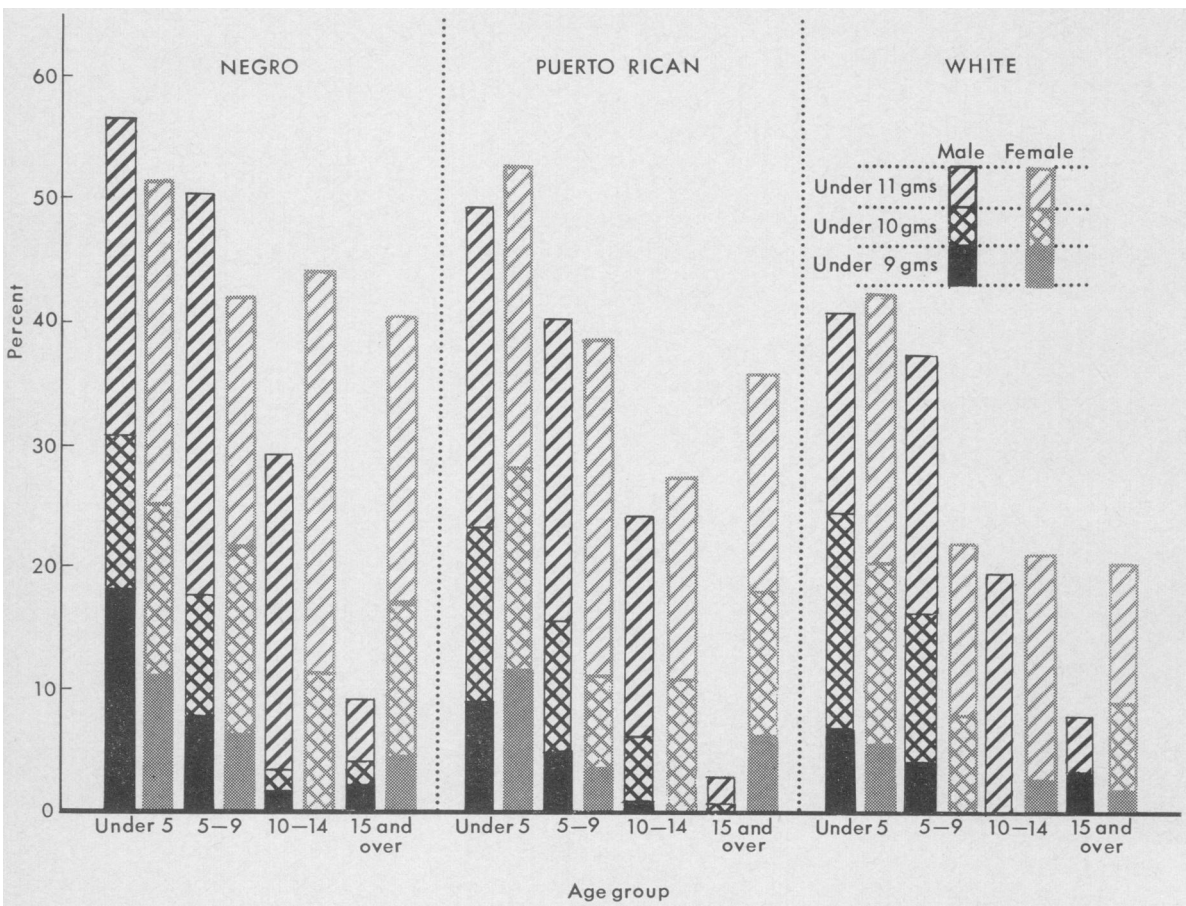
in the overall nutrition clinic subgroups, the frequency of low hemoglobin readings was not greater in households receiving public assistance.

Tuberculin skin test readings were recorded for 48.2 percent of all subjects under 15 years of age and 61.1 percent of those with specific hemoglobin determinations. Of the nurse-selected subjects, positive reactions were noted in 6.8 percent (10.8 percent of the Puerto Ricans, 4.2 percent of the Negroes, and 3.4 percent of the predominantly white group), with a slight excess among males. The frequency was appreciably, but not significantly ($P>0.05$), greater in children with hemoglobin levels above 11 gms. per 100 ml. than in those with levels below this. Positive reactions showed in 8.4 percent of persons in families receiving public assistance, as opposed to positive reactions in 4.6 percent of those not receiving assistance, a significantly greater frequency ($P<0.01$). In the smaller nutrition clinic sample, the frequency of positive tests was 10.7 percent, 12 percent for nonwelfare subjects and 9.7 percent for subjects receiving welfare assistance.

Discussion

The limitations of this study, notably that it is not a representative sample and that the hemoglobin estimations are imprecise, are obvious. The relative unreliability inherent in procedures performed outside the laboratory is compounded here by the large number and variable competence of the students who made these determinations. However, errors in the comparatively crude methods used probably balance on the average, with no consistent bias other than perhaps an anticipation of sub-

Figure 1. Frequency of anemia by ethnic group, sex, and age, in members of nurse-selected families, Brooklyn, N.Y., 1956–65



standard values throughout all low-income families, especially where anemia had already been demonstrated in one member of the household. Moreover, the sex and age differences in hemoglobin levels noted in this group are comparable to those demonstrated by more reproducible procedures (*4–10*).

Exception may be taken to the arbitrary categorization of hemoglobin levels as substandard, particularly where prevailing low concentrations encourage equating the usual with the normal. However, beyond an evident consensus that a concentration of 11 gms. per 100 ml. is below optimum even for younger subjects (*6–17*), the excessive frequency of readings below this level seems noteworthy in an area where higher standards ordinarily are applied.

Although anemia is not uncommon among the affluent and iron deficiency is found even in the obese (*18*), low hemoglobin levels should be anticipated more frequently among the less-favored economic groups from which this sample was derived (*4–6*). Poor dietary patterns, attributable to ignorance and apathy as well as to marginal availability of essential nutrients, commonly are among the factors responsible for substandard health in low-income areas. While a low blood hemoglobin level is not diagnostic of primary malnutrition in every instance, an appreciable frequency of reduced levels generally is considered evidence of substandard nutriture in population studies (*11*). Irrespective of cause, a low hemoglobin level even in an ostensibly healthy person indicates a need for medical attention.

The familial distribution of low hemoglobin concentrations, while consonant with expectations, seems not to have been documented previously in groups of predominantly well subjects. Common hereditary as well as environmental factors must be considered. The possibility that apparent ethnic differences in the frequency of

Figure 2. Frequency of anemia by ethnic group, age, and welfare status in members of nurse-selected families, Brooklyn, N.Y., 1956–65

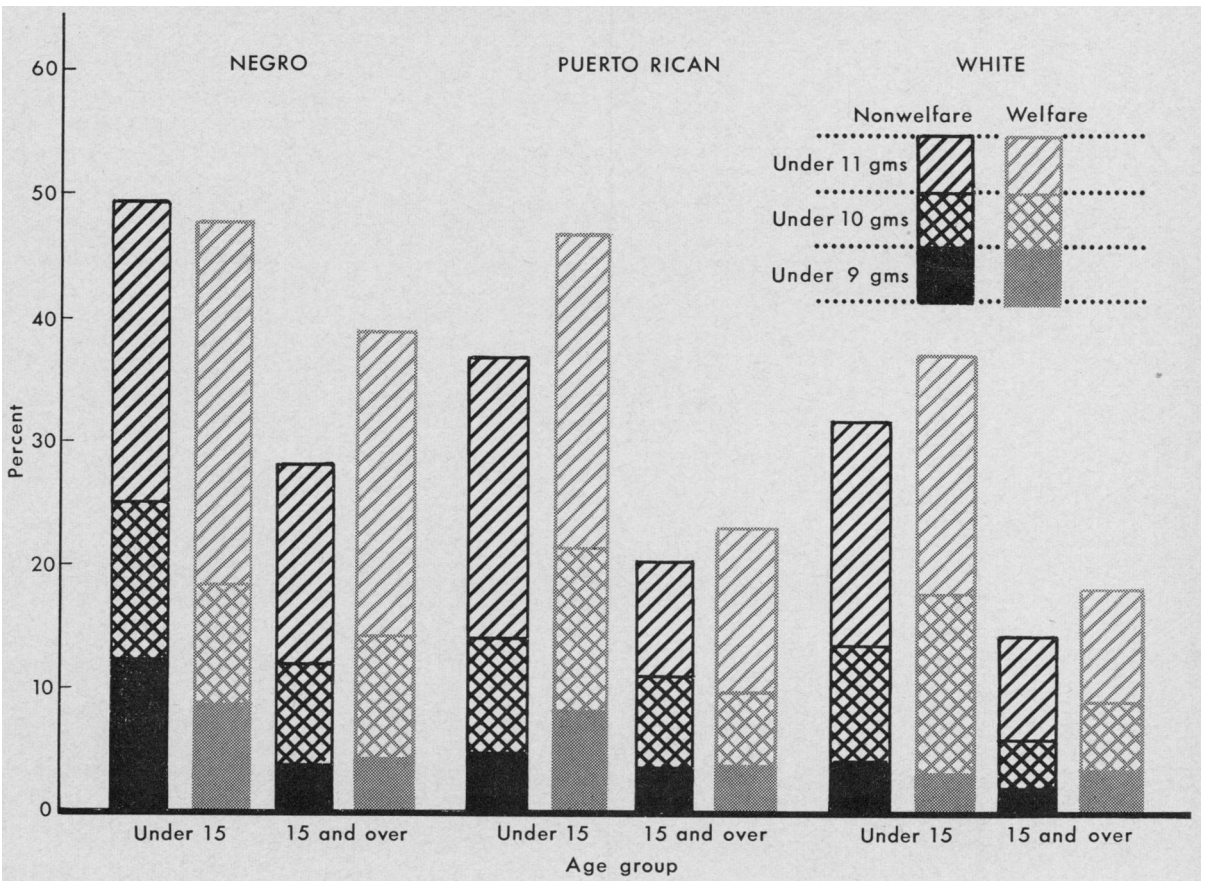


Table 4. Frequency of hemoglobin levels below 11 gms. per 100 ml. among relatives of nutrition clinic patients, by age and ethnic group, Brooklyn, N.Y., 1956–65

Ethnic group and age (years)	Hemoglobin level of nutrition clinic patients	Number of relatives of clinic patients	Percent of relatives of clinic patients with hemoglobin levels below 11 gms.
Negro:			
Under 15	Less than 11 gms	75	73.3
	11 gms. and over	81	30.9
15 and over	Less than 11 gms	30	46.7
	11 gms. and over	44	9.1
Puerto Rican:			
Under 15	Less than 11 gms	127	48.8
	11 gms. and over	257	24.1
15 and over	Less than 11 gms	83	18.1
	11 gms. and over	159	8.8
White and other:			
Under 15	Less than 11 gms	12	25.0
	11 gms. and over	55	29.1
15 and over	Less than 11 gms	4	0
	11 gms. and over	36	8.5

anemia are attributable to biological as well as to socioeconomic variables also should be more fully investigated.

Although these data permit no generalization concerning the prevalence of anemia in the general population, they do suggest a considerable, unacceptable frequency of low hemoglobin levels in what probably is a substantial segment of the community. More extensive studies are indicated to establish the magnitude as well as the immediate and long-term implications of this manifest public health problem.

Summary

Hemoglobin determinations were recorded for 5,597 persons (68.4 percent) in 1,342 predominantly low-income families in Brooklyn, N.Y., studied by fourth-year medical students over a 10-year period.

Blood hemoglobin concentrations were below 11 gms. per 100 ml. in 34.0 percent of the subjects, below 10 gms. in 14.2 percent, and below 9 gms. in 5.0 percent. The highest frequencies of anemia were observed generally among children 0–9 years old, notably in Negroes and, to a lesser degree, Puerto Ricans. Low hemoglobin readings also were relatively more common in younger males and in adult and pubescent females.

Anemia was more common among relatives of index patients with low hemoglobin levels and in families receiving public assistance. It was not more common among children with positive tuberculin tests.

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Travel Grants Available for Scientists to Attend Congresses on Tropical Medicine and Malaria

A grant to support travel of approximately 75 scientists to participate in the Eighth International Congresses on Tropical Medicine and Malaria has been awarded to the American Society of Tropical Medicine and Hygiene by the Public Health Service's National Institute of Allergy and Infectious Diseases. The congresses will be held in Teheran, Iran, September 7–15, 1968.

The grant, administered by a committee appointed by a council of the society, will provide support to cover the cost of a minimum rate round trip air ticket from the home of each recipient and $50 for other expenses incidental to travel, registration, and attendance.

Recipients will not be allowed to use funds from other U.S. Government sources to supplement their awards, and no other funds from the National Institutes of Health may be used for attending the congresses.

Applicants must be U.S. citizens or residents of the United States or Canada, and employees of the Federal Government will not be eligible. Members of the American Society of Tropical Medicine and Hygiene will not receive preferential consideration over nonmembers.

Applicants will be required to provide information on their official relationship to the congresses, that is, whether they are officers or invited participants, and to estimate the benefits accruing to themselves and their institutions through their participation.

The deadline for receipt of applications is March 1, 1968, but earlier submission of applications may result in an earlier decision. Decisions on the awards will be made as early as possible but not later than June 7, 1968.

All inquiries and letters of application should be addressed to the Executive Secretary, Travel Grants, American Society of Tropical Medicine and Hygiene, P.O. Box 295, Kensington, Md. 20795.

Program Notes

Dangers of Raw Milk

A district health department ordered a dairy in Yakima County, Wash., to stop distributing grade A raw milk, and all nonpasteurized products of the dairy were pulled from grocery shelves after an outbreak of salmonellosis in the county early in 1967. Thirty-seven cases of the disease were reported, and 28 persons were known to have been hospitalized.

Dr. Bernard Bucove, State health director, pointed out that the single dairy involved had met all legal requirements for general cleanliness and methods of operation. Yet a calf and three cows at the dairy were found to be shedding *Salmonella typhimurium* organisms, milk in a bulk-milk holding tank was found contaminated with salmonellae, and bottled raw milk bearing the dairy's label which was sampled in grocery stores was found to be contaminated with the organism.

Electric Vehicle Study

A 1967 State law establishes the New York Vehicle Electrification Corporation, a public service organization in which the health commissioner is to be a member along with other State officials and five persons appointed by the Governor. Corporation officials will explore new ideas in privately financed transportation which is powered electrically or by other means. Such transportation might include emergency medical transportation and even nuclear powered vehicles.

Increasing Bicycle Fatalities

Annually, 700 lives are being lost in the United States from pedal cycling accidents. Moreover, authorities estimate that between 120,000 and 150,000 persons sustain disabling injuries in such accidents in a single year.

Nearly nine of 10 deaths in pedal cycling are among males. Children 5–14 years account for 72 percent of the loss of life in cycling.

After age 19, the risk of fatal injury did not exceed one per million population until past age 64. Past 64, the rate was 1.6 per million, evidencing the popularity and the hazards of biking among the elderly.—*Statistical Bulletin* (Metropolitan Life Insurance Company), July 1967.

Laboratory Technician Training

The District of Columbia General Hospital is offering a 54-week course in laboratory techniques. The course is open to high school graduates with some science background who are 21 years of age or under. They must live in the Metropolitan Washington area. Subjects include bacteriology, chemistry, cystology, and hematology.

Students are granted free tuition and a weekly allowance of $20 plus transportation costs, free physical examination, medical benefits, and necessary school supplies.

Fatalities in School Children

The fatal accident rate among U.S. school-age children has returned to the high level that prevailed a decade ago. The rate at the years 5–14 rose sharply in 1966 to an estimated 20 per 100,000. Motor vehicle accidents were responsible for the setback.—*Statistical Bulletin* (Metropolitan Life Insurance Company).

Training for Mental Hygiene

New York State has begun a new part-time year-round working training program within the department of mental hygiene for high school students from disadvantaged areas. The program will give the students a chance to earn money during the early evening and weekends.

The young people will be assigned to hospitals for the mentally ill and schools for the retarded throughout New York State. They will earn $1.50 an hour. The program, modeled on a 6-week summer experiment, expects to enroll 1,000 pupils of working age from all parts of the State.

A supervisor at each institution will counsel and direct the trainees, assign jobs, and seek to find appropriate work for pupils who have already selected specified careers.

Life Expectancy in U.S.A.

The average length of life in 1965 in the United States was 70.2 years, the same as in 1964. Improvement in life expectancy in this country, while great since 1900, has been relatively stationary in the past decade.

Expectation of life at birth for white females in 1965 was 74.7 years and 67.6 years for white males. Thus, the expectation among white females exceeded that for white males by 7.1 years, compared with 6.4 years in 1956 and 2.9 years at the turn of the century.

Among nonwhites, expectation of life at birth in 1965 was 61.1 years for males, the same as in 1956. Among nonwhite females, the figure rose from 65.9 years in 1956 to 67.4 years in 1965.

Automated Air Pollution Detection

A fully automated, unattended field station for the transmission of air pollution data has been established in Allentown, Pa. It transmits air quality information to a base station of the Pennsylvania Department of Health's division of air pollution in Harrisburg.

Housed in a specially built and specially equipped automotive field unit, the Allentown station is the prototype of 24 more which will be sited elsewhere throughout the State as funds become available.

Measures being transmitted for printout in Harrisburg include windspeed and direction, sulfur dioxide concentrations in parts per million, concentration of carbon monoxide or organic gases, concentration of hydrocarbons, and concentration of particulates (or small particles of carbon and other solid matter).