

AN EXPERIMENT IN WEIGHT NORMALIZATION
OF
UNDERWEIGHT COLLEGE GIRLS

A DISSERTATION
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NELL MORRIS, B.S.,

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I hereby recommend that the thesis prepared
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Hoylande D. Young
In Charge of Thesis

[Signature]
Director of Department

Accepted:

W. H. Slack
Chairman, Committee on Graduate Study

PREFACE

There is at present considerable interest in underweight conditions among young women and their relation to health. Various universities and colleges have made studies of the prevalence and danger of underweight among the students. Morrison and Chenoweth found that tuberculosis was more frequent among young people below normal in weight than among those of normal weight. Meredith also found that adequate nutrition and normal weight were factors in preventing pulmonary infections.

With the above facts in view, this experiment in weight normalization was carried out at the Texas State College for Women to determine the effect of food and exercise upon the underweight college girl.

It is my pleasure to express my appreciation and thanks to Dr. Hoylande D. Young, who supervised this work, to the group of students who served as subjects, through whose interest and cooperation this study was made possible and to the Physical Education Department of the college.

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EXPERIMENT IN WEIGHT NORMALIZATION
OF UNDERWEIGHT COLLEGE GIRLS.

In recent years the prevalence of underweight among young women has attracted the attention of many people in both medical and nutritional fields. Fisher¹ states that before the age of twenty-five pronounced underweight is an unfavorable condition often associated with lack of resistance to pulmonary infections and to other diseases of youth. At any age when a condition of malnutrition exists with a constant loss of weight effort should be made to determine if there is any tuberculosis or other infection present. The weight² is of special interest because in many cases it can be modified by care and caution in simple hygienic procedures such as diet and exercise. Morrison³ and Chenoweth state that tuberculosis is a very common condition in young people and reduction in weight is one of its characteristic symptoms. Its importance as a cause of death, in relation to other diseases is greatest between twenty and twenty nine years.

Two-thirds of the deaths from all forms of tuberculosis

(1) Fisher and Fish, "How to Live", Sec.2. p. 305. Funk and Wagnallis Co., New York and London, 1921.

(2) Morrison and Chenoweth, "Normal and Elementary Physical Diagnosis", chapter 4, p.76. Lea and Febiger, Philadelphia 1928.

(3) Ibid. chapter 4, p. 76.

occur in the period between fifteen and forty-five years. Diseases of this type attack the undernourished more readily than they do the well nourished person. The earliest recognition of the need of adequate nutrition was by those⁴ who observed its effect in preventing tuberculosis.

In 1921 a study was made of the prevalence of under-⁵weight among the women attending the University of Chicago. One hundred and fifty of the five hundred entering in the Fall were found to be at least 10% underweight. Studies were made at other schools also. Thus in 1928 an experiment on "Weight Normalization" was undertaken at the University of Illinois.⁶ At East Lansing Michigan, in 1929 The Home Economics Department studied "Diets in the Control of Weight"⁷ regulating the diets of both overweight and underweight girls in order to establish normal weight.

Interest in these studies and reports and the observation that many of the students at the Texas State College for Women, were underweight led to the present study of weight normalization at this college.

(4) Meredith, "Hygiene", chapter 7, p. 467. Blakiston, Philadelphia 1927.

(5) Blunt and Bauer, "The Basal Metabolism and Food Consumption of Underweight College Women", Jour. Home Econ. 14, p. 174 (April 1922).

(6) Noyes, "Weight Normalization of College Woman", Am. Phys. Edu. Rev. 33, p. 450 (September 1928).

(7) Barto, "Diet and Exercise in the Control of Weight", Jour. Home Econ., 21, p. 21 (March 1929).

The experiment described here consisted in selecting a group of underweight girls and providing those girls with a liberal diet, encouraging them in suitable health habits and thereby establishing as completely as possible the conditions necessary for weight normalization.

A group of twenty-four underweight college girls varying in age from seventeen to twenty-two years and ranging from 7% to 26% below the weight standards set by Dr. Thomas D. Wood⁸, served as subjects for the diet and metabolism observations given in this paper. These girls were selected by Miss Agnes Murphy a member of the Physical Education Department. The college physician had pronounced all the subjects selected for this study, with one exception, to be normal except for their underweight.

The subjects were placed on the regular college diet with supplements of milk and cream. The college diet is a well balanced diet containing an abundance of fresh fruits and vegetables. These are available at all seasons of the year since they can be obtained through produce houses in Fort Worth and Dallas, Texas, from the Rio Grande Valley in the Southwestern portion of the state.

(8) Williams, "Personal Hygiene Applied", chapter 4, p. 183. W. B. Saunders and Co., Philadelphia and London, 1927.

On account of the mild temperature in the Valley, fruits and vegetables grow abundantly and are obtainable throughout the year. Since this diet was satisfactory it was used with supplements to increase the caloric content of the diet. The caloric content of the diet was approximately 2000 to 2500 calories. This diet was served over a period of fifteen weeks. Typical menus served to the subjects are recorded in table following.

TABLE I.

THESE MENUS ARE TYPICAL OF THOSE SERVED
DURING OBSERVATION PERIOD

BREAKFAST

Oranges
Cream of Wheat or Post Toasties
Bacon
Scrambled Eggs
Toast
Butter
Milk and Cream
Coffee

LUNCH

Salmon Loaf with Tartar Sauce
French Fried Potatoes
Escalloped Tomatoes
Whole Wheat Bread
Butter
Pear Salad with Grated Cheese
Apricot Whip
Cookies
Milk Shake

DINNER

Broiled Ham with Raisin Sauce
Sweet Potatoes with Marshmallows
Buttered Spinach
Apple Celery Salad
Hot Biscuits
Butter
Pecan Pie
Milk and Cream

BREAKFAST

Grapefruit
Bran Flakes or Shredded Wheat
Cinnamon Rolls
Preserves
Butter
Milk and Cream
Coffee

LUNCH

Vegetable Soup
Crackers
Seasoned Carrots
Mashed Potatoes
Whole Wheat Bread
Butter
Banana Salad
White Cake with Carmel Filling
Milk and Cream

DINNER

Swiss Steak
Rice (Steamed)
Asparagus
Lettuce Cucumber Salad
French Rolls
Butter
Ice Cream
Peanut Cookies
Milk Chocolate

BREAKFAST

Prunes
Oatmeal or Rice Krispies
Carmel Biscuits
Fried Eggs
Butter
Milk and Cream
Coffee

LUNCH

Cheese Souffle
Seasoned Squash
Fried Corn
Tomato Salad
Whole Wheat Bread
Butter
Milk and Cream
Chocolate Fudge Cake

DINNER

Lamb Chops with Mint Jelly
Buttered Potatoes
Creamed Peas
Royal Ann Cherry Salad
Snow Flake Rolls
Butter
Pineapple Sherbet
Angel Food Cake
Milk Shake

In order that individual observations could be made during the meal special tables were arranged in the college dining room for the subjects separate from the regular boarding students. Three meals, consisting of breakfast, lunch and dinner were served daily in the college dining room to the subjects. Each subject attended all three meals regularly as far as possible. Occasionally it was necessary for a subject to be absent on account of out of town visits or entertaining guests.

Records were kept on small cards of the amount of food eaten during each meal and also that which was eaten between meals and the calories per day were totaled. When it was necessary for one of the subjects to be out of town, record was kept of the quantity and kind of food eaten while absent and a report was made upon returning.

Each girl's caloric requirement was determined from her weight in kilograms and the amount and kind of exercise taken daily. An effort was made to obtain this caloric requirement throughout the period of observation. In order that the caloric requirement could be maintained a larger consumption of food was necessary than the subjects were accustomed of taking. There was at first some difficulty in developing an appetite for larger quantities of food, but later during the study this was overcome as the girls became more accustomed

to larger servings than they had eaten formerly. The physical capacity of the individual was, however, taken into consideration .

The Basal Metabolic Rate is determined by the activity of the organs, muscles and in part by body weight and body surface area, and the heat produced by the body is an indication of the metabolic activity of the tissues. The two factors most commonly and markedly affecting Metabolic Rate are exercise and food¹⁰. For this reason Basal Metabolic Rate determinations were made on some of the subjects during the observation period. The Bailey¹¹ gasometer method was employed in the collection of the air and for the gas analysis Bailey's¹² modification of the Haldane-Henderson gas analysis apparatus was used.

The subjects were enrolled in classes in Physical Education in which exercise was a fairly constant factor.

(9) Donelson, Nims, Hunscher, Shukes and Macy, "Simple Methods for Metabolic Balance Studies and Interpretations", Jour. Home Econ., 23, p. 267 (March 1931).

(10) Smell, Ford, Rountree, "Studies in Basal Metabolism", Jour. Am. Med. Assocn., 75, p. 515-522 (August 1930).

(11) Hawk and Bergeim, "Practical Physiological Chemistry", fifth edition, p. 520. P. B. Blakiston and Co., Philadelphia 1927.

(11) Bailey, "Notes on Apparatus Used in Determining the Respiratory Exchange in Man", Part I. Jour. Bio. Chem. 47, p. 277 (May 1921).

(12) Bailey, "Notes on Apparatus Used in Determining the Respiratory Exchange in Man", Part II. Jour. Bio. Chem. 47, p. 281 (May 1921).

During the week the importance of an adequate diet, correct exercise, and the correct way of resting were taught. Regular hours were advocated for all activities during the day and there was special emphasis upon the need for eight hours sleep at night in a well ventilated room.

The subjects were weighed at the beginning of the observation period and then weekly thereafter. For the initial weighing and measuring the girls wore gym suits and removed their shoes; however, for each weekly weighing the regular college uniform was worn. This clothing worn during the weekly weighing was very light and all of approximately the same weight. These weights were recorded on a table which contained the subjects' ages, height and normal weight. The height¹³ was taken at the initial weighing. This table served to stimulate interest among all the subjects throughout the observation period as comparisons in gains were made.

(13) Beveridge, "Our Health Habits", p.490. Rand McNally and Co., Chicago and New York 1928.

TABLE III

TABLE SHOWING RECORD OF WEIGHT TAKEN
DURING OBSERVATION PERIOD

Subject	Age	Height	Weight In Pounds	Normal Weight	Percent Under- Weight	Feb. 13	Feb. 20	Feb. 26	Mar. 5
1	23	64"	98	125	22%	99	99	99 $\frac{3}{4}$	100
2	20	64 $\frac{3}{4}$ "	92 $\frac{1}{2}$	126	26%	94	98 $\frac{1}{2}$	98 $\frac{1}{2}$	99 $\frac{1}{2}$
3	20	60 $\frac{1}{2}$ +"	93 $\frac{1}{2}$	110	11%	96	100	100	99 $\frac{1}{2}$
4	19	65"	99	126	17%	104	107 $\frac{3}{4}$	107 $\frac{3}{4}$	110 $\frac{1}{2}$
5	20	63 $\frac{1}{2}$ "	96	119	20%	100	102 $\frac{1}{2}$	103	103 $\frac{1}{4}$
6	20	61 $\frac{1}{4}$ "	107	126	11%	111	114	114	113
7	18	65 $\frac{1}{2}$ "	101	120	20%	102	102 $\frac{1}{2}$	102 $\frac{1}{2}$	101
8	19	62 $\frac{1}{2}$ +"	104	119	11%	105	106	106	108
9	20	62+"	95	115	18%	99	100 $\frac{1}{2}$	100 $\frac{1}{2}$	102 $\frac{1}{2}$
10	22	60 $\frac{1}{2}$ "	93 $\frac{1}{2}$	116	19%	96 $\frac{1}{2}$	101	102 $\frac{3}{4}$	103
11	18	62"	98 $\frac{1}{2}$	115	18%	101	101 $\frac{1}{2}$		
12	23	61 $\frac{3}{4}$ +"	110	119	18%	106	106	106	106
13	19	63 $\frac{1}{2}$ "	106	123	14%	109	112 $\frac{1}{2}$	115	116
14	19	62 $\frac{1}{2}$ +"	102	119	15%	108	110 $\frac{1}{2}$	111	109 $\frac{3}{4}$
15	17	60+" "	96	109	12%	100	100	100	100 $\frac{1}{2}$
16	18	65 $\frac{1}{2}$ "	107	128	16%	106	108	112 $\frac{1}{2}$	115 $\frac{3}{4}$
17	18	60+" "	83	111	26%	84	83	87 $\frac{1}{2}$	85
18	19	59 $\frac{1}{2}$ "	90	106	11%	96 $\frac{1}{2}$	100	100 $\frac{1}{2}$	100
19	19	62 $\frac{1}{2}$ +"	100 $\frac{1}{2}$	119	15%	104	107	108	108
20	18	63+" "	106	119	11%	109	109 $\frac{1}{2}$	110	112
21	18	60"	101	106	9%	102	102	102 $\frac{3}{4}$	102
22	19	62 $\frac{1}{2}$ "	105	121	15%	107	107 $\frac{1}{2}$	106 $\frac{1}{2}$	107
23	19	64"	111	123	11%	112	112 $\frac{1}{2}$	112 $\frac{1}{2}$	113 $\frac{3}{4}$
24	21	65"	120	128	7%	121	124	125 $\frac{1}{2}$	126 $\frac{1}{2}$

Mar. 12	Mar. 19	Mar. 26	Mar. 31	Apr. 9	Apr. 16	Apr. 23	Apr. 30	May 7	May 14	May 21	May 25	Total Weight Gain
104 $\frac{3}{4}$	100 $\frac{1}{2}$	100	100 $\frac{1}{2}$	100 $\frac{1}{2}$	100 $\frac{1}{2}$	101	102	100	99	100	101	3
100	103	101	102 $\frac{1}{2}$	102 $\frac{1}{2}$	103 $\frac{1}{2}$	103 $\frac{3}{4}$	104 $\frac{1}{2}$	105	105 $\frac{1}{2}$	105	106	13 $\frac{1}{2}$
99	100 $\frac{1}{4}$	100	100	98	96 $\frac{1}{2}$	98	98	96	97	97	-	3 $\frac{1}{2}$
109 $\frac{3}{4}$	110	111	111 $\frac{1}{4}$	110	110	109 $\frac{1}{2}$	109	109 $\frac{1}{2}$	110	110	110	11
103	103	104	104 $\frac{3}{4}$	105	103 $\frac{3}{4}$	102 $\frac{1}{2}$	104	104	104	103	-	7
114 $\frac{1}{2}$	113 $\frac{1}{2}$	114	117	112 $\frac{1}{2}$	115	114	116 $\frac{1}{2}$	116 $\frac{1}{2}$	116	116 $\frac{1}{2}$	-	9 $\frac{1}{2}$
101 $\frac{1}{2}$	103 $\frac{1}{2}$	103 $\frac{1}{2}$	104	104	104 $\frac{1}{2}$	105 $\frac{1}{2}$	105	105	105	104 $\frac{1}{2}$	-	3 $\frac{1}{2}$
108 $\frac{1}{4}$	109	109 $\frac{1}{2}$	109	109	108	108 $\frac{3}{4}$	109	109	108 $\frac{1}{2}$	108	109	5
102	102 $\frac{1}{2}$	103	104 $\frac{1}{2}$	103	104	104	102	103	104 $\frac{1}{2}$	105	105	10
114 $\frac{1}{2}$	105	105 $\frac{3}{4}$	108 $\frac{1}{4}$	107	109	108 $\frac{1}{2}$	110	112 $\frac{1}{2}$	112 $\frac{1}{4}$	111 $\frac{1}{2}$	112 $\frac{1}{2}$	19
	101 $\frac{1}{2}$	100 $\frac{1}{2}$	101 $\frac{1}{2}$	100	100	101 $\frac{1}{4}$	101 $\frac{3}{4}$	101 $\frac{1}{2}$	101 $\frac{1}{2}$	101 $\frac{1}{2}$	102	3 $\frac{1}{2}$
107 $\frac{3}{4}$	107 $\frac{1}{2}$	107 $\frac{1}{2}$	108 $\frac{1}{2}$	109 $\frac{1}{2}$	106 $\frac{1}{2}$	107	107	107 $\frac{1}{2}$	108	108 $\frac{1}{2}$	-	8 $\frac{1}{2}$
118	116 $\frac{3}{4}$	116	116	118 $\frac{1}{2}$	116	116 $\frac{1}{2}$	118	120 $\frac{1}{2}$	119	118	120	14
111	111 $\frac{1}{4}$	111 $\frac{1}{2}$	111 $\frac{1}{2}$	112 $\frac{1}{2}$	111	110	109 $\frac{3}{4}$	110	110	110	-	8
100	100	100 $\frac{1}{4}$	100	99	100	99	100	100	99	100	-	4
115	115 $\frac{3}{4}$	115	116 $\frac{1}{2}$	114	114 $\frac{1}{2}$	114	114	114	114	115	-	8
85 $\frac{1}{2}$	86	85 $\frac{1}{2}$	87 $\frac{1}{2}$	86 $\frac{1}{2}$	86	89 $\frac{1}{2}$	87 $\frac{1}{2}$	89 $\frac{1}{2}$	89 $\frac{1}{2}$	89 $\frac{1}{2}$	-	6 $\frac{1}{2}$
101	101	101 $\frac{1}{2}$	102 $\frac{1}{4}$	102	100	100 $\frac{1}{2}$	100 $\frac{3}{4}$	100 $\frac{1}{2}$	101	101	-	6
108	109	109 $\frac{1}{2}$	109	105	107	109	110	111 $\frac{1}{2}$	111	110	-	9 $\frac{1}{2}$
112 $\frac{1}{2}$	113 $\frac{3}{4}$	114	115 $\frac{1}{2}$	115	115	114 $\frac{1}{2}$	115	115	114	114	-	8
102 $\frac{1}{2}$	102	102 $\frac{1}{4}$	102	102	101	102 $\frac{1}{2}$	103 $\frac{1}{2}$	102	103	103	-	2
106 $\frac{1}{2}$	107 $\frac{1}{2}$	106	105	104	106	105	105	104	105	105	-	0
112 $\frac{1}{2}$	112 $\frac{3}{4}$	112 $\frac{3}{4}$	113 $\frac{1}{2}$	112	112	111	111 $\frac{1}{2}$	112	112	113	-	2
125 $\frac{3}{4}$	126	127 $\frac{1}{2}$	128 $\frac{1}{2}$	127	128	128 $\frac{1}{2}$	127 $\frac{1}{2}$	128 $\frac{1}{2}$	127 $\frac{1}{2}$	128 $\frac{1}{2}$	-	8 $\frac{1}{2}$

Standards for weight and height at various ages have been drawn up by nutritional workers, medical men and life insurance companies,¹⁴ who have weighed and measured large numbers of individuals estimating from these weights and measures what an average person of a given height should weigh at a given age. In selecting the ideal weight some allowance must be made for the physical type of the individual. Three main types are recognized:

- (a) Those with light framework
- (b) Those with medium framework
- (c) Those with heavy framework.

Criticisms of the use of the height-weight relation have been made because of the variance in type of build of different individuals of the same race and the differences between races.¹⁵ The tall thin rangy individual will always be underweight, and the short stocky and "thick set" type¹⁶ will always be overweight according to the average.

Nevertheless for practical purposes since the weight standards set forth are an average of various groups 10 to 12% or more below the weight standard is considered indicative of undernourishment.

(14) Fisher and Fish, "How to Live", Sec.I, p. 282. Funk and Wagnallis Co., New York and London, 1921.

(15) Morrison and Chenoweth, "Normal and Elementary Physical Diagnosis", Chapter 4, p. 75. Lea and Febiger, Philadelphia, 1928.

(16) Ibid. Chapter 4, p. 76.

By a comparative study of the weight averages, and by comparing the health of individuals at various weights, it has been possible to determine what weight is most likely to lead to the best health. In this way optimum weights have been computed. Meredith¹⁷ emphasizes the use of comparisons of the height-weight table in gauging one's nutrition.

¹⁸
Blunt and Bauer at the University of Chicago used as their height-weight standard, for young women, those set forth by life insurance companies. The standards of height-weight used for averaging the subjects' weight in this study were those of Dr. Thomas D. Woods,¹⁹ the standards used by the Physical Education Department.

(17) Meredith, "Hygiene", chapter 34, p. 456. Blakiston, Philadelphia 1927.

(18) Blunt and Bauer, "The Basal Metabolism and Food Consumption of Underweight College Women", Jour. Home Econ., 14, p. 171-180 (April 1922).

(19) Williams, "Personal Hygiene Applied", chapter 7, p. 183. W.B. Saunders Co., Philadelphia and London, 1927

HEIGHT-WEIGHT TABLE
BY DR. THOS.D. WOOD

TABLE III

WOMEN

Height	17	18	19	20	21 22	22 23	23 24	25 29	30 34	35 39	40 44	45 49
4' 10"			98	102	106	110	113	116	119	123	126	129
4' 11"			103	107	109	112	115	118	121	125	128	131
5' 0"	104	106	109	112	113	115	117	120	123	127	130	133
5' 1"	109	111	113	115	116	118	119	122	125	129	132	135
5' 2"	114	115	116	118	119	120	121	124	127	132	135	138
5' 3"	118	119	120	121	122	123	124	127	130	135	138	141
5' 4"	121	122	123	124	125	126	128	131	134	138	141	144
5' 5"	124	125	126	127	128	129	131	135	138	142	145	148
5' 6"	127	128	129	130	131	133	135	139	142	146	149	152
5' 7"	129	130	131	133	135	137	139	143	146	150	153	156
5' 8"	133	134	135	137	139	141	143	147	150	154	157	161
5' 9"	136	137	138	140	142	145	147	151	154	158	161	165
5' 10"	139	140	141	143	145	148	151	154	157	161	164	169
5' 11"	143	144	145	147	149	151	154	157	160	164	168	173
6' 0"	148	149	150	152	154	156	158	161	163	167	171	176

DISCUSSION

The subjects observed varied in age as well as height and activity. Characteristic of almost all the girls were nervousness, restlessness and a more or less "high strung" condition. Most of them tired easily and worried about their work. Chenoweth²⁰ states that worry is a common cause of underweight. Irregular hours and lack of sleep were characteristic of the entire group. On the whole the girls were distinctly below par in general appearance, though as a result of a physical examination made at the beginning of the Fall semester by the college physician all but one had been pronounced normal except for their underweight. This one girl had infected tonsils which were removed during the Spring Semester.

These girls were all studious and lived a fairly quite life as they were dormitory residents.

Noticeable individual characteristics of the group were:

1. Extreme restlessness
2. Bad posture
3. Excitability and nervousness
4. Unusual amount of energy
5. Studiousness
6. Unusual amount of fatigue
7. Very little appetite.

(20) Morrison and Chenoweth, "Normal and Elementary Physical Diagnosis", chapter 4, p. 76. Lea and Febiger, Philadelphia, 1928.

Nine per cent of the subjects were 7-10% below the average while twelve percent were 20-26% and seventy nine percent were 10-20% below the average weight standards set by Dr. Thomas D. Wood.²¹ From these percentages taken at the beginning of this observation it may be noted that the entire group of subjects were not meeting their caloric requirement. In an effort to overcome this underweight condition each girl's caloric requirement was estimated from her weight in kilograms and daily activities. These requirements were compared with the records of the caloric intake of each subject during the observation period to determine whether the caloric intake was adequate. In each case where the daily caloric requirements were met and no disorders such as colds were present a gain in weight was observed with the exception of subjects 3 and 22, who made only very slight gains.

(21) Williams, "Personal Hygiene Applied", chapter 7, p. 183. W.B. Saunders Co., Philadelphia and London, 1927.

TABLE IV
ESTIMATED CALORIC REQUIREMENT

Subject	Estimated Caloric Requirement	Average Intake Per Day	Average Gain In Weight Per Week
1	1556	1724	0.12
2	1678	2131	0.90
3	1515	3168	0.26
4	1796	1796	0.65
5	1524	2022	0.40
6	1670	2034	0.63
7	1541	1603	0.23
8	1651	1981	0.33
9	1460	1700	0.66
10	1484	1628	1.08
11	1485	1690	0.26
12	1588	1614	0.56
13	1923	2213	0.96
14	1619	1881	0.80
15	1524	1543	0.1
16	1698	1780	0.6
17	1317	1543	0.4
18	1428	1817	0.86
19	1595	1998	0.7
20	1682	1735	0.71
21	1603	1724	0.13
22	1650	1600	0.0
23	2014	1795	0.16
24	2177	2506	0.66

Subjects 2, 10 and 13 gained exceedingly well. They showed a splendid spirit of cooperation and were regular with all their habits. As a result of an adequate caloric intake, regular hours and good health habits, these three subjects had the highest average of gains throughout the observation period.

Subject 3 did not keep regular hours or cooperate as much as possible during the observation. She was also very susceptible to colds because of lowered resistance, a result of her malnourished condition.

Subject 4 cooperated in every respect and gained fairly well considering that she was of the tall thin athletic type and had never gained very much in her life. During the last few weeks of the observation some loss was noticed in her weight due to the fact that she was taking extra exercise (from her physical education) by practicing for the tennis tournament.

Subject 11 gained very little because after the first week of the observation she was absent from school for three weeks due to gland trouble disturbances. However this case had been pronounced normal at the beginning of

the semester by the college physician when the group was selected. Upon returning she was very regular with all her habits, cooperating well and had a good attitude.

Subject 19 at the beginning of the observation made only a slight gain, probably because of infected tonsils. Most of this weight was lost during the spring holidays after a tonsilectomy. Upon returning to school and resuming the regular habits and high caloric diet of the group under observation a marked change was noted in her weight record. She seemed to have a very good appetite and had very few food dislikes. Her attitude and cooperation were exceptionally good throughout the observation.

Subject 22 did not maintain her weight throughout the observation as she was an extremely restless, nervous type and could not be persuaded to eat an adequate diet.

Subject 23 was not able to retain her weight over a very long period due to the large amount of exercise taken and to her restlessness. Aside from her regular physical education class, special swimming work in life saving was taken. At times she would come to meals al-

most too exhausted to eat. This amount of exercise was too fatiguing. The body was overworked, and consequently there was but slight gain in weight. This subject did not cooperate well during the period of the experiment.

The underweight subjects who by the end of the experimental period were approximately normal in weight should maintain this weight if an adequate diet and good health habits are continued. However if an adequate diet is not maintained and the health habits and regularity in activities are neglected a loss in weight will be noted. In order that the subjects maintain this weight a very carefully planned program with regular habits should be carried out. There are very few girls who have determination or interest enough to follow a carefully planned program, aside from the group, without some special encouragement.

The permanent addition to the college dining room of the diet table for underweight girls seems worth consideration. Girls very much underweight, as some of the subjects under observation here, need more special attention than the girls of normal weight. Frequently these girls do not get sufficient food to meet their requirements when eating at the regular college dining tables because of timidity and slow eating habits. They seem to feel more at ease at the special table.

Furthermore these underweight girls should have more

food having a high caloric value than the girls of normal weight. When there is a special table special foods of high caloric value can be prepared in small quantities.

A stimulating effect of association with a group of girls who have a common interest in gaining weight is also helpful.

On the whole all the girls with few exceptions were greatly interested in the experiment and cooperated well throughout the period. As most of the subjects had been below normal for a large part of their lives they were proud of their increasing weights. The group of subjects at the tables were exceptionally congenial and from a psychological standpoint this was a very important factor.

From the basal metabolism determinations²¹ made on some of the subjects the Basal Metabolic Rate averaged about normal for all the subjects except number 2. Subject 2 had a higher Basal Metabolic Rate than some of the others. This perhaps explains her gain in weight as might have been expected from her caloric intake. Due to this fact there was more energy used in respiration than normally²² and consequently less fat storage. Lusk²² made the statement that a low dietary and emaciation decreases metabolism as experienced by two physiologists.

(21) DuBois, "Basal Metabolism in Health and Disease", second edition, chapter 1, p. 2. Lea and Febiger, Philadelphia 1925.

(22) Lusk, "The Physiological Effect of Undernutrition", Physio. Rev., 1, p. 523 (1921).

TABLE V
TABLE OF RESULTS FROM METABOLISM
OF UNDERWEIGHT SUBJECTS

Subject	Age	Height In Cm	Weight In Kg	Under- Weight Per Cent	Surface Area Sq. M	Calories Per Sq.M Per Hour	Per Cent
2	20	164.5	50.8	13	1.5	41.41	417
13	19	161.3	53.98	9	1.56	25.29	-3.37
10	22	153.7	50.349	6	1.46	35.7	-2.3
14	19	159.0	49.895	8	1.5	39.2	43.16
23	19	160.6	50.8	3	1.51	39.19	43.1

CONCLUSION

1. The most marked gains were made by those subjects who showed a spirit of cooperation throughout the observation period. These were in a better state of nutrition at the close of the experimental period than those who did not cooperate.

2. The Basal Metabolic Rates of the five girls upon whom determinations were made, were approximately normal.

3. The meals served in the college dining room with supplements contain sufficient calories to promote a gain in weight in underweight girls.

SUMMARY

An experiment in weight normalization of underweight college girls was carried out at the Texas State College for Women.

A group of twenty four underweight college girls was selected for this study. The weights of these girls ranged from 7% to 26% below the normal according to the standards of Dr. Thomas D. Wood but otherwise the girls were pronounced normal by the college physician. The group was given a special table in the college dining room and served the regular college meals with the addition of certain foods such as milk beverages, custards and puddings which increased the caloric value of the diet. In addition the girls were registered in a class in physical education planned especially for the underweight girl. They exercised regularly and were encouraged to rest and sleep sufficiently and to establish regular habits.

The Basal Metabolic Rates of five of the subjects were determined. For four of these the rates were practically normal. The Basal Metabolic Rate of the fifth subject was 17% above the normal according to the standard of Du Bois.

A record was made of all the food eaten by each girl throughout the period of observation, which lasted for fif-

teen weeks. From this record of food intake the caloric value of the diet was calculated. The estimated daily requirement ranged from 1317 calories to 2177 calories. The average daily caloric intake ranged from 1547 calories to 2506 calories. Only one subject (subject 23) consistently failed to meet her estimated caloric requirement.

The girls were weighed weekly. The total gains over the fifteen week period ranged from 0 to 19 pounds. The average weekly gain was from 0.0 to 1.08 pounds. There was only one subject who did not gain and this was due to glandular disturbances. Two subjects gained only two pounds during the observation period and this was due partly to over exercise and nervousness and partly to lack of cooperation. The remaining twenty one gained exceedingly well.

When underweight girls normal in all other respects cooperate and establish regular health habits and are given the regular college diet with the addition of certain foods of high caloric value a gain in weight results.

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