

NITROGEN INTAKE OF COLLEGE WOMEN AS
INDICATED BY NITROGEN OUTPUT

by

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INTRODUCTION

Accepted figures are available for protein requirement of the human. These figures have been obtained through careful balance studies. However, it is of interest to know something of the actual intake of human subjects, eating according to their own preferences and habits. This may be studied by means of weighed individual dietary studies, but the necessary supervision might unavoidably affect the nature of the diet, so that it would not be according to habit and usage.

Several experiments have been carried on in an attempt to determine the nitrogen output of college men, but very few studies have been made to investigate the actual nitrogen intake and output of college women. It seemed of interest to add to the scanty data existing relative to actual nitrogen intake and output of college women.

REVIEW OF LITERATURE

There has been little discussion in the literature concerning the actual nitrogen intake and output of college women. Hetler (9) conducted an investigation on a group of healthy college women for the purpose of determining their habits of protein intake. Determinations were made of urinary nitrogen, basal metabolism, and protein and caloric

intake of 85 women students.

Chittenden (5, 6) conducted many investigations regarding nitrogen intake and output, using himself, students and associates as subjects. His data confirmed the statement that the nitrogen output tends to keep pace with the income of nitrogen, the body always striving to maintain a condition of nitrogen equilibrium. In recent years reports have been made regarding nitrogen elimination of medical students. In 1929, Brooks (4) reported a study of 192 male medical students after determining nitrogen excretion. Beard (2) in 1927 reported data for the nitrogen excretion of 400 male medical students. Borgstrom and Bost (3) in 1926 presented data regarding protein intake as indicated by urinary nitrogen for two subjects during a period of one year. In 1924, Denis and Borgstrom (8) reported a study of a group of 242 medical students, including 9 women and 233 men. The nitrogen excretion per kilogram body weight was about the same for the women as for the men.

EXPERIMENTAL PROCEDURE

The subjects used for this study were twenty-five healthy college women; 11 graduate and 14 undergraduate students. The group included women who had free choice of food, at college cafeteria, or at home and those eating the food provided at boarding houses, sorority houses, and

the dormitory. The subjects were engaged in the usual activities of college life as shown by the individual record sheets. In an interview with each subject, she was asked to follow customary habits, especially regarding food intake. Also, instructions were given concerning the collection of urine but the exact nature of the study was not discussed, on account of possible influence on the choice of food. Each subject was given record sheets on which she agreed to enumerate the foods eaten daily during each period with approximate amount. Copies of the dietary and activity sheets are given. A daily record was made of the weight of each subject.

Each subject agreed to make complete urinary collections for 4 consecutive days sometime during the fall months of October and November, and again during the winter months of January and February. Sundays, holidays and special occasions of all kinds were avoided; so that days during which the collections were made would be representative of the usual conditions for that student. The urine collections were divided into 24-hour periods from 7 A.M. to 7 A.M.

The daily volume of urine for each subject during the two periods was accurately measured and recorded. A representative sample, taken after thorough mixing, was preserved for analysis. The urinary grams of nitrogen in 5

cubic centimeters of the representative sample was determined in duplicate by the Kjeldahl-Gunning quantitative method (1). Multiplying, the total urinary nitrogen was determined for each day for each subject. Since the body adjusts the nitrogen output to the nitrogen intake, (5, 6) 90 per cent of the nitrogen output appearing in the urine, the nitrogen of the urine may be considered as 90 per cent of the nitrogen of the protein consumed. Multiplying the total nitrogen in the diet by 6.25, the grams of protein in the daily diet was calculated for each subject.

DISCUSSION

Table I presents the urinary nitrogen determinations made for each of the 25 subjects during the fall and winter periods. The data show that the grams of urinary nitrogen varied from day to day and from period to period. The lowest daily urinary nitrogen, in grams, were 3.03 and 3.51 for fall and winter periods respectively; while the highest were 12.36 and 10.98 for same periods. The calculated daily averages of urinary nitrogen were used in preparing Table II. For purposes of comparison the urinary nitrogen was used as an index of the protein consumed, as indicated. Further, the protein consumed was calculated to a uniform basis of a 70 kilogram subject.

From data given in Table II, the points were located on Figures 1 and 2. For purposes of comparisons the Sherman (10, 11) minimum of 44.4 grams of protein per 70 kilograms, the Sherman (10, 11) standard of 66.6 grams of protein per 70 kilograms and the Chittenden (7) minimum of 0.12 gram of nitrogen per kilogram of body weight per day were used to plot the designated lines. It is to be noted that the Sherman standard allows a margin of safety of fifty per cent above the Sherman minimum. During the fall period only one subject was consuming protein below the Sherman minimum. About three-fourths of the subjects were above the Chittenden minimum while one-third were above the Sherman standard allowance.

During the winter period no subject was consuming protein below the Sherman minimum. One-sixth of the subjects were below the Chittenden minimum while five-sixths were above this requirement. About one-sixth of the subjects were above the Sherman standard allowance. It is to be noted that a large proportion of the subjects fall below the Sherman standard allowance, 68 per cent in the fall and 84 per cent in the winter.

The average grams of protein was calculated for all subjects for each period and for the subjects choosing their food freely and for those eating set meals. Table III shows that in all groups the protein consumed was higher in the

TABLE I
URINARY NITROGEN OF ALL SUBJECTS

Subject	Day	Fall Period			Winter Period		
		Urine cc.	Total gm. N	Av. Daily gm. N	Urine cc.	Total gm. N	Av. Daily gm. N
1. ML	1	1100	5.83		730	7.20	
	2	1630	5.41		1080	8.66	
	3	1800	7.31		1370	4.51	
	4	520	6.79	6.34	1210	4.46	6.21
2. RMc	1	1345	6.97		850	5.83	
	2	1160	7.26		820	8.73	
	3	1020	7.30		1180	8.84	
	4	980	7.35	7.22	1380	8.09	7.87
3. RC	1	1555	6.38		2400	5.52	
	2	1400	3.81		2000	4.96	
	3	1475	5.07		1950	6.98	
	4	1390	5.98	5.31	1380	5.22	5.67
4. ME	1	1120	4.73		1330	5.21	
	2	1170	5.36		1170	8.12	
	3	1465	5.95		1140	6.47	
	4	1760	10.21	6.54	750	6.82	6.66
5. WJ	1	1180	10.41		630	7.41	
	2	1125	10.39		1280	10.98	
	3	1120	8.96		1245	9.36	
	4	1750	10.92	10.17	1070	8.54	8.82
6. SM	1	650	5.81		820	6.03	
	2	650	2.22		740	5.03	
	3	470	6.15		810	7.55	
	4	720	8.54	5.68	1145	8.31	6.71
7. GJ	1	1080	7.41		650	8.33	
	2	1230	3.37		670	8.01	
	3	1820	6.73		1140	7.57	
	4	1160	7.89	6.35	850	7.05	7.74
8. HB	1	1870	6.03		2030	7.47	
	2	2000	7.04		1650	7.34	
	3	2500	8.92		1540	6.21	
	4	1400	5.63	6.90	1370	6.40	6.85
9. GB	1	670	7.72		800	9.70	
	2	865	8.79		780	10.34	
	3	680	9.60		760	10.17	
	4	750	9.17	8.82	740	8.33	9.63
10. FH	1	470	5.47		630	5.96	
	2	820	7.53		580	6.01	
	3	930	7.46		1480	5.50	
	4	1030	8.90	7.34	1075	8.56	6.51

TABLE I (CONTINUED)

Subject:	Day	Fall Period			Winter Period		
		Urine cc.	Total gm. N	Av. Daily gm. N	Urine cc.	Total gm. N	Av. Daily gm. N
11. LR	1	1685	7.04		1140	7.53	
	2	1100	6.75		1220	4.90	
	3	1840	6.81		2065	7.56	
	4	1965	8.96	7.39	1500	6.93	6.73
12. LG	1	875	9.28		690	6.07	
	2	1380	9.99		960	9.25	
	3	1160	9.30		960	6.43	
	4	1360	7.75	9.08	1050	7.56	7.33
13. HD	1	2350	6.69		2360	7.17	
	2	2000	7.07		3040	8.02	
	3	1900	5.51		2685	8.27	
	4	1560	4.72	6.00	2320	6.17	7.41
14. IG	1	2380	3.03		1100	6.78	
	2	2000	4.24		1585	7.10	
	3	2515	4.78		1500	7.02	
	4	2000	6.88	4.73	1790	8.41	7.33
15. NS	1	1130	10.71		1360	3.51	
	2	950	4.64		1460	9.84	
	3	1405	7.05		430	5.27	
	4	1040	4.97	6.84	850	6.49	6.28
16. HE	1	700	7.71		520	5.75	
	2	860	7.53		700	8.72	
	3	1450	7.63		560	5.34	
	4	890	7.99	7.72	1060	9.37	7.30
17. EF	1	725	7.79		580	6.99	
	2	660	7.04		710	9.06	
	3	770	7.85		900	8.03	
	4	970	7.51	7.55	1260	7.52	8.04
18. SS	1	1340	5.82		1690	8.52	
	2	1360	6.47		2070	10.72	
	3	1390	6.87		1320	5.81	
	4	1700	6.14	6.32	950	5.24	7.57
19. MR	1	580	5.49		570	4.97	
	2	910	9.01		720	5.96	
	3	500	5.03		720	5.30	
	4	740	7.52	6.76	660	6.40	5.66
20. EN	1	900	5.60		1325	6.68	
	2	710	6.64		945	9.18	
	3	760	5.56		1200	8.26	
	4	1130	8.75	6.64	1340	8.07	8.05

TABLE I (CONTINUED)

		Fall Period			Winter Period		
		Urine	Total	Av.	Urine	Total	Av.
Subject:	Day	cc.	gm. N	gm. N	cc.	gm. N	gm. N
21. ZL	1	435	3.36		1070	7.42	
	2	900	8.51		640	5.75	
	3	1520	12.28		1460	5.84	
	4	1060	4.98	7.28	800	9.02	7.01
22. AB	1	640	6.49		740	6.04	
	2	700	6.06		900	7.06	
	3	960	7.95		810	8.05	
	4	880	8.20	7.20	810	4.37	6.38
23. RR	1	1470	4.56		2150	5.16	
	2	1400	6.55		1220	4.13	
	3	1170	5.30		1880	6.77	
	4	2060	8.57	6.24	1910	7.37	5.86
24. DB	1	915	7.19		840	8.52	
	2	660	10.17		660	6.11	
	3	700	8.51		730	6.13	
	4	920	8.57	8.61	740	5.33	6.52
25. ZMc	1	1155	7.44		1350	7.48	
	2	955	9.74		660	6.37	
	3	1220	8.68		970	7.46	
	4	1230	12.39	9.55	830	9.35	7.67

TABLE III
AVERAGE PROTEIN PER 70 KG.

Daily Protein Gms.	Fall	Winter	Average
All subjects	:66.4 gms.	:61.1 gms.	:63.8 gms.
Free choice of food	:68.7 gms.	:59.6 gms.	:64.0 gms.
Set meals	:64.0 gms.	:61.6 gms.	:62.8 gms.

TABLE IV
PROTEIN INTAKE INDICATED BY
URINARY NITROGEN
CALCULATED FOR A 70 KG. SUBJECT

College	Urinary Nitrogen	Protein Intake
K. S. C. (women)	: 8.78 gms.	:63.8 gms.
Illinois U. (women)	: 9.48 gms.	:65.8 gms.
Tulane U. (men)	:11.07 gms.	:76.9 gms.
Western Reserve U. (men)	:11.16 gms.	:76.7 gms.
N. Carolina U. (men)	:10.43 gms.	:72.4 gms.

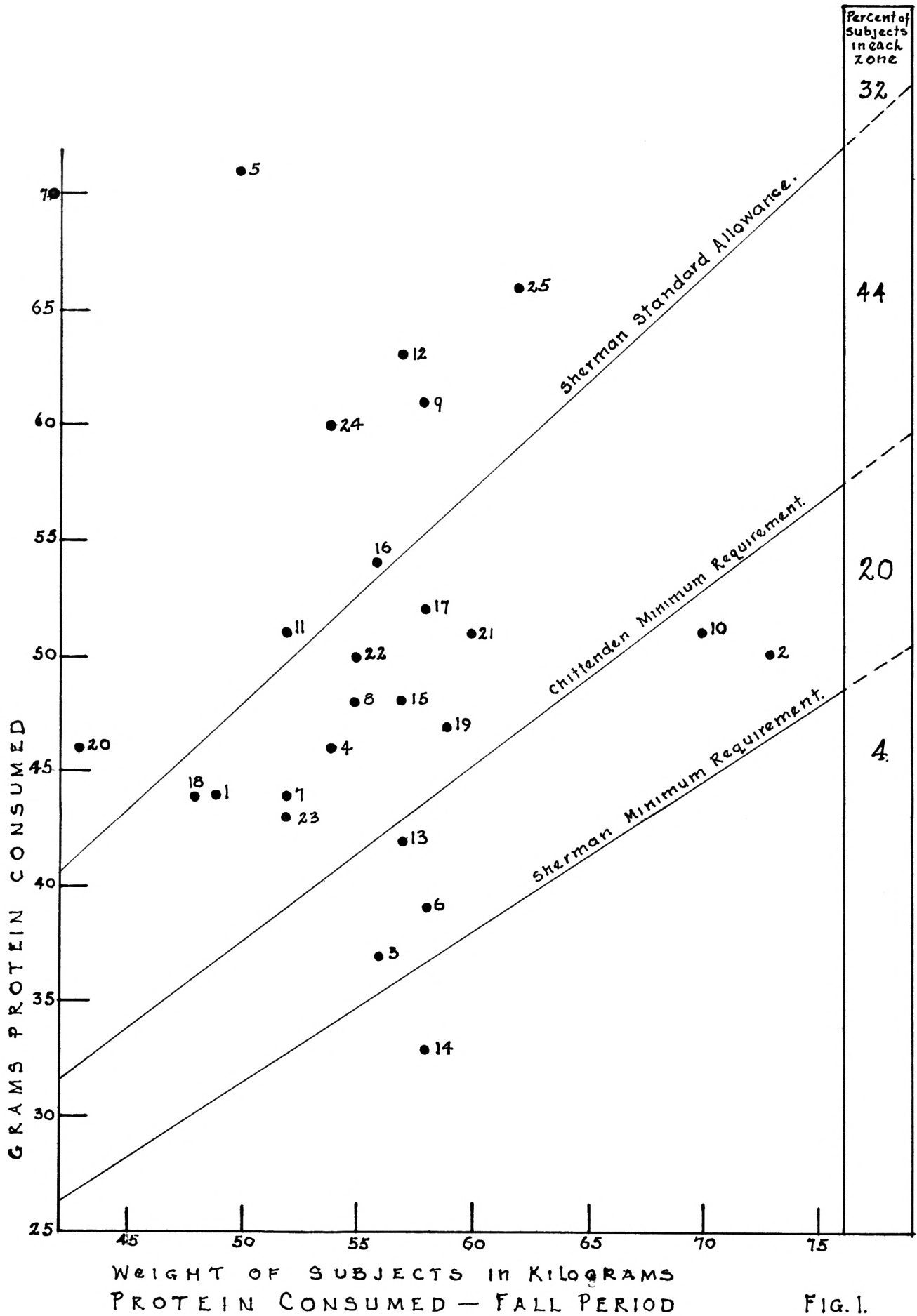
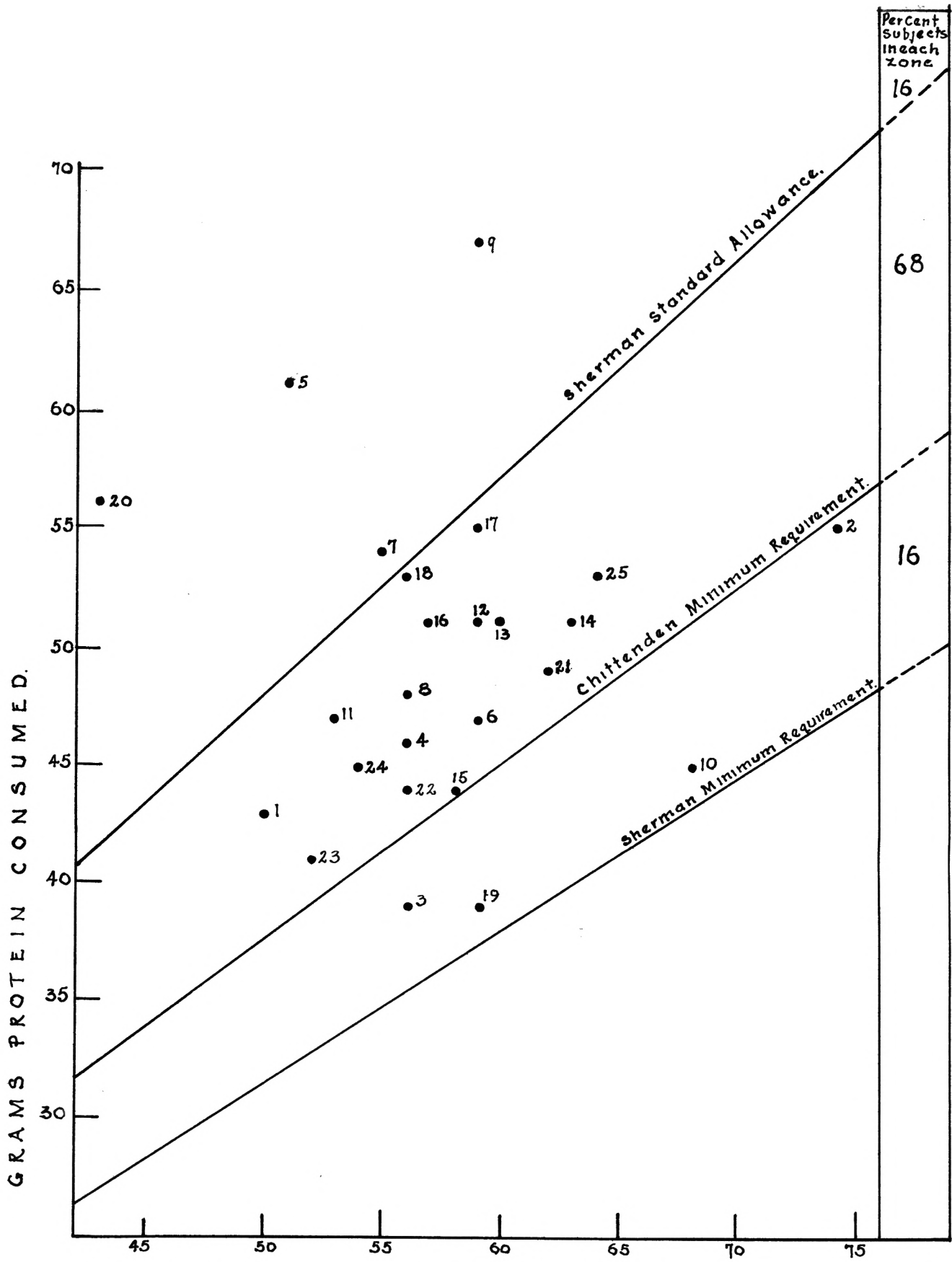


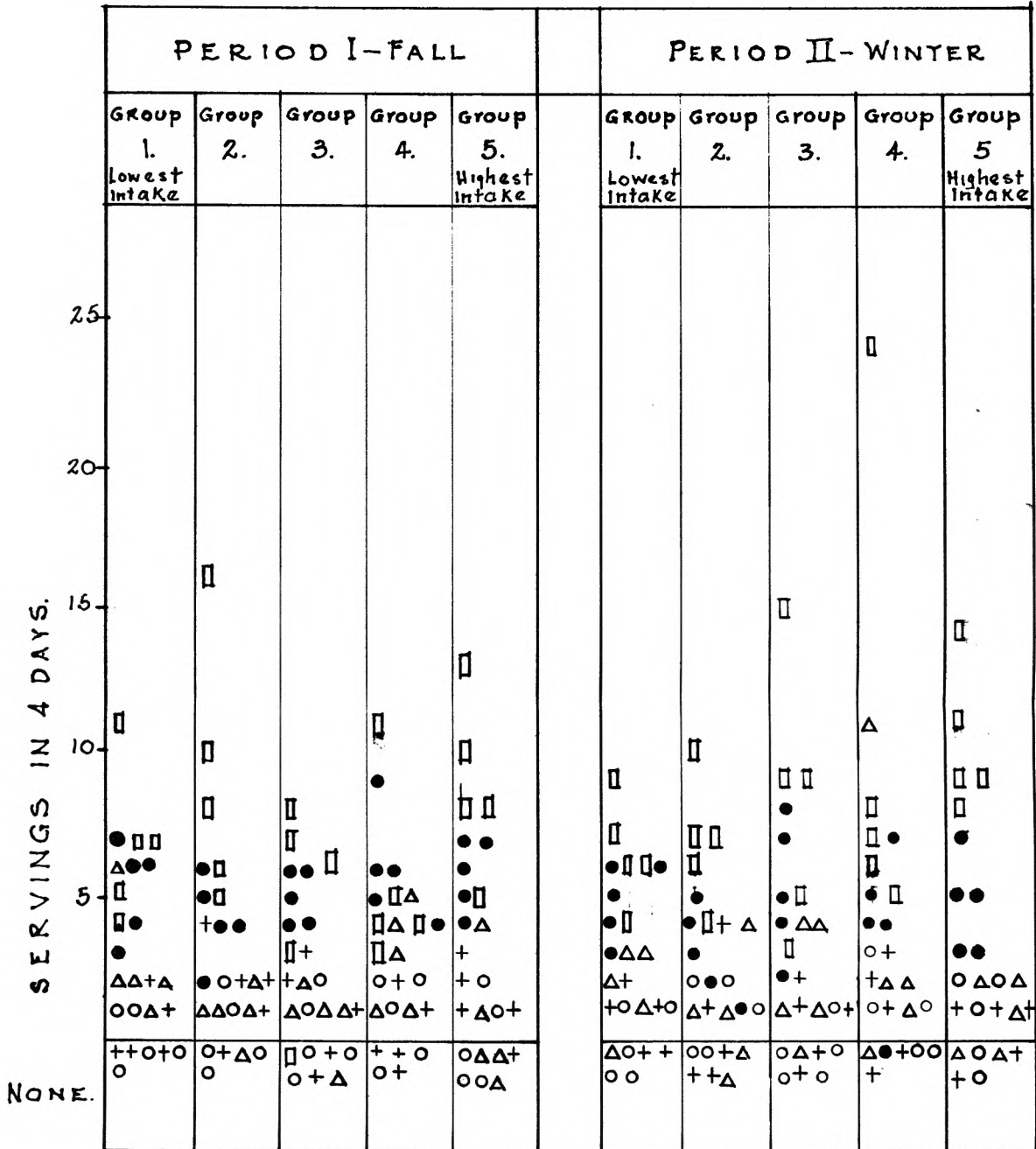
FIG. 1.



Weight of Subjects in Kilograms
 PROTEIN CONSUMED — WINTER PERIOD. FIG. 2.

SERVINGS OF HIGH PROTEIN FOOD IN 4 DAYS

subjects divided into five groups according to calculated intake of protein. Group 1. being the lowest



● MEAT □ MILK Δ EGGS + CHEESE ○ LEGUMES

REPORTED SERVINGS OF HIGH PROTEIN FOODS IN 4 DAYS

Fig. 3.

the fall period than in the winter period; the subjects having free choice of food during the fall period consumed protein in excess of those having set meals, while those having free choice were lower in protein intake during the winter period. The protein of the subjects having free choice of food was not widely different from that of the subjects eating set meals.

For each period the subjects were ranked according to the calculated protein of the diet. The 25 subjects were divided into 5 groups, Group 1 those of lowest protein and so on. Servings of high protein foods reported on the daily dietary record sheets were counted for each subject for each period and entered in the proper group in Figure 3. No consistent relationships are to be observed between number of servings of high protein foods and groupings of the subjects. It is evident that the records were not sufficiently exact, particularly regarding the important matter of size of servings. The accuracy of such dietary records is questioned when these, kept by cooperative subjects with some training in nutrition, fail to correlate with quantitative determinations.

It seemed of interest to compare the results of this study with results of similar studies made in other colleges in recent years. Table IV shows that the urinary nitrogen and calculated protein intake of subjects used in this study

were slightly lower than women students at University of Illinois (9) and distinctly lower than the results obtained by studies made at Tulane University (3, 8), Western Reserve University (2) and North Carolina University (4), on male medical students. In both of the studies with college women the average protein per 70 kilograms is slightly below the Sherman (10, 11) standard allowance of 66.6 grams. The 3 studies made with college men gave averages above this standard.

SUMMARY

A study was made of the nitrogen intake of 25 college women as indicated by the output of urinary nitrogen. The subjects made complete daily collections of urine for two four-day periods, in the fall and again in the winter. Daily records were also kept by the subjects, showing the nature of the foods consumed. Subjects were asked to follow customary habits, particularly as regards food intake. Nitrogen determinations by the Kjeldahl-Gunning quantitative method (1) were made in duplicate on 5 cubic centimeters samples, from which total daily urinary nitrogen was calculated for each subject. As 90 per cent of the nitrogen ingested by the adult will appear in the urine, and since $N \times 6.25$ equals protein, the average daily protein intake of each subject was calculated.

This study shows that college women of this group were not consuming large amounts of protein. Sixty-eight per cent of the subjects during the fall period and 84 per cent in the winter period were below the Sherman standard. The averages for calculated protein intake are not widely different from figures reported for women students at University of Illinois (9), averages of all subjects in both cases being slightly below the Sherman standard.

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