INFLUENCE OF MEDIUM AND HIGH PROTEIN DIETS ON THE CHLORINE METABOLISM OF TWO PRESCHOOL CHILDREN

THESIS FOR THE DEGREE OF M. S.

Margaret Barry

1933

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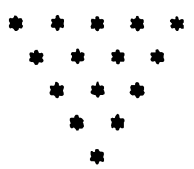

by

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A Thesis Submitted to the Faculty of
Michigan State College
in Partial Fulfillment of the Requirements for the
Degree of Master of Science

Department of Foods and Nutrition
Division of Home Economics
1933

THESIS

ACKNOWLEDGMENT

I wish to express my appreciation to Dr. Marie Dye and Dr. Jean Hawks for their helpful criticisms throughout this study.

TABLE OF CONTENTS

LIST OF TABLES

List of Tables (Cont'd)

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Introduction

It has long been known that chlorides are important in many pathological conditions and especially in the treatment of the edema of nephritis. This is true, because of the ability of chlorides to regulate the fluid content of the body. Chlorides also help to maintain the physical neutrality in the body fluids, and are significant in conditions in which there is a disturbance of the acid-base equilibrium. Another function of the chlorides is to aid in the control of the relative distribution of water between the circulating blood and body cells. However, the knowledge is meager regarding the chlorine needs of the normal individual, and additional study of this element in respect to chlorine metabolism should help to further determine its function.

The objects of this investigation were first, to determine the utilization of chlorine by two normal, preschool children receiving weighed diets of either medium or high protein content, second, to compare the chlorine metabolism of the two children, third, to determine to some extent the the daily variations in the chlorine metabolism of the two subjects, and fourth, to give some information about the amount of chlorine used by children of this age.

Review of Literature

A review of American literature revealed very few studies concerning the chlorine metabolism of subjects of any age. A few investigators have studied the chlorine metabolism of infants fed various kinds of milk. Wang and Davis (12) reviewed the work done by foreign scientists and their results are summarized in Table I. Observation of this table reveals that, with three exceptions, the amount of chlorine ingested on the basis of gram per kilogram of body weight varied from 0.034 to 0.081 gram for the different subjects. Although the percentage of the intake absorbed varied from 59 to 97 percent, the amount absorbed per kilogram of body weight was quite similar in the majority of cases, and varied directly with the amount ingested. The chlorine retention fluctuated from 8 to 84 percent of the intake. The amount retained, however, was surprisingly constant, ten out of the twelve balances reported varying only between 0.011 and 0.027 gram per kilogram of body weight. Tangle fed a fairly high chlorine intake to his two cases and observed that only 8 percent of the intake was retained. These retentions were low when compared to those ranging from 20 to 50 percent of the intake, as recorded by other investigators.

In their own study, Wang and Davis (12) compared the metabolism of the mineral constituents of cows milk and breast milk on five apparently healthy infants between the ages of

TABLE I

DATA ON THE CHLORIDE METABOLISM OF HEALTHY INFANTS*

Author	Subject	Length of Period	Age	Weight	Chloride Intake per twenty-four hours		Chloride Output per twenty-four Hours			Chloride Absorption per twenty-four Hours			Chloride Retention per twenty-four Hours		
					Total	Per Kg.	Feces	Urine	Total	Total	Per Kg.	% Intake	Total	Per Kg.	% Intake
	Breast Milk	Days	Mo.	Kg.	Gm.	Gm.	Gm.	Gm.	Gm.	Gm.	Gm.		Gm.	Gm.	
Freund	1	4	4.5	4.94	0.170	0.034	0.07	0.126	0.153	0.163	0.030	96.1	.037	0.007	21.8
	2	6	3.0	2.95	0.238	0.081	0.07	0.156	0.163	0.231	0.078	97.0	.075	0.025	25.4
Tobler L. and Noll F.	1	6	2.5	4.24	0.069	0.002	0.003	0.056	0.059	0.066	0.002	95.6	.010	0.000	14.4
Lindberg G.	1		2.5	4.28	0.254	0.059	0.013	0.152	0.165	0.241	0.056	94.9	0.088	0.021	34.8
				4.37	0.255	0.058	0.024	0.142	0.166	0.231	0.053	90.4	0.089	0.020	34.8
				4.37	0.185	0.042	0.016	0.072	0.088	0.169	0.039	91.3	0.097	0.022	52.4
				4.37	0.195	0.044	0.036	0.086	0.122	0.159	0.036	81.7	0.073	0.017	37.6
Blauberg	1	6	5	----	0.203	-----	0.014	0.013	0.027	0.189	-----	93.1	0.176	-----	84.0
Michel C. and Perret W.	---	---	3	4.725	0.278	0.059	0.010	0.199	0.209	0.268	0.057	96.6	0.069	0.015	24.6
Klotz M.	---	---	2.5	3.42	0.224	0.066	0.073	0.056	0.130	0.151	0.044	67.2	0.094	0.028	42.1
	Cows Milk														
Blauberg	---	---	---	----	0.173	-----	0.071	0.239	0.310	0.102	-----	58.9	0.138	-----	----
Tongle	---	---	3	4.51	0.890	0.197	0.029	0.791	0.819	.862	0.191	96.9	0.071	0.016	8.0
			4.7	5.41	0.696	0.129	0.025	0.610	0.634	.671	0.124	96.4	0.061	0.011	8.8

* Calculated from the table giving the NaCl metabolism of healthy infants. (12)

eleven days and six months. The subject were fed alternately with breast milk and modified cows' milk for a period of six days - three of which were for adjustment to the diet and three experimental. Analysis were made of the chlorine content of food, feces and urine. Table II which gives a summary of the studies reported in American literature reviews the results of Wang and Davis. Their data show that the chlorine intake of the babies on a diet of cows' milk exceeded their intake on breast milk, the average being 0.898 gram and 0.268 gram respectively per twenty-four hours.

The amount of chlorine excreted in both feces and urine was greater when cows' milk was fed. The average excretion in the feces was 0.068 gram and 0.035 gram and in the urine 0.666 gram and 0.179 gram on the respective diets.

The absorption of chlorides ran parallel to the urinary chloride. The average on the diet of cows milk was 92.4 percent and on the breast milk 87.0 percent of the total intake.

There was a great variation in the chloride retention of different subjects both in the percentage of the intake and in the amount which was retained per kilogram of body weight. There appeared to be no relation between the amount ingested and the amount retained. The average percentage retained on either kind of milk was approximately the same, being 20.6 percent for breast milk and 18.2 percent for

TABLE II

SUMMARY OF THE DATA ON CHLORINE METABOLISM AS REPORTED BY VARIOUS AUTHORS

Author	Type of Diet	Length of Period	Age	Weight	Chloride Intake per twenty-four hours		Chloride Output per twenty-four hours			Chloride Absorption per twenty-four hours			Chloride Retention per twenty-four hours		
					Total	Per Kg.	Feces	Urine	Total	Total	Per Kg.	% Intake	Total	Per Kg.	% Intake
		Days	Mo.	Kg.	Gm.	Gm.	Gm.	Gm.	Gm.	Gm.	Gm.		Gm.	Gm.	
Hoobler (4)	Cows Milk	----	9	---	1.405	-----	0.025	1.359	1.384	1.379	----	98.2	0.021	-----	1.4
	Breast Milk	-----	9	---	0.200	-----	0.008	0.108	0.116	0.192		95.9	0.084		42.0
Wang & Davis (12)	Cows Milk	3	3.0	4.39	0.788	0.180	0.094	0.538	0.633	0.694	0.158	88.0	0.155	0.035	19.7
		3	5.5	7.43	0.979	0.132	0.184	0.778	0.962	0.795	0.107	81.2	0.017	0.002	1.7
		3	4.3	4.04	0.870	0.215	0.069	0.660	0.729	0.801	0.198	92.1	0.141	0.035	16.2
		3	0.4	3.26	0.747	0.229	0.011	0.494	0.506	0.735	0.226	98.5	0.241	0.071	32.3
		3	1.3	3.82	0.950	0.249	0.027	0.676	0.703	0.923	0.242	97.1	0.247	0.065	25.9
		3	2.1	4.44	0.154	0.238	0.023	0.849	0.872	1.031	0.232	97.8	0.183	0.041	17.3
	Breast Milk	3	2.6	4.13	0.245	0.059	0.068	0.126	0.194	0.177	0.059	72.2	0.051	0.012	20.7
		3	3.3	4.46	0.331	0.074	0.035	1.161	0.196	0.295	0.066	89.3	0.134	0.030	40.6
		3	5.7	7.33	0.323	0.127	0.069	0.217	0.285	0.255	0.045	78.7	0.038	0.005	11.7
		3	4.3	4.04	0.231	0.057	0.004	0.226	0.230	0.227	0.056	98.1	0.011	0.002	5.3
		3	1.4	3.62	0.205	0.057	0.021	0.137	0.158	0.183	0.051	89.6	0.046	0.013	22.7
		3	1.6	3.99	0.271	0.068	0.010	0.211	0.221	0.261	0.065	96.2	0.051	0.013	18.6
		3	2.4	4.66	0.277	0.060	---	0.322	---	---	---	--	---	---	--
Shohl, Wakeman, and Shorr(8)	High Mineral	4	8	5.9	3.80	0.644	0.03	2.97	3.00	3.77	0.639	99.2	0.80	0.136	2100
	Cows Milk	5			1.56	0.264	0.10	1.35	1.45	1.46	0.247	93.5	0.4	0.019	7.0
	Cows Milk	3	7	8.8	0.79	0.090	0.014	0.639	0.653	0.774	0.088	98.2	0.135	0.015	14.8
Shohl and Sato (9)	Diet + 250 cc. .1 NHCl				1.650	0.188	0.302	1.615	1.917	1.348	0.153	81.7	+0.267	---	--
	Cows Milk	3	9	5.5	0.545	0.099	0.018	0.454	0.472	0.527	0.096	96.7	0.073	0.013	13.4
	Diet + 473 cc. .1 $NaHCO_3$				0.545	0.099	0.049	0.528	0.577	0.496	0.090	91.0	+0.032	---	--
Sawyer, Bawman and Stevens (7)	Normal High Fat	2-3	5yr	22.7	6.930	0.305	0.099	7.242	7.341	6.831	0.301	98.6	+0.411	-0.018	--
					7.458	0.329	0.066	7.029	7.095	7.392	0.326	99.1	0.363	0.016	4.9
	Normal High Fat	2-3	8yr	23.0	6.930	0.301	0.018	7.029	7.047	6.912	0.305	99.7	+0.117	-0.005	--
					7.458	0.329	0.016	7.794	7.810	7.442	0.324	99.8	+0.351	-----	--

cows' milk. The authors found that as age increased, there was a decrease in the amount retained with cows milk, but that no such relation existed with the breast milk. No definite relation between age and percentage retention could be found.

Shohl, Wakeman and Shorr (8) investigated the mineral metabolism of an eight months old male infant on a normal and on a high mineral diet. The study was divided into two periods. In the first period of four days the subject received a diet of skimmed cows' milk and cane sugar to which salts had been added to make the concentration of each mineral approximately double that of cows' milk. After a ten day preliminary period, the same food, without the salt addition, was fed for five days. Excretion in the urine and feces was determined and a balance of each of the minerals computed.

The conclusions were that a baby on a skimmed milk diet, after salt constituents were doubled, retained salts in approximately the same proportion but in twice the amounts. However, the data submitted in Table II reveals that the chlorine retained on the high mineral diet (0.80 gram) was approximately seven times greater than on the diet without the added salts (0.11 gram).

Shohl and Sato (9) studied the effect of acid and base on the metabolism of two seven months old infants for two three day periods. The normal food consisted of

whole milk and water mixtures with added cane sugar, and was fed to each infant for one period. Then, without alteration of the diet, in one case 250 c.c. .1 N HCl were added, and in the other, 473 c.c. .1 N $NaHCO_3$. Food, urine, and feces were analyzed and the acid base value calculated.

During the period of normal feeding the reactions of the two subjects were quite similar. On the kilogram basis, the infants eliminated 0.074 gram and 0.086 gram of chlorine respectively, while the absorption ranged from 0.088 to 0.098 gram for the two subjects. On an intake of approximately 0.09 gram per kilogram the babies retained 0.015 and 0.013 gram. Though the intake during the acid administration was approximately double that of the normal and base feedings, a negative retention of -0.267 gram resulted. While a slight negative retention (-0.032 gram) occurred when sodium bicarbonate was fed the output and absorption consistently followed those of the normal period.

In a series of metabolism studies Hoobler (4) fed both cows milk and breast milk to a nine months old infant. He found that the excretion of sodium chloride took place almost entirely through the urine and that the absorption was 96 to 98 percent of the intake. Although the intake on cows' milk was greater than that on breast milk, the actual retention was greater on breast milk. The author, however, stated that the retention of sodium chloride was only sufficient to cause a balance to be maintained in body fluids

under normal conditions.

Sawyer and her coworkers (7) studied the mineral metabolism of two apparently normal male children aged five and eight years respectively. The investigation consisted of two three day periods during one of which the children received a normal and, on the other, a high fat diet. The mineral, calorie and nitrogen intakes for the two diets were practically identical.

The data, included in Table II, show that the intake per kilogram of body weight during the normal period was approximately 0.30 gram for both children. While the fecal chlorine varied the urinary chlorine was very similar, namely, 7.242 grams and 7.029 grams respectively. Both subjects absorbed practically 99 percent of the intake. During the period of normal feeding the two children showed negative retentions of -0.018 gram and -0.005 gram per kilogram of body weight. On the high fat diet, however, one subject retained 0.016 gram per kilogram of body weight. This retention compares favorably with the results obtained by Shohl and Sato (9) and with some of the results found by Wang and Davis (12) on the infants fed breast milk.

The only long time experiment found was that conducted by Clark (3) who studied the mineral metabolism of five men in the California state prison for a period of twenty-eight weeks. These men had no history of disease which might lead to abnormal metabolism. The experiment consisted of

five periods in which the diet varied in the cereal, sugar, vegetable, and milk content. During the last period magnesium oxide and calcium lactate were given orally. The intake, output and retention were recorded in weekly periods both in grams per week and in c.c. of normal solution.

Table III shows the average daily balances computed from these data which indicate that the amount of chlorine ingested per kilogram of body weight ranged from 0.062 to 0.094 gram for all of the subjects. The average daily chlorine retentions showed considerable variation for each period as well as in different periods for the same subject. When compared on the kilogram basis, the variations in the retention for the different subjects corresponded to the differences in the intake. With some exceptions, the retentions for a given individual tended to increase as the diet was increased in its chlorine content.

The data regarding chlorine metabolism obtained by various scientists indicate that chlorine is excreted chiefly in the urine, that over 90 percent of it is absorbed, and that, unless the amount ingested is too great, there is, in general, a higher retention per kilogram of body weight on a higher intake. The fact that on a similar intake infants and adults retained approximately the same amount of chlorine per kilogram of body weight may perhaps signify that the retention on this basis does not vary significantly with age. However, a search of literature revealed no

TABLE III

SUMMARY OF CLARK'S CHLORINE METABOLISM STUDIES ON MEN

Subject	Age	Weight	Chloride Intake per twenty-four hours		Chloride Output per twenty-four hours			Chloride Absorption per twenty-four hours			Chloride Retention per twenty-four hours		
			Total	Per Kilogram	Feces	Urine	Total	Total	Per Kilogram	Percentage of Intake	Total	Per Kilogram	Percentage of Intake
	Yrs	Kg.	Gms.	Gms.	Gms.	Gms.	Gms.	Gms.	Gms.		Gms.	Gms.	
J. W.	42	57.7	4.090	0.071	0.038	2.818	2.856	4.052	0.070	99.0	1.234	0.021	30.2
S. K.	22	62.3	5.400	0.087	0.146	4.302	4.448	5.254	0.084	97.2	0.952	0.015	17.6
L. M.	31	67.7	5.880	0.087	0.088	4.686	4.774	5.792	0.085	98.5	1.106	0.016	18.8
J. S.	49	57.7	4.570	0.079	0.135	2.820	2.955	4.435	0.077	97.0	1.615	0.028	35.3
E. E.	36	80.9	5.510	0.068	0.065	5.430	5.495	5.445	0.067	98.8	0.065	0.008	1.2

record of long time studies of chlorine metabolism of normal preschool children. Sawyer and her coworkers (7) reported the only balance study made on apparently normal children. Unfortunately both of the subjects were in negative chlorine balance, and the results, therefore, cannot be compared directly with these reported in this study. Since almost all of the observations on the chlorine metabolism of infants were conducted for a short period of time there is a need for further studies.

Procedure

The experiment reported here is a portion of a calorie, protein, and mineral metabolism study conducted on two preschool boys, D.A. and W.W. aged four years and nine months and four years and seven months respectively. Throughout the study the children lived under supervision in the Home Economics Building. According to physical and medical examinations made before this experiment, the children were in excellent physical condition. Table IV records the height and weight of the children and the percent variation of these from the Woodbury Height-Weight-Age Tables.

TABLE IV

THE HEIGHT AND WEIGHT OF THE CHILDREN AS COMPARED TO THE WOODBURY HEIGHT-WEIGHT-AGE TABLES (13).

Subject	Age	Weight			Height		
		Observed	Normal	% Variation	Observed	Normal	% Variation
	Mo.	Lbs.	Lbs.		In.	In.	
W.W.	55	41.75	36.47	+12.6	43.75	40.67	+7.0
D.A.	57	38.38	37.14	+ 3.2	42.88	41.08	+4.2

According to age W. W. was 12.6 percent and D. A. 3.3 percent above the average weight. Their heights were 7.0 and 4.2 percent respectively above the average given for their age.

Throughout the study the children lived under supervision and were kept under a regular routine as to their meals, toilet,habits, sleep and outdoor exercise. The

investigation extended from February 1 to March 22, 1932. After a six day preliminary period the study was divided into two parts - a thirty day period in which the diet furnished three grams of protein and a fifteen day period in which it furnished four grams of protein per kilogram of body weight. These were considered a medium and a high level of protein intake. This paper reports the chlorine balances during the last nine days of the medium protein level and the first twelve days of the high protein level.

Tables V and VI give the diets for the two periods and indicate that the caloric content was approximately the same. Observation of these tables show that the milk, egg, butter, cod liver oil, vegetables and fruits included in both diets furnished an adequate supply of minerals and vitamins.

All food which the children received was carefully weighed, and, in every case, all that was served was eaten. To insure an even sample the food was first mixed, then ground or pureed. Sufficient food for a three day period was prepared at one time and daily samples were weighed and stored in a refrigerator. The food was cooked and served in the same dish. A small amount of sodium chloride was added to the food for the first three day period on each diet and none thereafter. Four hundred grams of distilled water were used daily for drinking and for food preparation.

Duplicate samples of food, equivalent to the amount D. A. received, were saved for analysis. These were dried,

TABLE V

COMPOSITION OF THE MEDIUM PROTEIN DIET (2),(6),(10),(11)

Food	Weight	Protein	Calories	Sodium	Chlorine	Residue	
	gms.	gms.		gms.	gms.	Acid cc N/10	Base cc N/10
Whole Milk	720	23.8	497	0.367	0.763		129.6
Egg	45	6.	67	0.064	0.048	49.9	
Raw Beef	45	10.1	52	0.040	0.036	51.7	
Whole Wheat Bread	72	7.0	174	0.284	0.437	52.6	
Uncooked Farina	18	2.	65	0.012	0.014	17.3	
Cooked Potato	63	1.4	72	0.013	0.024		37.8
Strained Tomatoes	90	1.1	19	0.009	0.031		50.4
Strained Carrots	72	0.8	30	0.073	0.026		77.8
Strained Prunes	90	0.5	113	0.062	0.015	156.0	
Strained Applesauce	90	0.3	88	0.010	0.004		40.5
Lettuce	14	0.2	2	0.007	0.010		10.4
Strained Orange Juice	180	---	65	0.014	0.005	-----	81.0
Sugar	18	---	72	---		----	----
Butter	18	0.2	138	0.142	0.218	----	----
Cod Liver Oil	45		41	---	---	----	----
Totals	1539.5	53.4	1495	1.094	1.632	327.5	427.5

TABLE VI

COMPOSITION OF THE HIGH PROTEIN DIET (2),(6),(10),(11)

Food	Weight	Protein	Calories	Sodium	Chlorine	Residue	
		gms.		gms.	gms.	Acid cc N/10	Base cc N/10
Whole Milk	425	14	293	0.217	0.450		76.5
Skim Milk	425	14.5	157	0.221	0.467		76.5
Egg	90	12.0	133	0.129	0.095	99.9	
Raw Beef	90	20.2	104	0.081	0.072	103.5	
Whole Wheat Bread	60	5.8	145	0.236	0.364	43.8	
Uncooked Farina	18	2.0	65	0.012	0.014	17.3	
Cooked Potato	50	1.2	57	0.010	0.019		30.0
Strained Tomatoes	100	1.2	21	0.010	0.034		56.0
Strained Carrots	70	0.8	29	0.071	0.025		75.6
Strained Prunes	90	0.5	113	0.062	0.015	156.0	
Strained Applesauce	90	0.3	88	0.010	0.004		40.5
Lettuce	14	0.2	2	0.004	0.010		10.4
Orange Juice	200	---	72	0.016	0.006		90.
Sugar	10	---	40	---	---		----
Butter	20	0.2	154	0.158	0.242		----
Cod Liver Oil	4.5		41	---	---		----
Totals	1765.5	72.9	1514	1.236	1.821	421.5	455.5

ground, seived, and stored in glass stoppered bottles. Twenty-four hour specimens of urine were collected and preserved with totuene. Daily collection of feces were also made using charcoal and carmine alternately as markers. These were dried and stored in the same manner as the food.

In the experiment the analysis were made by the Peters and.VanSlykes (5) modification of the Volkard-Harvey titration. The ferric alum,silver nitrate and nitric acid were combined into one solution. This combination made one less reagent solution and the nitric acid stabilized the $AgNO_3$. To insure a more permanent end point, the silver chloride was filtered off before titrating with ammonium sulfo cyanate. The accuracy of the method was tested by recovering chlorine from known solutions. These data, as shown in Table VII, indicated that the recovery was within 2 percent of the theoretical value.

The food and feces were ashed in an alkaline medium (1). From 3-5 cc of 5 percent NA_2CO_3 were added to the weighed samples of food or feces and evaporated to dryness on a hot plate. The samples were then ashed in an electric furnace at a full red heat. The ashed samples were taken up in hot water. The filter paper and residue were then ashed, and taken up again in 1:4 HNO_3. The entire ashed sample was used for a single analysis. Determination of urinary chlorine was made on urine samples previously preserved with toluene. Either duplicate or triplicate determinations were made in all cases.

TABLE VII

RESULTS OF TESTS TO SHOW THE ACCURACY OF THE CHLORINE METHOD

Urine	Kcl	Trial	Chlorine Present		
			Calculated	Analyzed*	Percentage Recovered
cc	cc		gm.	gm.	
	2	1	0.075	0.0744	99.1
		2		0.0740	98.6
		3		0.0743	99.1
		4		0.0742	98.8
		5		0.0745	99.3
10		1		0.0175	
		2		0.0174	
		3		0.0176	
		4		0.0174	
		5		0.0177	
5	2	1	0.0925	0.0910	98.2
		2		0.0911	98.3
		3		0.0915	98.8
		4		0.0913	98.6
		5		0.0917	99.1

* Average of three trials.

Discussion of Results

Table VIII records the results of the daily chlorine metabolism for the last nine days on the medium protein diet. Since the food was weighed in three day periods these data have also been calculated on this basis and are given in Table IX. These two tables will be discussed at the same time.

The daily chlorine intake during the first 3 day period was 2.353 grams for D. A. and 2.583 grams for W. W. These values were practically 0.40 gram higher than those of the other two periods because a small amount of sodium chloride was added to the food. The average intake was 2.120 grams for D. A. and 2.313 grams for W. W.

The total percentage of the chlorine excreted ranged from 83 to 86 percent of the total intake. In both subjects practically all of the chlorine (80 and 83 percent) was eliminated by the way of the kidney.

The urinary output of D. A. followed closely the variations in the intake. On the first day the excretion was low. During the next three days the highest elimination of chlorine occurred and corresponded, with a one day lag, to the period when the chlorine was highest in the diet. These values were comparatively constant during the remainder of the medium protein diet.

W. W. showed a greater daily fluctuation in the urinary chloride than did D. A. Nevertheless, with the

TABLE VIII

DAILY CHLORINE METABOLISM ON A MEDIUM PROTEIN DIET

Subject	Day	Total Intake	Output			Absorption		Retention	
			Urine	Feces	Total	Total	Percent of Intake	Total	Percent of Intake
		gm.	gm.	gm.	gm.	gm.	%	gm.	%
D. A.	1	2.353	1.606	0.062	1.668	2.291	97.4	0.685	29.1
	2	2.353	1.805	0.031	1.836	2.322	98.7	0.517	22.0
	3	2.353	1.822	0.042	1.864	2.311	98.2	0.489	20.8
	4	1.994	1.823	0.060	1.883	1.934	97.0	0.111	5.6
	5	1.994	1.668	0.057	1.726	1.937	97.1	0.269	13.5
	6	1.994	1.643	0.055	1.698	1.939	97.2	0.296	14.8
	7	1.960*	---	0.077	---	---	---	---	---
	8	1.960	1.507	0.116	1.623	1.843	94.0	0.336	17.2
	9	1.960	1.657	0.039	1.697	1.920	98.0	0.263	13.4
Average		2.120	1.691	0.058	1.749	2.062	97.3	0.371	17.5
W. W.	1	2.588	1.809	0.047	1.857	2.541	98.2	0.732	28.3
	2	2.588	2.204	0.036	2.239	2.553	98.6	0.349	13.5
	3	2.588	1.542	0.040	1.582	2.548	98.4	1.006	38.9
	4	2.194	2.251	0.069	2.320	2.125	96.8	-0.126	----
	5	2.194	1.787	0.053	1.840	2.140	97.6	0.353	16.1
	6	2.194	1.758	0.099	1.857	2.094	95.5	0.337	15.3
	7	2.156	2.012	0.048	2.060	2.108	97.8	0.095	4.4
	8	2.156	1.862	0.074	1.936	2.081	96.5	0.219	10.2
	9	2.156	2.022	0.065	2.087	2.091	97.0	0.069	3.2
Average		2.313	1.916	0.059	1.975	2.253	97.4	0.337	14.6

TABLE IX

THREE DAY AVERAGE OF THE DAILY CHLORINE METABOLISM ON A MEDIUM PROTEIN DIET

Subject	Period	Intake	Output						Absorption		Retention	
			Urine	Percent of Intake	Feces	Percent of Intake	Total	Percent of Intake	Total	Percent of Intake	Total	Percent of Intake
		gms.	gms.		gms.		gms.		gms.		gms.	
D.A.	1	2.353	1.744	74.1	0.045	1.9	1.789	76.0	2.308	98.3	0.564	24.0
	2	1.994	1.711	85.8	0.057	2.9	1.769	88.7	1.937	97.2	0.225	11.3
	3	1.960	1.582	80.7	0.078	4.0	1.660	84.7	1.882	96.0	0.300	15.3
Average		2.120	1.679	79.9	0.060	2.8	1.739	82.7	2.042	97.3	0.363	17.5
W.W.	1	2.588	1.852	71.5	0.041	1.6	1.893	73.1	2.547	98.4	0.695	26.9
	2	2.194	1.932	88.0	0.074	3.4	2.006	91.4	2.120	96.6	0.188	8.6
	3	2.156	1.965	91.1	0.062	2.9	2.028	94.1	2.093	97.1	0.128	5.9
Average		2.313	1.916	82.9	0.059	2.5	1.975	85.4	2.253	97.4	0.337	14.6

exception of the third day, the results showed the same tendency, to decrease on the day following a decrease in the chlorine content of the diet. The average urinary excretion was 1.691 grams for D.A. and 1.916 grams for W.W. When these data were calculated on the three day basis (Table IX) the output was quite constant regardless of the intake. The average fecal chloride was practically identical for the two children, namely 0.060 gram for D.A. and 0.059 gram for W.W.

The amount of chlorine minus that which appeared in the feces was considered absorbed. Because of the high solubility of chlorine each child absorbed an average of 97 percent of his intake, and none of the values fluctuated far from this average. The grams of chlorine absorbed were directly proportional to the intake in the case of each child. These results agree with those of Hoobler (4), who, in his study on infants, stated that the chlorine absorption was usually over 90 percent of the intake.

The retentions for both subjects varied greatly. The values for D.A. were greatest during the first three days which corresponded to the period of the highest chlorine intake. There was a lowered chlorine retention on the fourth day, but the remaining five days showed a tendency to become constant. This tendency is also shown when these data are averaged in three day periods. The two highest balances for W.W. occurred on the first and third days when

the chlorine content of the diet was highest. On the fourth day of this experiment W.W. showed a negative retention which was preceded by an unusually high retention. This negative balance may have been due to the elimination of chlorine held over from the high retention of the day before. The average retentions as calculated by three day periods also show that the most chlorine was retained during the period of highest intake. The average retentions were 0.363 gram for D.A. and 0.337 gram for W.W.

The percentage of the intake retained for both children varied from 3 to 39 percent. The data show definitely that there is a greater percentage as well as a greater number of grams of the chlorine retained with an increased intake. The average percentage of the intake retained by D.A. and W.W. was 17.5 and 14.6 percent respectively.

Table X gives the chlorine metabolism of the two children on a medium protein diet expressed in grams per kilogram of body weight. The chlorine intake during the first three day period was 0.135 gram. The intake for the next six days was practically constant furnishing approximately 0.11 gram per kilogram.

The respective averages for the total output, 0.100 and 0.104 gram were practically identical for the two children. These data show the same tendencies as those discussed under the total chlorine, namely: excretion of

TABLE X

THE DAILY CHLORINE METABOLISM ON A MEDIUM PROTEIN DIET EXPRESSED IN GRAMS PER KILOGRAM OF BODY WEIGHT

Subject	Weight	Day	Total Intake	Output			Total Absorption	Total Retention
				Urine	Feces	Total		
	Kg.		gms.	gms.	gms.	gms.	gms.	gms.
D.A.	17.44	1	0.133	0.092	0.003	0.096	0.131	0.039
		2	0.135	0.103	0.002	0.105	0.133	0.030
		3	0.135	0.104	0.002	0.107	0.132	0.028
		4	0.114	0.104	0.003	0.108	0.111	0.006
		5	0.114	0.096	0.003	0.099	0.111	0.015
		6	0.114	0.094	0.003	0.097	0.111	0.017
		7	0.112	---	0.004	---	---	---
		8	0.112	0.086	0.007	0.093	0.106	0.019
		9	0.112	0.095	0.002	0.097	0.110	0.015
	Average		0.121	0.097	0.003	0.100	0.118	0.021
W.W.	18.98	1	0.136	0.095	0.002	0.098	0.134	0.039
		2	0.136	0.116	0.002	0.118	0.134	0.018
		3	0.136	0.081	0.002	0.083	0.134	0.053
		4	0.116	0.119	0.004	0.122	0.112	-0.007
		5	0.116	0.094	0.003	0.097	0.113	0.019
		6	0.116	0.093	0.005	0.098	0.110	0.018
		7	0.114	0.106	0.002	0.108	0.111	0.045
		8	0.114	0.098	0.004	0.102	0.110	0.012
		9	0.114	0.106	0.003	0.110	0.110	0.004
	Average		0.122	0.101	0.003	0.104	0.119	0.018

practically all of the chlorine through the kidney, an increased excretion of this element in the urine on the day following an increase in the diet, a fairly constant fecal output and a variation in the total elimination from day to day.

The daily absorption on this basis quite closely followed the variations in the intake. Based on average results D.A. absorbed 0.118 gram and W.W. 0.119 gram per kilogram of body weight.

The greater retentions (with the exception of the second day for W.W.) occurred when the chlorine intake was the highest. It is interesting to note that the one negative retention for W.W. and the lowest retention for D.A. were on the first day following a reduction of chlorine in the diet. The average retentions per kilogram of body weight were approximately the same being .021 gram for D.A. and .018 gram for W.W.

The data per kilogram of body weight calculated as average figures per three day periods is shown in Table XI. This table reveals clearly the similarity between the reaction of the two children. The average amount of the intake absorbed was virtually the same for both subjects. The average urinary elimination of D.A., being approximately 3 percent less than that of W.W., caused his average retention to exceed W.W.'s by that amount.

Table XII records the data for the daily chlorine

TABLE XI

THREE DAY AVERAGE OF THE DAILY CHLORINE METABOLISM ON A MEDIUM PROTEIN DIET EXPRESSED IN GRAMS PER KILOGRAM OF BODY WEIGHT

Subject	Period	Intake	Output			Absorption	Retention
			Urine	Feces	Total	Total	Total
D.A.	1	0.135	0.100	0.003	0.103	0.132	0.032
	2	0.114	0.098	0.003	0.101	0.111	0.013
	3	0.112	0.091	0.004	0.095	0.108	0.017
	Average	0.120	0.096	0.003	0.100	0.117	0.021
W.W.	1	0.136	0.098	0.002	0.100	0.134	0.037
	2	0.116	0.102	0.004	0.106	0.112	0.010
	3	0.114	0.103	0.003	0.107	0.110	0.0077
	Average	0.122	0.101	0.003	0.104	0.119	0.018

TABLE XII

DAILY CHLORINE METABOLISM ON A HIGH PROTEIN DIET

Subject	Day	Total Intake	Output			Absorption		Retention	
			Urine	Feces	Total	Total	Percent of Intake	Total	Percent of Intake
		gm.	gm.	gm.	gm.	gm.	%	gm.	%
D. A.	1	2.958	2.358	0.052	2.409	2.906	98.2	0.548	18.5
	2	2.958	2.268	0.051	2.318	2.907	98.3	0.639	21.6
	3	2.958	2.273	0.041	2.319	2.912	98.4	0.638	21.6
	4	2.415	1.792	0.032	1.824	2.383	98.7	0.591	24.4
	5	2.415	1.730	0.068	1.798	2.347	97.2	0.617	25.6
	6	2.415	1.894	0.038	1.932	2.376	98.4	0.483	20.0
	7	2.450	2.088	0.038	2.126	2.412	98.4	0.324	13.2
	8	2.450	2.102	0.041	2.143	2.409	98.3	0.307	12.5
	9	2.450	2.074	0.039	2.113	2.411	98.4	0.337	13.8
	10	2.175	1.878	0.050	1.923	2.125	97.7	0.252	11.6
	11	2.175	1.881	0.063	1.945	2.112	97.1	0.230	10.6
	12	2.175	1.736	0.036	1.773	2.139	98.3	0.402	18.5
	Average	2.499	2.006	0.046	2.052	2.463	98.1	0.447	17.9
W. W.	1	3.254	2.201	0.053	2.254	3.201	98.4	0.999	30.7
	2	3.254	2.409	0.075	2.484	3.179	97.7	0.770	23.6
	3	3.254	2.620	0.064	2.690	3.190	98.0	0.564	17.3
	4	2.656	2.029	0.085	2.115	2.571	96.8	0.542	20.4
	5	2.656	2.276	0.054	2.330	2.603	98.0	0.326	12.3
	6	2.656	2.221	0.058	2.280	2.598	97.8	0.377	14.2
	7	2.695	2.128	0.058	2.186	2.636	97.8	0.509	18.9
	8	2.695	2.305	0.041	2.347	2.654	98.5	0.348	12.9
	9	2.695	2.424	0.024	2.448	2.671	99.1	0.247	9.2
	10	2.393	1.986	0.066	2.052	2.327	97.2	0.341	14.2
	11	2.393	2.183	0.045	2.228	2.348	98.1	0.165	6.9
	12	2.393	2.289	0.035	2.323	2.357	98.5	0.068	2.8
	Average	2.749	2.256	0.055	2.311	2.694	98.0	0.438	15.9

metabolism during the first twelve days of the high protein diet. Table XIII which gives these values averaged by three day periods will also be discussed at this time. The diet during the first three day period, the chlorine content of which was increased approximately one gram over the last three day period of the medium protein diet, contained a higher amount of chlorine than any other period. During the next two periods of six days the chlorine intake was constant and was practically 0.5 gram lower than during the first three days. On the last three days the chlorine content of the diet was lowered 0.2 gram below that of the previous period. The average chlorine intake for D.A. was 2.499 grams and for W.W., 2.749 grams.

The daily urinary chloride varied from 2.358 grams to 1.730 grams for D.A., and from 2.626 grams to 1.986 grams for W.W. The highest urinary output for D.A. occurred on the same days that the chlorine intake was the highest. With two exceptions the output followed the fluctuations in the intake and there was no evidence of a one day lag as was revealed on the medium protein diet. The data for W.W. do not show such a clear cut tendency to follow the intake when the daily values are considered, but if the values are averaged into three day periods (Table XIII) there is again a relationship between intake and output.

The daily fecal output of chlorine ranged from 0.025 to 0.086 gram, the average being 0.046 gram for D.A. and 0.055 gram for W.W. These average values are almost

TABLE XIII

THREE DAY AVERAGE OF THE DAILY CHLORINE METABOLISM ON A HIGH PROTEIN DIET

Subject	Period	Intake	Output				Total	Percent Intake	Absorption		Retention	
			Urine	Percent Intake	Feces	Percent Intake			Total	Percent Intake	Total	Percent Intake
		gm.	gm.	%	gm.	%	gm.	%	gm.	%	gm.	%
D.A.	1	2.958	2.300	77.7	0.049	1.7	2.349	79.4	2.908	98.3	0.609	20.6
	2	2.415	1.805	74.7	0.046	1.9	1.852	76.7	2.369	98.1	0.563	23.3
	3	2.450	2.088	85.2	0.039	1.6	2.127	86.8	2.411	98.4	0.323	13.2
	4	2.175	1.830	84.1	0.050	2.3	1.880	86.4	2.125	97.7	0.295	13.6
Average		2.499	2.006	80.2	0.046	1.8	2.052	82.1	2.453	98.1	0.447	17.9
W.W.	1	3.254	2.412	74.1	0.064	2.0	2.476	76.1	3.190	98.0	0.777	23.9
	2	2.656	2.175	81.9	0.066	2.5	2.241	84.4	2.590	97.5	0.415	15.6
	3	2.695	2.286	84.8	0.041	1.5	2.327	86.3	2.654	98.5	0.368	13.6
	4	2.393	2.153	90.0	0.049	2.0	2.201	92.0	2.344	98.0	0.191	8.0
Average		2.749	2.256	82.1	0.055	2.0	2.311	84.1	2.694	98.0	0.438	15.9

identical with those on the medium protein diet.

The total percentage of the chlorine excreted ranged from 76 to 92 percent of the intake - 80 to 82 percent in the urine and 2 percent in the feces. It is interesting to note (Table XIII) that the average percentage of the chlorine excreted in the urine was practically the same as that on the medium protein diet, namely, 80 percent for D.A. and 82 percent for W.W.

Although the urinary values are less consistent on the high protein than on the medium protein diet, the daily chlorine absorption was more constant, and in each case it followed the chlorine intake closely. Therefore, more grams of chlorine were actually absorbed by the kidney. The absorption ranged from 97.1 to 98.7 percent for D.A. and from 96.8 to 99.1 percent for W.W. The average daily absorption for the two children however, was the same and it was less than 1 percent higher than the average absorption on the medium protein diet.

Again W.W. showed a greater variation than D.A. in the amount of chlorine retained, though both children again showed a tendency to store more chlorine on the days when the intake of this element was the greatest. This fact (Table XIII) is especially evident when the data are averaged in three day periods. The average retention for D.A. was 0.447 gram and for W.W. 0.438 gram.

Each child retained almost the same percentage of his chlorine intake whether he had a high or a medium protein

diet. The average values were 17.5 and 17.9 percent for D.A., and 14.6 and 15.9 percent for W.W. These data also show that there was only a 2 to 3 percent difference in the amounts retained by the two children.

Table XIV records the daily chlorine metabolism on a high protein diet expressed in grams per kilogram of body weight. Table XV gives these data averaged in three day periods. The chlorine intake varied from 0.13 gram to 0.17 gram for either child. As previously discussed the chloride excreted in the urine generally followed the changes in the intake. The average values excreted in grams per kilogram of body weight were 0.115 gram for D.A. and 0.119 gram for W.W. These amounts were slightly higher than those on the medium protein diet, but increased in proportion to the increase in diet. The amount of fecal chlorine on this basis was the same for the two children (0.003 gram) and was fairly constant day by day. The average fecal chlorine per kilogram was the same on the high as on the medium protein diet for both subjects.

The daily absorption followed the intake very closely, the average value being practically identical for the two children (0.141 and 0.142 gram). The body actually absorbed more grams as well as a greater percentage of the chlorine intake on the high protein than on the medium protein diet. Approximately 98 percent of the intake was absorbed in both cases which is a value higher than those obtained by the majority of early investigators. Some

TABLE XIV

DAILY CHLORINE METABOLISM ON A HIGH PROTEIN DIET EXPRESSED IN GRAMS PER KILOGRAM OF BODY WEIGHT

Subject	Weight	Days	Total Intake	Output			Total Absorption	Total Retention
				Urine	Feces	Total		
	kg.		gm.	gm.	gm.	gm.	gm.	gm.
D.A.	17.44	1	0.170	0.135	0.003	0.138	0.167	0.031
		2	0.170	0.130	0.003	0.133	0.167	0.037
		3	0.170	0.130	0.003	0.133	0.167	0.037
		4	0.138	0.103	0.002	0.105	0.137	0.034
		5	0.138	0.099	0.004	0.103	0.135	0.035
		6	0.138	0.109	0.002	0.111	0.136	0.028
		7	0.140	0.120	0.002	0.122	0.138	0.019
		8	0.140	0.120	0.002	0.123	0.138	0.018
		9	0.140	0.119	0.002	0.121	0.138	0.019
		10	0.125	0.107	0.003	0.110	0.122	0.014
		11	0.125	0.108	0.004	0.111	0.121	0.010
		12	0.125	0.100	0.002	0.102	0.123	0.023
	Average		0.143	0.115	0.003	0.118	0.141	0.026
W.W.	18.98	1	0.171	0.116	0.003	0.119	0.169	0.053
		2	0.171	0.127	0.004	0.131	0.167	0.041
		3	0.171	0.138	0.003	0.142	0.168	0.030
		4	0.140	0.107	0.004	0.111	0.135	0.029
		5	0.140	0.120	0.003	0.123	0.137	0.017
		6	0.140	0.117	0.003	0.120	0.137	0.020
		7	0.142	0.112	0.003	0.115	0.139	0.027
		8	0.142	0.121	0.002	0.124	0.140	0.018
		9	0.142	0.128	0.001	0.129	0.141	0.013
		10	0.126	0.105	0.003	0.108	0.123	0.018
		11	0.126	0.115	0.002	0.117	0.124	0.009
		12	0.126	0.121	0.002	0.122	0.124	0.004
	Average		0.145	0.119	0.003	0.122	0.142	0.023

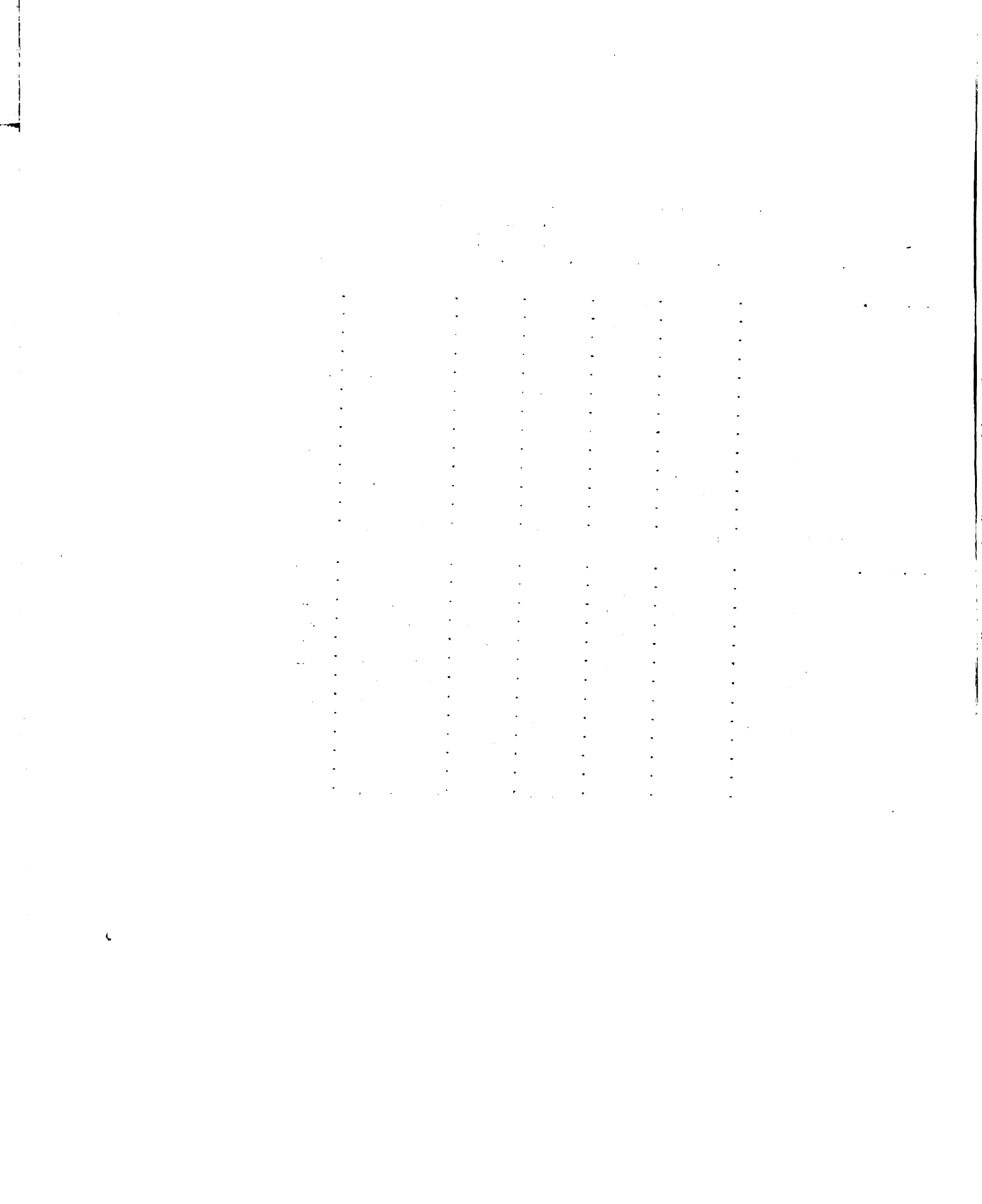

TABLE XV

THREE DAY AVERAGE OF THE DAILY CHLORINE METABOLISM ON A HIGH PROTEIN DIET EXPRESSED IN GRAMS PER KILOGRAM OF BODY WEIGHT

Subject	Period	Intake	Output			Absorption	Retention
			Urine	Feces	Total	Total	Total
		gm.	gm.	gm.	gm.	gm.	gm.
D.A.	1	0.170	0.132	0.003	0.135	0.167	0.035
	2	0.138	0.103	0.003	0.106	0.136	0.032
	3	0.140	0.120	0.002	0.122	0.138	0.018
	4	0.125	0.105	0.003	0.108	0.122	0.017
Average		0.143	0.115	0.003	0.118	0.141	0.026
W.W.	1	0.171	0.127	0.003	0.130	0.168	0.041
	2	0.140	0.115	0.003	0.118	0.136	0.022
	3	0.142	0.120	0.002	0.123	0.140	0.019
	4	0.126	0.113	0.003	0.116	0.123	0.010
Average		0.145	0.119	0.003	0.122	0.142	0.023

American workers (Hoobler (4), Shohl and his coworkers (8), and Sawyer, Bauman and Stevens (7)), however, obtained absorption figures which were correspondingly high.

The average retentions per kilogram of body weight were approximately the same for both children. On the high protein diet, which furnished 0.14 gram of chlorine per kilogram of body weight, D.A. and W.W. retained 0.026 and 0.023 gram respectively. These values were very similar to the 0.021 and 0.018 gram retained on the medium protein diet which furnished 0.12 gram of chlorine.

The results of foreign investigators, as shown in Table I, indicate that on the kilogram basis the chlorine intakes were lower and usually resulted in lower retentions than those in the experiment reported here, although the percentages of the intakes retained were similar. In the cases where the intakes were higher, the retentions were usually proportionally higher which indicates, as does this experiment, that there is some relationship between intake and retention. On the other hand, on a greater chlorine intake (0.30 gram) Sawyer and her coworkers found that their subjects were in slight negative balances (-0.018 and -0.005 gram per kilogram of body weight). There is a possibility, however, that these subjects may have been accustomed to a higher chlorine intake previous to the experiment.

The adult subjects studied by Clark (3) received a slightly lower intake per kilogram than did the children in

this study, but they retained approximately the same amount of chlorine. This substantiates the opinion of Wang and Davis (12) that possibly there is no relation between age and retention.

Definite conclusion regarding the amount of chlorine needed by pre-school children can be drawn neither from the literature cited nor from this study. The result of this investigation reveal, however, that with the exception of one day, the children were able to remain in a positive chlorine balance over a period of twenty-one days on an intake as low as 0.12 to 0.14 gram per kilogram. This indicates that probably they were receiving a sufficient amount of this element in the diet. Since very little sodium chloride was added to the diet, these results appear to confirm the theory that very little, if any, table salt need be added to the food of preschool children.

SUMMARY

A study of the chlorine metabolism of two normal preschool boys fed either a medium or a high protein diet was conducted for a period of twenty-one days.

1. The average intakes on the medium diet were 2.120 grams for D.A. and 2.313 grams for W.W. while those on the high protein diet were 2.499 grams and 2.749 grams respectively.
2. With the exception of one day for one subject the children were in a positive balance throughout the entire study.
3. From 80 to 83 percent of the chlorine intake was excreted in the urine.
4. The fecal chloride was identical for both subjects on both diets averaging from 2 to 3 percent of the intake.
5. On the kilogram basis the total amount of chlorine excreted by the two children was practically the same.
6. The daily absorption followed the intake closely, average values ranging from 97 to 98 percent of the ingested chlorine.
7. The average amounts of chlorine retained per kilogram of body weight on both diets were similar for the two subjects, namely 0.021 and 0.026 gram for D.A. and 0.018 and 0.023 gram for W.W.

8. The fact that the high protein diet furnished slightly more chlorine than the medium protein diet did not appear to materially affect the percentage of the intake absorbed or retained, but did cause an actual increase in the number of grams retained.
9. No definite conclusions can be drawn regarding the amount of chlorine needed by preschool children.

APPENDIX

TABLE XVI

DAILY CHLORINE METABOLISM ON A MEDIUM PROTEIN DIET EXPRESSED IN GRAMS OF SODIUM CHLORIDE

Subject	Day	Total Intake	Output			Absorption		Retention	
			Urine	Feces	Total	Total	Intake	Total	Intake
		gm.	gm.	gm.	gm.	gm.	%	gm.	%
D.A.	1	3.868	2.656	0.106	2.763	3.763	97.2	1.107	28.7
	2	3.868	2.982	0.051	3.033	3.818	98.7	0.836	21.6
	3	2.868	3.010	0.070	3.079	3.799	98.2	0.790	20.4
	4	3.271	3.007	0.100	3.107	3.172	96.9	0.165	5.1
	5	3.271	2.747	0.093	2.840	3.179	97.1	0.432	13.2
	6	3.271	2.714	0.090	2.804	3.182	97.2	0.468	14.3
	7	3.228*	---	0.131	---	---	--	---	--
	8	3.228	2.487	0.194	2.681	3.035	93.9	0.549	17.0
	9	3.228	2.729	0.066	2.795	3.164	98.0	0.434	13.4
Average		3.484	2.779	0.096	2.888	3.392	97.3	0.598	17.1
W.W.	1	4.256	2.987	0.078	3.065	4.173	98.1	1.191	28.0
	2	4.256	3.639	0.060	3.699	4.196	98.6	0.557	13.1
	3	4.256	2.547	0.065	2.612	4.191	98.5	1.644	38.6
	4	3.600	3.705	0.115	3.820	3.485	96.8	-0.220	--
	5	3.600	2.946	0.091	3.036	3.509	97.5	0.563	15.6
	6	3.600	2.899	0.166	3.066	3.433	95.4	0.534	14.8
	7	3.552	3.322	0.078	3.400	3.474	97.8	0.152	4.3
	8	3.552	3.072	0.127	3.199	3.426	96.4	0.354	9.9
	9	3.552	3.345	0.107	3.445	3.445	96.9	0.107	2.7
Average		3.803	3.162	0.100	3.261	3.704	97.4	0.542	14.2

TABLE XVII

THE DAILY CHLORINE METABOLISM ON A HIGH PROTEIN DIET EXPRESSED IN GRAMS OF SODIUM CHLORIDE

Subject	Day	Total Intake	Output			Absorption		Retention	
			Urine	Feces	Total	Total	Intake	Total	Intake
		gm.	gm.	gm.	gm.	gm.	%	gm.	%
D.A.	1	4.894	3.889	0.085	3.975	4.808	98.2	0.919	18.8
	2	4.894	3.736	0.080	3.817	4.813	98.4	1.079	22.0
	3	4.894	3.762	0.074	3.836	4.819	98.5	1.057	21.6
	4	3.972	2.954	0.047	3.001	3.924	98.8	0.970	24.4
	5	3.972	2.850	0.111	2.961	3.861	97.2	1.011	25.4
	6	3.972	3.120	0.064	3.185	3.907	98.4	0.787	19.8
	7	4.049	3.443	0.064	3.507	3.985	98.4	0.541	13.4
	8	4.049	3.466	0.064	3.530	3.985	98.4	0.519	12.8
	9	4.049	3.423	0.062	3.485	3.987	98.5	0.564	13.9
	10	3.678	3.098	0.083	3.182	3.595	97.7	0.497	13.5
	11	3.678	3.104	0.106	3.210	3.572	97.1	0.468	12.7
	12	3.678	2.875	0.062	2.937	3.616	98.3	0.741	20.1
Average		4.148	3.227	0.075	3.385	4.073	98.2	0.763	18.4
W.W.	1	5.383	3.578	0.095	3.673	5.288	98.3	1.710	31.8
	2	5.383	3.981	0.128	4.109	5.255	97.6	1.274	23.7
	3	5.383	4.334	0.099	4.434	5.294	98.3	0.949	17.6
	4	4.369	3.360	0.139	3.499	4.230	96.8	0.870	19.9
	5	4.367	3.748	0.091	3.839	4.277	98.4	0.529	12.1
	6	4.369	3.672	0.100	3.772	4.269	97.7	0.596	13.6
	7	4.454	3.514	0.100	3.614	4.354	97.7	0.840	18.8
	8	4.454	3.805	0.068	3.873	4.386	98.5	0.581	13.0
	9	4.454	4.007	0.041	4.049	4.413	99.1	0.405	9.1
	10	4.046	3.273	0.107	3.381	3.939	97.3	0.665	16.4
	11	4.046	3.608	0.075	3.683	3.971	98.1	0.363	9.0
	12	4.046	3.781	0.059	3.840	3.987	98.5	0.206	5.1
Average		4.563	3.722	0.092	3.730	4.472	98.0	0.749	16.4

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