THE EFFECT OF THE ADMINISTRATION OF IODINE
ON THE COMPARATIVELY LOW BASAL METABOLIC RATE OF A
GROUP OF KANSAS COLLEGE WOMEN

by

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INTRODUCTION

Metabolism is the term used to describe the sum of all the physical and chemical processes by which one single living organized substance is produced and maintained, also the transformation by which energy is made available for the use of the organism (1). Basal metabolism as defined by Sherman (2) is the rate of energy metabolism of the body when at complete rest (both mentally and physically) in the so-called "post absorptive state" (12-18 hours after the last intake of food) in a room of comfortable temperature and when the body temperature is within normal range.

The basal metabolic rate of Kansas college women has been studied during a ten-year period as part of the North Central States Cooperative project on the Nutritional Status of College Women. The seven states included in this study were Kansas, Nebraska, Oklahoma, Ohio, Iowa, Minnesota and Wisconsin. This collective group of workers reported significant differences among the states in the deviations from the normal basal metabolic rate of specific age groups. The results (3) of this study have showed a generally lower basal metabolic rate for residents in warm climates. However, little correlation could be found between basal metabolic rate and such factors as pulse, respiration, body temperature, outside temperature, humidity or hours of sunshine. During five years, the same subjects were used but intra-individual variation tended to mask any change in relation to the age of the subject. The factors thus investigated were considered minor in relation to the results obtained (4).

It was suggested by the members of this project that one factor needing further investigation was the effect of iodine on the comparatively low basal metabolic rate of college women.

The purpose of this study was to determine the effect of iodine on the comparatively low basal metabolic rate of a group of Kansas college women.

REVIEW OF LITERATURE

Authorities (5) have reported that Lavosier formally founded the science of nutrition, by stating the true nature of oxidation within and without the body. According to DuBois (6), Lavoisier, who lived from 1743-1799, not only discovered the significance of oxygen in respiration, but with the aid of Seguin, a fellow worker, successfully constructed an apparatus which measured the metabolic rate of man. Lavoisier probably was the first to understand and give a concrete example of the nature of oxidation through his demonstration of the increase in body heat production caused by food consumption, exposure to cold, and many forms of exercise.

Two methods have been used for determining the basal metabolic rate: (a) the direct method determined the heat exchange and (b) the indirect method determined the oxygen consumed and the carbon dioxide produced at a constant respiratory quotient. Sherman (2) has reported that the respiratory quotient could be calculated by dividing the volume of carbon dioxide given off in respiration by the volume of oxygen consumed.

$$\frac{\text{Volume of carbon dioxide produced}}{\text{Volume of oxygen consumed}} = \text{Respiratory quotient (R.Q.)}$$

Regnault and Reiset (7) in 1849 published a description of a closed circuit apparatus for the measurement of the oxygen intake and the carbon dioxide output of laboratory animals. The general principles used by these two early workers are found in the present day closed circuit apparatus. It was not until 1862 that Pettenkofer and Voit (6) constructed a respiration chamber large enough for man.

Atwater (5), studying in Germany, began work in the year 1892 on a calorimeter for man. Atwater, at this time, was associated with Rosa. Together they completed a calorimeter for man in 1897.

One year previously in 1896, Atwater, while working with Benedict, built two respiration chambers for studying energy metabolism in man. Lusk (6), an associate of Benedict, used a similar but smaller apparatus to study the effects of food and intermediary metabolism on the processes which take place in the human body.

Zuntz and Coppart (6), realizing the importance of complete muscular repose, built a portable open circuit apparatus which measured the oxygen intake and carbon dioxide production for short intervals of time.

During the time Regnault and Reiset were working in France, two German scientists Bidder and Schmidt (6) developed a method for calculating the oxygen intake and the carbon dioxide expelled during metabolism.

Rubner (5), during his association with Carl Voit's laboratory in 1887, was able to show the relationship of the heat of food burned in the body to the heat of that burned outside the body. Atwater (6) furthered Rubner's findings and completed the values for heat production in man.

DuBois (5), a pupil of Lusk, made such contributions as standards for the normal basal metabolic rate of man. He showed that the metabolic rate depended not so much upon the body's total weight as on its amount of active protoplasmic tissue, and that this was directly related to the surface area of the body. It is through this work of DuBois (6) that accurate measurements of surface area for various body shapes have been formulated. DuBois and DuBois (2) used two methods for computing the surface:

> (1) from a series of nineteen measurements of different parts of the body, the surface of each part being computed and the results added together (linear formula), and (2) a 'height-weight formula' which they derived

> mathematically from the data of all available measurements of height, weight, and surface.

Thus by constructing a chart for surface area, DuBois enabled the student of metabolism to obtain this value with practically no mathematical computations.

There are many standards for basal metabolism among which are those established by Aub and DuBois in 1917 using height and weight; Harris and Benedict in 1919 using height, weight, and age; Dreyer in 1921 using weight and age (two supplementary formulas were based on sitting height and the circumference of the chest), and Stark in 1932 using height and weight. The standards of Aub and DuBois have been modified by Boothby and Sandiford of the Mayo Clinic and are at the present time used by many investigators to determine the normal basal metabolic rate. These last mentioned workers constructed nomograms for estimating the surface area from height and weight.

Jenkins (8) has stated that all borderline or doubtful cases should be calculated by more than one standard and until new standards can be proven definitely and statistically superior the field of investigation is better off without them.

Many studies have shown normal women to be below the standards given by Harris and Benedict or Aub and DuBois. Such possible causes have been investigated as the state of nutrition, activity, climate, outside temperature, humidity, hours of sunshine, age, body temperature, respiration and pulse rate.

Tilt (9), observing 52 girls in Florida from 17 to 25 years of age, found they averaged 9.9 per cent below the Harris and Benedict predictions and 10.6 per cent below those of Aub and DuBois. In this same age range, McKittrick (10) reported that the basal metabolic rates of Wyoming University women were 3.18 per cent below the predicted standards of Aub-DuBois and 2.54 per cent below the predicted Harris-Benedict standards. Pittman et al. (3) reported basal metabolism determinations on 1179 college women from five mid-western states. The ages ranged from 17 to 24 years, inclusive. This group of workers stated there was little evidence for correlation of basal metabolism with age, body temperature, outside temperature, humidity, hours of sunshine, respiration, or pulse rate; however, they stated that the lower rates found among Kansas and Oklahoma women as compared with northern states may be attributed to the warmer climate.

On the other hand, Coons and Schiefelbusch (11) attributed the lower basal metabolism of a group of Oklahoma women to a prolonged period of undernutrition. Tilt and Walters (12) observed 30 normal young women who had lived in Florida eight years or longer. A comparison of the average basal metabolism of young women living in Florida with those from northern states shows a decidedly lower rate for Florida women. These authors attributed the lower basal metabolic rate to climate. One factor which has not been considered by these workers is the effect of iodine on the comparatively low basal metabolic rate of college women.

Iodine is an essential constituent of the hormone, thyroxin, secreted by the thyroid gland. This gland consists of numerous lobules separated from one another by connective tissue partitions. Wolf (13) states that the thyroid owes its function to the hormone, thyroxin, of which iodine is an essential constituent, comprising about 65 per cent of the thyroxin molecule.

The thyroid gland secretes thyroxin daily and stores it in the colloid spaces as thyroglobulin to be released as the body needs it. The thyroid gland is the only gland presently held responsible for the storage of iodine, and the regulation of the iodine content within the body. Plummer (14) has calculated that the daily requirement of thyroxin for normal individuals is from 0.5 to 1.0 mg. which is an equivalent of 0.3 to 0.6 mg of iodine. Plummer and Boothby (15) have placed the daily thyroxin requirement at 0.2 to 0.4 mg. One and one-half grains of a preparation of dried thyroid, conforming to U. S. P. requirements has a total organic iodine concentration of 0.22 per cent, therefore one and one-half grain or 0.1 gram will contain 0.22 mg. of iodine. Means (16) has concluded that the body needs of 0.2 mg. of iodine per day for the purpose of making 0.33 mg. of thyroxine (or less) since this amount is destroyed in the body or excreted daily. It is possible that the anterior pituitary gland through its influence on the thyroid may affect the iodine content indirectly. Blomm (17) has stated that iodine is essential for the production of the hormone thyroxine, but should be identified with it merely as a part of the whole. Watson (18) has stated that the thyroid gland apparently is the only organ which is capable of extracting iodine from the normal blood flow and storing it. Curtis (19), in published material, has said that the blood iodine and urinary iodine are valuable criteria for determining thyroid function. The iodine content of normal blood is made up of approximately two-thirds organic and one-third inorganic iodine. The inorganic iodine is believed to be ingested in food.

Myxedema and cretinism are two examples of deficiency of the thyroid gland (13). Myxedema is a chronic deficiency characterized by a low metabolic rate, usually impaired mentality and an increase in weight. Cretinism may be either a hereditary endemic or sporadic chronic disease which has its beginning in fetal life or in infancy. It is characterized by retarded bodily and usually mental development (13).

Chatin (20), a French worker, has postulated the theory that endemic goiter is the result of a deficiency of iodine. A direct experimental proof of Chatin's theory has not been carried out in the United States of America. Contradictory to this belief, Greenwald (20) has concluded that endemic goiter is not due to a lack of iodine. Hellwig (21), of Wichita, Kansas, attempted to produce goiter in white rats by feeding a diet poor in iodine. He concluded that iodine deficiency was not the essential cause of goiter since his attempts to produce goiter in white rats by feeding a diet poor in iodine gave negative results. Levin, Remington and von Kollnitz (22) fed rats a diet low in iodine and produced hyperplasia of the thyroid gland.

Little conclusive evidence has been presented as to the effect of iodine on the basal metabolic rate of college women. Most of the reported work has been done on laboratory animals. Meyer and Danow (23) reported that in thyroidectomized rats daily dosages of thyroid from rats or rabbits fed 5 mg. and 15 mg. of iodine, respectively, for two or three weeks caused in the thyroidectomized rats an increase in metabolic stimulation. Linton (23), while studying human subjects, observed an occasional metabolic increase after iodine medication.

Watson (18) has stated that anatomical and functional abnormalities of the thyroid gland may be considered as an alteration of iodine metabolism. He has stated there is no correlation between the basal metabolic rate and iodine tolerance. The iodine tolerance test is the amount of ingested iodine necessary to produce saturation or urinary excretion of iodine.

Contrary to the above data, Marine, Deutch, and Cipra (24) have stated that the dosage of iodine in any form will not only cause a resumption of a normal condition of the thyroid if hyperplasia or enlargement from an increase in elements has occurred but will prevent occurrence of hyperplasia in all orders of animals studied. These workers studied several species of fish, birds, and mammals including rats, guinea pigs, rabbits, cats, dogs, sheep, pigs, horses, cattle, and man.

Greenwald (20) wrote that in simple goiter the basal metabolic rate is quite normal. This statement was based on his review of literature. Elmer and Schops (20) reported 11 cases of simple goiter and found the basal metabolic rate to vary between plus 11 and minus 27 per cent of the normal.

Boothby (25) has stated that in simple endemic goiter the basal metabolic rate may be within the normal range but tending toward the lower limits. Further study on the significance of the effect of iodine on the low basal metabolic rate will have to be carried out before correlations can be made.

PROCEDURE

Equipment Used

In this research, the basal metabolic rate was determined by the indirect method of calorimetry. A Benedict-Roth closed circuit portable metabolism apparatus was used throughout this study. The subject was connected to the apparatus by means of a rubber mouthpiece. The spirometer chamber was filled with U. S. P. medical oxygen from the oxygen storage tank attached to the apparatus. The subject inhaled the oxygen and exhaled carbon dioxide. The exhaled air was transmitted through a container of soda lime to insure complete absorption of the carbon dioxide.

Care of Equipment

When the apparatus was not in use, it was disassembled (26) to allow for ventilation. The soda lime was taken from the container, carefully spread out on an aluminum tray, and allowed to dry. Soda lime was discarded after 60 consecutive basal metabolism tests were made.

Procedure Preliminary to Test

Before the subject was connected to the apparatus, and before the basal tests were begun, the apparatus was checked for leaks. The spirometer bell was filled with oxygen, the kymograph was started, and the recording pen placed in position. After a one-minute period, a 60-gram weight was placed on the spirometer bell. The weight was lifted at the end of the second one-minute period and the kymograph allowed to continue rotating for a third one-minute period. The presence of a leak would cause a rapid rise in the slope of the record. The escape of oxygen would cause the pen to rise perpendicularly to the record for the first one-minute period. If no leaks were present the pen would fall to the first one-minute level. When the subject was connected to the apparatus, leaks might have occurred at the mouth-piece if the lips were not fitted over the rubber insert or if the nose clamp was not tight enough. During each test period, frequent checks were made to see that leaks were not occurring.

Procedure During Test

The subject came to the laboratory and was asked to remain at bed rest for a period of 30 minutes. The room was kept as free from external stimulus as possible, and at a comfortable temperature. As was recommended by Means (16), the room was kept as free from the appearance of a hospital as possible.

At the end of the rest period, the body temperature was taken orally. A clinical thermometer was used; normal deviations were considered. The average figure for the normal body temperature was considered to be 98.6 degrees Fahrenheit. The normal limit was 98.2 to 98.8 degrees Fahrenheit. Any student with a body temperature outside what is considered the normal range was not tested. The respiratory rate was taken without the subject's knowledge for an interval of 30 seconds. The respiratory rate was compared with the actual recording made on the kymograph drum. Pulse rate was counted for a 30-second period then for a second 30-second period as a check on the first.

Two tests were given each day. The first test was an eight minute test, the second test a six minute test. The tests were calculated on the basis of six minutes. Ceiling lights were turned out during the test.

The spirometer was carefully adjusted to prevent its scraping the sides of the container during each test period.

Temperature of the room was observed before and after each test. The temperature of the spirometer was taken before and after each eight minute and six minute test period. The average was used for calculations. In this study adjustment for the temperature was unnecessary since the temperature did not change one degree centigrade. The standard correction amounts to 0.5 cc of oxygen for each degree rise in temperature.

The barometric pressure in millimeters of mercury was recorded at the beginning of each test period.

Procedure After Test

After the subject had been given the basal metabolism test, height and weight measurements were made. Weight was recorded in kilograms, height in centimeters.

Two cards were filed for each subject. One card contained the collected data (Form 1) and the other card recorded the history of the subject (Form 2).

The operator made notations on the data cards as soon as the information was given. Questions concerning the start of the last active menstrual period, the time to bed and the hour of rising were asked after the test. The history card was carefully checked after each basal metabolism test. Inconsistencies were noted in this manner. Mental tests and scholastic records were obtained from college records.

The medical record was based upon the physical examination given to the subjects by the head of the department of student health.

Organization of Experimental Group

In choosing the subjects for this study, 20 girls were asked to report for a preliminary basal metabolism test. These girls were chosen from Van Zile Hall, after discussing the study with them, and allowing them to volunteer for active participation in the study. Two girls not living at this residence hall asked to be included in the study.

In an effort to limit variables, girls from the ages of 18 to 20 years were first chosen. Most girls in this age group were willing to report to Calvin Hall for one test, but declined further participation in the study.

Form 1. Data Card

Name

Date						
Barometric P.						
O_2 Bell Before						
O_2 Bell After						
Room Temperature						
Outside, Mean						
Outside, Range						
Patient Temp.						
Pulse Rate						
Respiration Rate						
Height, cm.						
Weight, Kg.						
Surface area						
Calories/hr. a.						
b.						
ave.						
Calories/24 hrs.						
Cal./sq.m./hr.						
Deviation from stand.						
Disturbing Factors						

Name

Date						
Date of Last mense strt.						
Days after mense						
Coffee, cups per day						
Cigarettes per day						
Time to Bed						
Time of rising						
Hours of sleep prev. nite						

Other observations

Form 2. History Card

HISTORY

Name Age

Date

Place of Living

Permanent Address

School Curriculum Classification

Mental Tests

Scholastic Record

Medical Record

Extra Curricular Activities:

Employment: Yes No Where?

Use of Iodized Salt

Fish

Goiter

Previous Sicknesses

Length of Kansas Residence Yrs. Months.

Dietary Habits

Two subjects were chosen at the age of 21 years. One girl 20 years plus when the study began became 21 years before the study was completed. There was no limit on the activity of the girls participating. Every effort was made to obtain a random sample of the normal average college student. In the preliminary test period girls were scheduled to arrive at Calvin Hall before class periods. Each student's class schedule was carefully checked and arrangements for the basal test made on the day most convenient for the subject.

Students were sent instructions (Form 3) through the college post office three days or more before the scheduled tests were to take place. The subjects were instructed to secure at least eight hours of sleep, or rest in bed, the night before the test was given. They were to eat a light supper and eat no food (except water) after supper. Breakfast was given to the subject after the basal metabolism test had been given. They were asked not to smoke on the morning of the test. Taxi tickets were issued to each participant so that the subject would not exert herself in walking to the laboratory. Basal tests were not given during the active menstrual period nor were they given within four or five days after, or prior to the active menstrual period.

Organization for Experimental Period

After a preliminary test period, subjects were paired on

Form 3. Directions for Basal Appointments

1. Have at least eight hours of sleep the night before the test.

2. Eat a light supper.

3. Eat no food (except water) after supper. Do not have breakfast.

4. Do not smoke on the morning before the test.

5. Allow enough time to dress in the morning so that there will be no need to hurry.

6. Come to Calvin Hall in a taxi. Get your tickets in advance.

7. Breakfast will be served after the test.

8. Avoid having the test taken within four or five days after the last menstrual period, or five days before the next period.

9. Avoid having the test taken on an examination day even if you do not feel excited.

If for some reason you will be unable to keep your appointment, please call Miss ________, and a new appointment will be made.

the basis of their basal metabolism as measured in calories per square meter per hour. The subject was asked to report to the student health department for a physical examination (Form 4). One girl was asked not to participate because of a toxic nodular goiter. The test solution containing potassium iodide and the placebos containing salt solution were prepared by a member of the department of student health in like quantity. The solutions were colorless; the potassium iodide and salt solutions were placed in identical bottles. Eyedroppers of like dimension were given for each solution.

One member of each pair was assigned to the group receiving potassium iodide solution. The other member of each pair was assigned to the group receiving sodium chloride solution. No subject knew which solution she was receiving or with whom she was paired. Each girl was instructed to take six drops of her designated solution daily for seven days. Six drops of the test solution were equivalent to three milligrams of potassium iodide. The total dosage, given on seven consecutive days, was 21 milligrams of potassium iodide (Form 5).

Basal metabolism tests were run seven days, 14 days, and 28 days after the beginning of the dosage period. Menstrual periods were avoided.

Form 4. Directions for Persons Reporting for Physical Examination

Please report to Doctor ____________, Head of the Student Health Department, Anderson Hall (day) ________, (date) ______________ or on (day) ________________, (date) ______________.

If it is impossible for you to be there at either of the specified times please notify Miss ____________.

Form 5. Directions for Iodine Medication

1. Solution has been prepared and prescribed by Doctor ______________ Head of the Student Health Department.
2. Keep solutions in your room at room temperature.
3. Your next basal metabolism test will be given after you have taken ____(no. of drops) each day, for one week. Return solutions to the laboratory the morning of the basal test.
4. Do not take medication the morning of the basal test.
5. You will be notified when to begin taking daily dosages through the college post office.
6. One basal test will be taken one week after the drops and one basal test two weeks after the drops.

Note: Carefully follow directions, if you have any questions please call Miss __________ at your earliest convenience.

DISCUSSION OF RESULTS

Normal Basal Metabolic Rate

In the preliminary tests on 12 girls ranging in age from 18 to 21 years, the mean basal metabolic rate was 31.17 calories per square meter per hour with a range from 26.82 to 35.88 calories per square meter per hour (Table 1). This was 16 per cent below the standard of Boothby and Sandiford (6) for the 20 to 24 year age range and it was 10 per cent below the mean of 34.87 calories per square meter per hour reported by Shinkle (27) in a study of 54 Kansas college women between the ages of 17 and 24 years. Talbot (28) found that the normal variation for girls 18 years of age was from 15 per cent above to 15 per cent below the average standard.

Previous work carried on by the North Central States Cooperative Project over a period of 10 years and summarized by Donelson et al. (29) has given a mean of 33.1 calories per square meter per hour with a range of means from 32.8 to 35.6 calories per square meter per hour for 379 Kansas college women in the age groups from 17 to 24 years. The lower basal metabolic rates obtained in this study may be due to a variation in climate, activity, or training of subjects. When the subjects were paired on the basis of their basal metabolic rates measured in calories per square meter per hour the potassium iodide

Table 1. Results of preliminary tests on the basal metabolic rate of a group of Kansas State College women.

Pair	Age: years	Age: mos.	Solution	Weight (kg.)	Cal/sq m/hr.	Deviation from Standard-Boothby and Sandiford (a)	Deviation from Standard-Boothby and Sandiford (b)
I	18	8	KI	50.53	26.82	-27.9	-27.9
II	21	0	KI	55.67	29.90	-18.9	-18.9
III	19	2	KI	66.54	30.52	-17.9	-17.9
IV	21	11	KI	50.50	31.30	-15.9	-14.4
V	20	3	KI	57.26	33.46	- 9.3	- 9.3
VI	19	1	KI	49.58	32.47	- 9.1	-10.7
Mean				55.09	30.74		
I	19	7	NaCl	72.80	29.84	-21.3	-18.8
II	19	2	NaCl	59.90	30.12	-17.6	-20.7
III	20	8	NaCl	56.75	31.09	-15.1	-15.1
IV	19	3	NaCl	50.55	30.78	-16.4	-18.0
V	19	2	NaCl	51.19	31.87	-14.4	-14.3
VI	18	9	NaCl	51.95	35.88	- 2.0	- 5.0
Mean				57.18	31.60		
Mean for total group				56.16	31.17		

group and the sodium chloride group did not differ significantly from each other.

Seven Day Test

Four of the six paired subjects receiving potassium iodide showed an increase in basal metabolic rate; the other two members showed a decrease in rate though for only one was it an appreciable decrease (Table 2). The mean basal metabolic rate for this group was 32.88 with a range from 26.49 to 42.55 calories per square meter per hour.

Five of the six paired subjects receiving sodium chloride showed a decrease in calories per square meter per hour during this same period. The mean calories per square meter per hour was 25.79 with a range from 22.06 to 30.29. The mean difference between members of the pairs in their response to supplementation was 8.0 calories per square meter per hour in favor of the potassium iodide group.

In the group receiving sodium chloride, the comparison of the preliminary test with the seven day test showed a wide range of variability. The lowest test was -40.6 per cent which is believed to be a pre-menstrual figure (6) for this individual, and the highest test was -17.6 per cent below the modified Aub DuBois standard. Variability may be due in part to age, activity, heredity, and climatic factors (4).

Table 2. Results of seven-day tests on the basal metabolic rate of a group of Kansas State College women.

Pair	Age: years	Age: mos.	Solution	Weight (kg.)	Cal/sq m/hr.	Deviation from Standard-Boothby and Sandiford (a)	Deviation from Standard-Boothby and Sandiford (b)
I	18	8	KI	49.70	26.49	-27.[illegible]	-26.4
II	21	0	KI	55.90	34.98	- 5.1	- 5.1
III	19	2	KI	60.25	[illegible]2.43	-12.8	-12.8
IV	21	11	KI	50.53	33.35	- 9.5	- 9.5
V	20	3	KI	57.66	42.55	+16.7	+13.9
VI	19	1	KI	50.13	27.52	-26.0	-26.0
Mean				50.03	32.98		
I	19	7	NaCl	73.88	30.29	-18.5	-18.5
II	19	2	NaCl	59.89	24.08	-33.2	-36.0
III	20	6	NaCl	56.83	23.01	-37.6	-37.6
IV	19	3	NaCl	49.70	22.06	-40.6	-40.6
V	19	2	NaCl	51.53	25.14	-32.4	-32.4
VI	18	9	NaCl	52.50	30.16	-20.6	-17.6
Mean				57.38	25.79		

Fourteen Day Test

The results of the 14 day tests on the group receiving potassium iodide showed a decrease in the mean basal metabolic rate to 26.15 calories per square meter per hour while on the other hand the group receiving sodium chloride gave evidence of a rise in the mean basal metabolic rate to 32.65 calories per square meter per hour (Table 3). The mean difference between members of pairs in basal metabolic rate changes were not significant. One member receiving potassium iodide was unable to report for the 14 day test. This member was a senior student with a full class schedule, and before a second date was made for the test the active menstrual period began.

Twenty Eight Day Test

In the 28 day test, the group receiving potassium iodide showed a rise in the basal metabolic rate to 32.99 mean calories per square meter per hour, while the group receiving sodium chloride gave evidence of a slight increase to 33.60 mean calories per square meter per hour (Table 4). The mean difference in the basal metabolic rate changes over a 28 day period showed only 1.59 calories per square meter per hour which was in favor of potassium iodide, thus there appeared to be no real difference in basal metabolic rate between the group receiving

Table 3. Results of fourteen-day tests on the basal metabolic rate of a group of Kansas State College women.

Pair	Age: years	Age: mos.	Solution	Weight (kg.)	Cal/sq m/hr.	Deviation from Standard-Boothby and Sandiford (a)	(b)
I	18	8	KI	49.81	24.85	-33.8	-32.4
II	21	0	KI	57.20	26.02	-28.0	-30.8
III	19	2	KI	60.63	28.92	-21.5	-22.9
IV	21	11	KI	-	mens.	mens.	mens.
V	20	3	KI	56.89	31.39	-14.9	-14.9
VI	19	1	KI	50.45	19.61	-48.0	-46.5
Mean				54.09	26.15		
I	19	7	NaCl	74.13	24.61	-33.8	-33.8
II	19	2	NaCl	58.92	33.18	-10.8	-10.8
III	20	8	NaCl	55.45	30.09	-18.6	-19.9
IV	19	3	NaCl	49.81	32.40	-12.9	-12.9
V	19	2	NaCl	51.48	32.45	-12.7	-12.7
VI	18	9	NaCl	52.07	43.21	+17.7	+14.5
Mean				56.98	32.65		

Table 4. Results of twenty-eight day tests on the basal metabolic rate of a group of Kansas State College women.

Pair	Age: years	Age: mos.	Solution	Weight (kg.)	Cal/sq m/hr.	Deviation from Standard-Boothby and Sandiford (a)	(b)
I	18	8	KI	48.52	31.27	- 1.6	- 1.6
II	21	0	KI	56.20	33.63	- 7.3	-10.2
III	19	2	KI	60.23	37.10	+ 1.1	+ 1.8
IV	21	11	KI	50.26	32.69	-11.3	-11.3
V	20	3	KI	57.21	28.68	-21.6	-23.0
VI	19	1	KI	50.51	34.60	- 6.9	- 6.9
Mean				53.83	32.99		
I	19	7	NaCl	73.80	26.93	-27.5	-27.5
II	19	2	NaCl	59.29	32.87	-11.6	-11.6
III	20	[illegible]	NaCl	56.92	34.68	- 6.4	- 6.4
IV	19	3	NaCl	49.52	33.61	- 8.0	-11.2
V	19	2	NaCl	-	-	-	-
VI	19	9	NaCl	52.10	39.92	+ 7.3	+ 7.3
Mean				58.31	33.60		
Mean for total group				56.07	33.26		

potassium iodide and the group receiving sodium chloride after 28 days.

In the relationship of iodine to the basal metabolic rate, Winkler (30) studying 30 humans with hypothyroidism has stated that as soon as the basal metabolic rate was normal and the clinical manifestations of hypothyroidism were relieved the blood serum iodine was invariably within normal limits, though it may have been considerably lower in the severe stages of hypothyroidism. Hoskins (31) stated that high degrees of functional deficiency can arise from the lack of iodine. Myxedema and cretinism are characterized by abnormally low rates of heat production or hypofunction of the thyroid gland. Since the thyroid and iodine metabolism are so closely related, this further substantiates the hypothesis that subclinical hypothyroidism, characterized by a low basal metabolic rate, may be due to a prolonged deficit of the iodine stores in the body.

Pulse

Pulse rates varied from 64 to 76 beats per minute (Table 5) with a mean of 70 in the preliminary and 7-day tests and a mean of 71 in the 14-day and 28-day tests. The range for the preliminary test was from 64-74, the 7-day test from 68-76, the 14-day test from 68-74, and the 28-day test from 68-76 beats

Table 5. Variation in pulse rate over a twenty-eight day period for Kansas State College women.

Pair number	Solution	Pulse rate							
		Preliminary		Seven-day		Fourteen-day		Twenty-eight-day	
		(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
I	KI	70	70	70	70	70	70	68	68
I	NaCl	70	70	76	76	74	74	72	72
II	KI	74	74	72	72	74	74	74	74
II	NaCl	68	68	72	72	70	70	76	76
III	KI	72	72	70	70	72	72	72	72
III	NaCl	70	70	70	70	68	68	68	68
IV	KI	70	70	70	70	-	-	70	70
IV	NaCl	70	70	70	70	70	70	70	70
V	KI	68	68	72	72	70	70	72	72
V	NaCl	70	70	74	74	74	74	74	74
VI	KI	64	64	68	68	70	70	68	68
VI	NaCl	74	74	70	70	70	70	70	70
Mean		70	70	70	70	71	71	71	71
Mean of total daily readings		70		70		71		71	
Range		64	74	68	76	68	74	68	76

per minute. According to Kimber and Gray (27), this range is normal for women from 18 to 24 years of age.

Body Weight

The members of the group receiving potassium iodide showed little fluctuation in body weight with the exception of one subject (Tables 1, 2, 3). This subject lost six kilograms of weight between the preliminary and seven-day test. During this period, she had restricted her diet somewhat in an effort to lose weight. This subject's weight remained relatively constant throughout the remainder of the study. The mean weight of the potassium iodide group ranged from 55.09 kilograms in the preliminary test to 53.83 kilograms in the 28-day test. The members of the group receiving sodium chloride showed little weekly fluctuation in weight. The mean weight of this group ranged from 57.18 kilograms in the preliminary test to 58.31 kilograms in the 28-day period.

Dietary Habits and Medical Record

Records were kept of food likes and dislikes. All girls stated they ate fish at least once a week, and none of the girls expressed a wide range of food dislikes. The only food dislikes mentioned by more than one girl were cabbage and onions. Two girls were positive they had been receiving iodized salt prior to this study. Ten girls were uncertain and stated they were sure that no effort was made in their homes to purchase iodized salt. This is correlated with the fact that Kansas is not located in the goiter belt.

Girls on the test solutions were repeatedly asked if they had noticed any effects from the solution they were taking. The answer most often given was that the solution tasted much like water, and they could not taste anything. Skin eruptions which may be due to an overdose of iodine, in the form of potassium iodide, were not reported by any of the paired subjects.

CONCLUSION

The administration of potassium iodide, under the condition of this study, has been shown to have at least a transitory effect in raising the comparatively low basal metabolic rate of a group of Kansas State College women.

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