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THE RATE OF WATER ABSORPTION IN MAN AND THE RELATIONSHIP OF THE WATER LOAD IN TISSUES TO DIURESIS.

BY F. H. SMIRK (*Beit Memorial Fellow*).

(*From the Medical Unit, University College Hospital Medical School, London.*)

INTRODUCTION.

WHEN water is taken by mouth the rate of absorption cannot be assumed [Heller and Smirk, 1932 *a*, *d*, *e*]. For the interpretation of the resulting diuresis it is therefore desirable to have some method of estimating the rate of absorption. It is known [Tashiro, 1926; Baer, 1927; Glass, 1928; Heller and Smirk, 1932 *a*, *c*] that the water absorbed passes mainly to the muscles and skin. Hence there should be a decrease in the weight of the abdomen and an increase in the weight of the limbs during absorption: and the weight of the limbs should decrease as the excess of water is excreted. The following method was devised for the purpose of measuring such weight changes in man and thus deducing the rate of absorption.

EXPERIMENTAL PROCEDURE.

Abdomen weighing experiments.

The subject lies horizontally face downwards with the abdomen on the footplate (*D*) of the weighing machine (*B*) which is suitably padded (Fig. 1). The head, thorax and thighs rest on rigid but padded supports. In order that the weight of the buttocks may be partly counterbalanced by the weight of the legs, the lower two-thirds of the legs are without support and project over the padded block (*C*) which supports the thighs.

Weights placed in the scale pan (*E*) will balance whatever proportion of the abdominal weight is resting on the footplate, and if water is then taken by means of a rubber tube held in the mouth without any change in posture the weight of the abdomen is seen to increase rapidly as the water is swallowed and then to diminish gradually as the water is absorbed.

Although even the movement of respiration is revealed by oscillations of the steelyard, it appears easy to maintain a steady posture, and, apart from respiration, spontaneous changes in the abdominal weight indicated are infrequent, and unless the subject has been unduly active beforehand this weight remains constant from a few moments after the position on the apparatus is assumed.

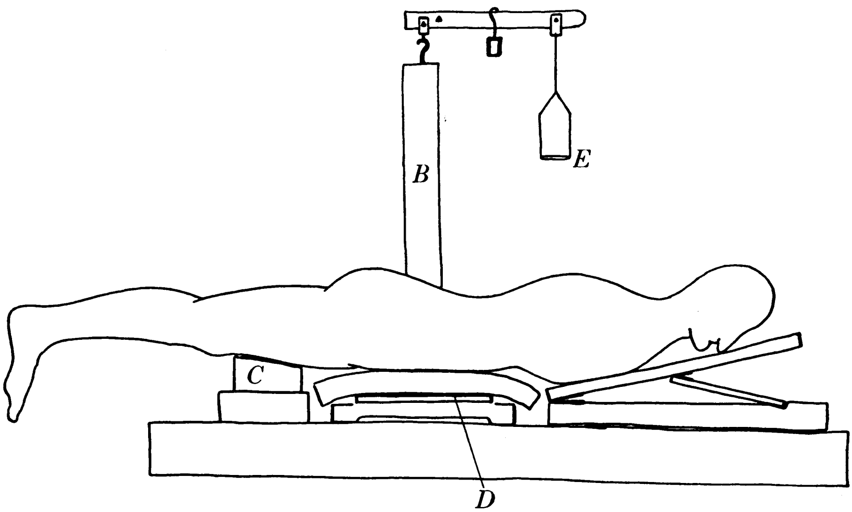

Fig. 1. Abdomen weighing experiment.

Leg weighing experiments.

The subject of this experiment lies on a couch. The head is slightly raised and the lumbar region is supported on a rounded elevation which combines comfort with stability of posture. The foot of the couch is a little higher than its head, and the padding must be of material such as horsehair which will allow the formation of a depression by the weight of the buttocks, but will not slip and make it difficult to immobilize the subject. The padding (a detachable hair mattress) is held in position by a block of wood *A* nailed to the wood at the bottom of the couch. A piece of board rests at one end upon the buttock just above the block *A*, and in the middle has a groove which is pivoted on the knife edge *C*. This knife edge is fixed to the footplate of the weighing machine *D*. The feet are tied together. The ischial tuberosities of the patient should be situated on the padding of the couch about 2 in. from the block of wood *A*, and the position of the knife edge *C* should be near the bend of the knee. By placing suitable weights in the scale pan *E* the legs are balanced. It is necessary for the subject to remain in one posture, since movements even of the arms or head produce changes in the apparent weight of the legs. The movements of respiration are associated with oscillations of the balance pan. It is advisable for the subject to remain silent, as conversation is accompanied by irregularity and increased amplitude of the respiratory movements. The sensitivity of the system

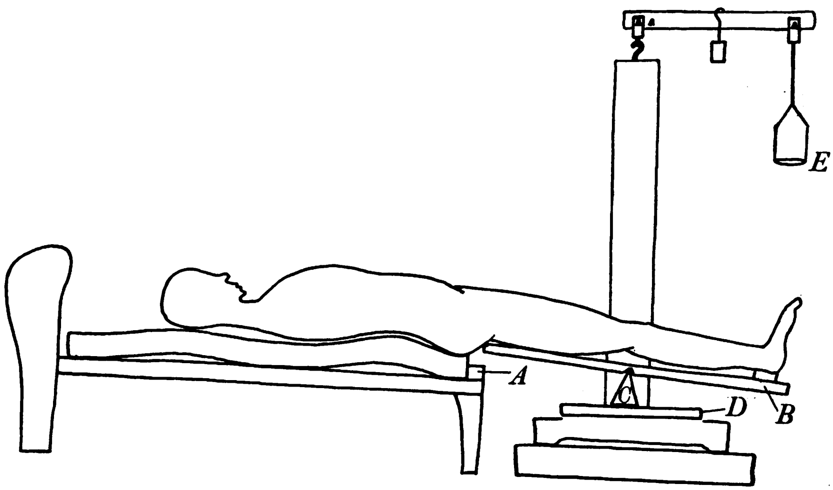

Fig. 2. Leg weighing experiment.

should be tested by placing a 10 g. weight by the feet. The subject should not be exposed to draughts or have the arms or legs exposed, and the experiment should be conducted in a warm room, since changes in limb volume and weight occur as a result of the vaso-motor changes induced by temperature regulation. It will be observed that for a few minutes after lying down the limb weight is somewhat variable, probably owing to vascular adjustments. At the end of 10 min. the limb weight is usually steady and observations of the basal weight are made. In experiments where it is necessary for the subject to be recumbent throughout, the water is taken from a rubber tube held in the mouth—otherwise he sits up while drinking. In either case the same weights are left in the balance pan and, when necessary, equilibrium is restored by means of the rider, and the sensitivity of the system is tested by a 10 g. weight. It is essential that the water should be at 37° C.

In a few experiments the apparatus was modified so as to allow the subject to occupy the sitting posture.

The bladder is emptied before starting, and the amount of urine is given in c.c. Samples of urine may be obtained during the experiment, avoiding as far as possible a change in posture, and the rider is then used to correct the disturbance of equilibrium due to altered posture.

Results.

In Figs. 3 to 14 the vertical scale records the weight placed in the scale pan which counterpoises the weight of the abdomen or legs. 1 g. in the scale pan represents a change of 100 g. on the footplate. In the leg weighing experiments the balance is quite sensitive to 0·1 g. In the scale pan, and in the abdomen weighing experiments to 0·3 g. The abscissæ indicate the time relationships in the experiment.

Abdomen weighing experiments.

When the subject lies with the abdomen upon the footplate of the weighing machine and 1000 g. of warm water are drunk without change of posture the weight required to counterpoise the water is usually much more than 10 g. The reason for this is that the distension caused by the water raises the abdomen and throws a greater proportion of the body weight upon the footplate of the weighing machine.

Nevertheless, a 100 g. weight placed on the middle of the back above the footplate is counterbalanced by 1 g. on the scale pan and 1000 g. weight in this position is counterbalanced by 10 g. These weights placed over the thorax or legs cause relatively slight changes.

It does not follow that the absorption of each successive 200 c.c. of water will necessitate the removal of equal weights from the scale pan. It is usually found, however, that the additional weight in the scale pan which counterbalances the water consumed is roughly the same as the weight subsequently removed from the pan during water absorption.

Leg weighing experiments.

The weight in the scale pan again represents 1/100th part of the pressure upon the footplate of the weighing machine, which is a proportion of the actual leg weight and varies according to the posture. The pressure upon the footplate is generally increased by 200 or 300 g. after drinking 1000 g. of water.

Throughout any single experiment the weight needed to counterpoise the leg weight is a constant but unknown proportion of the actual leg weight, so that if any changes in the apparent leg weight are expressed as a p.c. of the apparent leg weight this p.c. is also the p.c. change in the true leg weight. If the changes in leg weight represent proportionally equal changes in other parts of the body the excretion of say 0·5 p.c. of the body weight of urine should cause a 0·5 p.c. decrease in leg weight, and the absorption and non-excretion of say 1·5 p.c. of the body weight of water should cause approximately 1·5 p.c. increase in the leg weight. The average stable weight of the legs is called 0 p.c.

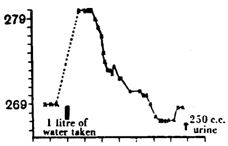

Fig. 3. Exp. 1 *a*. (S.)

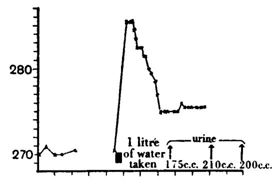

Fig. 4. Exp. 2 *a*. (S.)

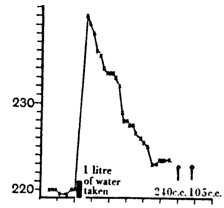

Fig. 5. Exp. 3 *a*. (N.)

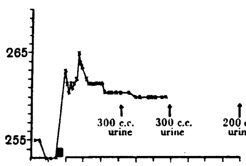

Fig. 6. Exp. 4 *a*. (S.)

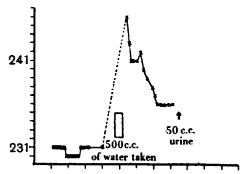

Fig. 7. Exp. 5 *a*. (S.)

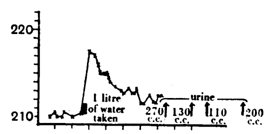

Fig. 8. Exp. 6 *a*. (N.)

Figs. 3–8. Changes in the weight of the abdomen during and after drinking water. Abscissa: Time of the experiment (10 minute intervals). Ordinate: Weight in g. needed to counterpoise the abdomen.

(*a*) *Control on the constancy of the abdominal weight when no water is given.*

It is quite clear from Exps. 2 *a*, 3 *a*, 4 *a*, 5 *a*, 6 *a*, that there is little difficulty in maintaining a steady posture and that the weight recorded, whatever relation it bears to the weight of the abdomen, is much less liable to extraneous variations than is the limb weight.

(*b*) *The decrease in abdominal weight during water absorption.*

In Exps. 1 *a*–6 *a* it will be seen (Figs. 3–8) that after drinking a litre of water the weight needed to counterpoise the abdomen is at once increased. After a delay, which varies from 0 to 10 min., the weight needed to counterpoise begins to decrease and continues to do so for a period which has varied in our experiments from 22 to 55 min. With the onset of diuresis the abdominal weight has sometimes risen again, owing no doubt to the accumulation of urine in the bladder. There seems little doubt that the fall in weight is due to the absorption of water from the intestines and its distribution to peripheral parts of the body: the subsequent rise in weight to the withdrawal of water from the tissues and its return to the abdomen in the form of urine.

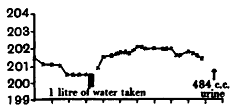

Fig. 9. Exp. 1. (N.)

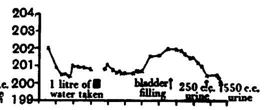

Fig. 10. Exp. 2. (M.)

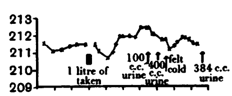

Fig. 11. Exp. 3. (S.)

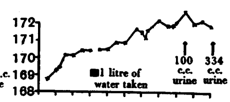

Fig. 12. Exp. 4. (N.)

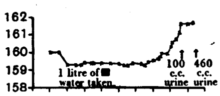

Fig. 13. Exp. 5. (N.)

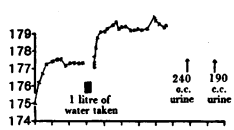

Fig. 14. Exp. 6. (N.)

Figs. 9–14. Changes in the weight of the legs after drinking water. Abscissa: Time of experiment (10 minute intervals). Ordinate: Weight in g. needed to counterpoise the legs.

(c) Control on the constancy of the leg weight when no water is given.

For several minutes after the subject has taken his place on the apparatus changes are observed in the leg weight, which are due presumably to adjustments in the volume of blood contained in the limb as a result of the altered posture. The direction of these changes is not constant. Often the limb weight increases (as in Exps. 4 and 6), sometimes it falls (Exps. 1 and 5), but after 10–15 min. the limb weight has usually reached a level which remains constant so long as the subject is undisturbed. This is particularly evident in Exps. 5 and 6. No spontaneous increase in leg weight occurs when the initial changes due to alteration of posture are complete.

(d) Increase in leg weight after water drinking.

It is sufficiently clear that an increase in the leg weight takes place after water drinking, which continues for as long as 25–55 min. after taking the water. It remains to be considered in Sections (*e*) and (*f*) if this increase in weight is caused mainly by the storage of water in the limbs.

(*e*) *Evidence that a part of the observed increase in the weight of the legs may be the result of changes other than the storage of water.*

It is not suggested that the entire change recorded in the leg weight is an accurate representation of the storage of water. There is in Section (*f*) abundant evidence that the changes in leg weight after water drinking are mainly the result of water storage, but it is desirable to know something of the factors which prevent quantitative accuracy. Gross mechanical movements are readily detected by the subject, and cause no difficulty: they are accompanied as a rule by an erratic and immediate change in the apparent leg weight, which is distinct from the steadily progressing changes resulting, as I believe, from water storage. These gross changes should be corrected by adjustments of the rider (see Fig. 2) so that the weight which was in the scale pan before the movement took place once more will balance the weight of the leg. But smaller changes in posture may doubtless take place without the knowledge of the subject. These will be recorded and constitute a source of experimental error. A subject who has remained in one posture for over an hour may be troubled by muscular twitches of a sufficient magnitude to change the apparent weight. Where this has happened, either the experiment has been terminated or the subject allowed to rest on his side for a few minutes before resuming the original posture. Adjustments are then made with the rider.

Changes in the distribution of blood about the body are part of the mechanism for temperature regulation. An account of some of the vasomotor responses to a need for thermo-regulation has been published by Pickering [1932]. No accurate measurements of changes in the limb weight resulting from thermo-regulation have been made in these experiments, but it has been noticed on several occasions that the immersion of one hand in cold water was associated with appreciable diminution in the leg weight. The counterpart to this appears in a paper of Gibbon and Landis [1932] who have observed a vaso-dilation in the legs following the application of heat to an arm.

In Exp. 9 the temperature of the water when taken was well above 37° C. Soon the subject felt flushed and noticed a moderate degree of sweating which lasted for 2 min. The leg weight meanwhile increased rapidly to a peak—an increase in the leg weight of 3·1 p.c. having taken place within 7 min. The weight then fell rapidly by 1 p.c. of the limb weight in 2 min. and then rose more gradually, the total increase being 3·8 p.c. of the body weight. Since only 1·3 p.c. of the body weight of water had been given it is clear that this rapid increase in the weight of the limbs must in part represent something other than the storage of water. It is probable that the gradual increase, and the gradual fall corresponding to the increased urine formation, were the result of water storage and excretion, but superimposed are two peaks which are the result of vaso-motor disturbance.

In Exp. 3 the water taken was cooler than 37° C. and an initial fall in leg weight was recorded.

Without entering into further details it is evidently desirable that the precautions suggested in the experimental procedure should be followed strictly, and all possible care taken to minimize errors.

(*f*) *Evidence that the observed changes in the weight of the legs and abdomen are mainly the result of water storage and excretion.*

In Section (*b*) it has been shown that a record may be obtained which demonstrates changes in the weight of the abdomen corresponding to the absorption of water. When a litre of water has been consumed through a rubber tube without change of posture the weight required to counterpoise the abdomen increases and, after a short delay, diminishes again. The fall in weight has occupied periods of from 22 to 55 min. There seems every reason to believe that the fall of the abdominal weight is the result of water absorption, and an increase in the leg weight is to be expected from the storage of this absorbed water.

This increase in the weight of the legs is indeed observed, but it is necessary to present evidence that the change is actually the result of water storage.

If we take the changes in leg weight recorded towards the end of Exps. 1, 2 and 3, and for shorter periods in Exp. 4, it will be seen that as more urine is formed the leg weight decreases and, although the fall in leg weight does not tally precisely with the amounts of urine formed, it is of the same order. Thus in Exps. 1, 2 and 3 the leg weight has decreased 0·38, 0·90 and 0·40 p.c. in correspondence with a urine formation of 0·69, 0·79 and 0·57 p.c. body weight.

In Exp. 7 the subject had taken a large drink of water not long before the observations began. His basal rate of urine formation was therefore high and the weight of the legs was falling gradually. The second dose of water (715 c.c.) caused a rapid increase in the rate of urine formation, so that 640 c.c. of urine were excreted within 40 min. The leg weight did not alter appreciably, as the accumulation of water in the body was prevented by the previous establishment of diuresis.

In Exps. 2 and 5 the subjects had lunched 1 hour previously, and during the experiment drank their water lukewarm in the horizontal posture. For periods of about 20 min. both subjects complained of a marked sensation of gastric distension which passed off just before the leg weight began to increase. Previous to this the leg weight had been constant. There seems every reason to believe that a large part of the water was retained in the stomach, and delay in the increase of leg weight was due to non-absorption of the water. This suggestion is supported by the fact that there was a rather longer delay before the onset of diuresis.

If we examine the degree of increase in the water content of the legs at the time when the leg weight has reached its maximum but before urine formation has increased greatly, the actual figures are 0·85, 0·75, 0·65, 1·45, 1·35, 1·35, 1·70 p.c., averaging 1·15 p.c. leg weight. If the leg represents the rest of the body the increase in total body weight is also 1·15 p.c. The quantity of water given (as a p.c. of body weight) is about 1·3 p.c., and making due allowance for experimental errors this is a surprising approximation.

These results, compared with those recorded in the last of the subsequent papers where diuresis was prevented by pituitrin, show clearly that the addition of water to the body causes an increase and removal of water a decrease in leg weight.

(*g*) *The rate of water absorption.*

Section (*f*) would justify the assumption that the changes in the weight required to counterpoise the legs and the abdomen after water drinking are mainly the result of water absorption. Yet, as mechanical and vaso-motor changes influence the magnitude of the deviations, one cannot deduce accurately the amount of water absorbed from the degree of change in the weight of the leg or abdomen. But so long as appropriate changes are taking place in these weights, it is likely that absorption is still in progress, and when a steady state has been attained, that the process of absorption is over. Therefore, irrespective of the magnitude of the changes, the water given is assumed to be absorbed when the weight of the legs or abdomen has reached a steady state. If, however, the rate of urine formation has increased to a degree which equals the rate of absorption a correction must be applied, as in this instance there will be no further increase in the leg or decrease in the abdomen weight, and completion of the process of absorption may appear to be earlier than it actually is. It will be seen however (Section (*h*)) that the error from this cause is usually small, and it may be eliminated entirely if the increased urine formation is prevented by pituitary hormone (see the last of the subsequent papers). It is, therefore, believed that, when due correction has been made for the amount of urine formed, the completion of water absorption may be determined either by the

TABLE I. The rates of water absorption in man determined by counterpoising the abdomen.

Exp. No.	Factors which may have influenced the rate of water absorption	Time expended in the absorption of 1 litre of water (min.)
1 *a.* (S.)	Water taken 2·5 hours after lunch. Temperature of water exactly 37° C. Sensation of gastric distension for 8 min.	55
2 *a.* (S.)	Water taken 2·5 hours after lunch. Temperature of water exactly 37° C. Sensation of gastric distension for 2 min.	27
3 *a.* (N.)	Water taken 3 hours after lunch. Temperature of water exactly 37° C.	40
4 *a.* (S.)	Water taken 1·5 hours after breakfast of egg in milk. Temperature of water exactly 37° C.	Doubtful
5 *a.* (S.)	Water taken 2·5 hours after lunch. Temperature of water exactly 37° C. No sensation of gastric distension. Water taken in the standing posture	22 (only 500 c.c. water taken)
6 *a.* (N.)	Water taken 3 hours after breakfast. Temperature of water exactly 37° C.	35

TABLE II. The rates of water absorption in man determined by counterpoising the legs.

Exp. No.	Factors which may have influenced the rate of water absorption	Time expended in the absorption of 1 litre of water (min.)
1. (N.)	Water taken 3 hours after lunch. Temperature of water exactly 37° C. Horizontal posture	28
2. (M.)	Water taken 2·5 hours after lunch. Temperature of water exactly 37° C. Sitting posture. Sensation of gastric distension for 15 or 20 min. Delayed increase	45
3. (S.)	Water taken 3 hours after breakfast. Temperature of water below 37° C. Horizontal posture	30
4. (N.)	Water taken 1·5 hours after lunch. Temperature of water about 37° C. Horizontal posture	55
5. (N.)	Water taken 2 hours after lunch. Temperature of water about 37° C. Horizontal posture. Sensation of gastric distension for about 20 min. Delayed increase	45
6. (N.)	Water taken 2·5 hours after lunch. Temperature of water exactly 37° C. Sitting posture. No sensation of gastric distension	20–25
7. (R.)	Water taken 1·5 hours after lunch. Temperature of water about 37° C. Horizontal posture	About 50
8. (S.)	Water taken 2·5 hours after breakfast. Temperature of water about 37° C. Horizontal posture	50
9. (S.)	Water taken 2·5 hours after lunch. Temperature of water well above 37° C. Sitting posture. No sensation of gastric distension	35

cessation of decrease in the weight of the abdomen or by the cessation of increase in the weight of the legs.

The above tables summarize the rates of water absorption so determined, and indicate some of the factors which probably influence this rate.

It will be seen that the time taken to absorb a litre of water at 37° C. has varied between 25 and 55 min. and that in the single experiment where only 500 c.c. of water were taken absorption was completed in 22 min. In the two experiments where water was taken 1·5 hours after lunch the times of absorption were 55 and 50 min. In the four experiments where water was not taken until 3 hours after a meal the times of absorption have been 30, 28, 40 and 35 min. While there is no accurate relationship water appears to be absorbed more rapidly after a 3 hours' fast, and this is probably related to the rate of emptying of the stomach.

If we refer to the instances where the rate of water absorption has been determined by weighing the legs, it is usually observed that there is a period of delay before the weight begins to increase at all. It is possible that this delay is occasioned by the holding up of a large part of the water in the stomach. This is supported by the subjective sensations of the victim. In most experiments the subjects have been asked to observe the duration of a sense of gastric distension. Usually gastric discomfort passes off shortly before the leg weight increases. If water absorption is determined by counterpoising the abdomen there is seemingly a shorter period of delay before the weight of the abdomen begins to decrease. The duration of the discomfort from gastric distension is less in the prone posture, but more marked while it lasts. In the prone posture emptying of the stomach is probably more rapid as a result of the increased intra gastric tension.

It has been mentioned that, if the rate of urine formation had increased much before absorption was ended, there would be an error in our calculation of the absorption rate. Estimated by counterpoising the abdomen there would be a deceptive period when the fall in weight occasioned by absorption is balanced by an increase due to accumulation of urine in the bladder. When the leg weight is counterpoised the increase due to storage is balanced by the withdrawal of water for excretion by the kidneys. In actual practice, however, the error is not great.

When diuresis is prevented by pituitary hormone this error is eliminated and it will be seen in the last of the subsequent papers that the time expended in attaining the maximum leg weight is not increased thereby. The time expended in water absorption appears the same in the subjects receiving 0·1 c.c. pitressin as in the experiments where diuresis was allowed to proceed normally.

(*h*) *The relationship of the water load to diuresis.*

It will be clear from the preceding sections that the absorption of a litre of water in man usually nears completion before diuresis starts. One may refer, however, to the actual amounts of urine formed in various experiments. When the completion of water absorption was determined by counterpoising the legs the amounts of urine formed when water absorption was ended averaged something under 230 c.c. and in the abdomen weighing experiments under 200 c.c.

Now it is evident from the examination of many diuresis curves in man that where 1000 c.c. of water have been given the maximum rate of urine formation is reached when about half of the urine to be excreted has been formed, and that when absorption is complete the amounts of urine already formed are much less than half of the urine to be excreted. From the amounts of urine recorded on Figs. 3–14 it can be calculated that the rate of urine formation continues to increase after the completion of absorption. We may conclude from this that absorption is complete before the maximum diuresis is attained, and it follows that the maximum load of absorbed but as yet unexcreted water in tissues must be present some time before the maximum rate of urine formation is attained.

Discussion.

It will be clear from the foregoing results that, when a man drinks water, an increase in weight can be detected later in situations outside the alimentary canal and at times which correspond to a decrease in the weight of the abdomen. Thus for 25–55 min. after drinking water the limb weight has continued to increase, but after this time (which varies in individual subjects) there is no further increase in the weight of the legs. Where pituitrin has been given (see the last of the two subsequent papers), and diuresis thereby prevented, no further increase in leg weight takes place after 25–55 min., and as the water is but slowly excreted this increased leg weight is maintained. The degrees of increase in weight have been 0·85, 0·75, 0·65, 1·45, 1·35, 1·35, 1·70 p.c., averaging 1·15 p.c. of leg weight, the amount of water given being approximately 1·3 p.c. of body weight. The order of increase is in general roughly what would be expected from the amount of water given. An accurate correspondence between the p.c. increase in limb weight and the p.c. body weight of water given should not be anticipated, since vaso-motor changes and undetected movements play their part in determining the final weight recorded. Nevertheless, at the time when either the weight of the legs ceases to increase or the weight of the abdomen to decrease, it is very likely that water absorption is complete, so that knowing the volume of water given, the approximate of absorption can be ascertained.

If diuresis starts before absorption is complete we must consider the volume of urine excreted. In Exp. 7 where 715 c.c. of water were taken, the rate of urine formation was considerable at the outset owing to previous drinking of water and the weight of the legs was not greatly changed. In this experiment it will be seen that 640 c.c. of urine were excreted in 40 min., and since the limb weight remained unaltered we must consider that roughly 640 c.c. of water have also been absorbed in these 40 min. to replace the water lost as urine. In the experiments where it has been possible to continue observations for a sufficient time the leg weight may be observed to fall about the time when the subject becomes aware of a full bladder. At this time there is sometimes a slight increase in the weight required to counterpoise the abdomen, probably due to the accumulation of urine in the bladder.

In a number of experiments the water was taken about 1·5 hours after the mid-day meal. A sensation of distension was produced which lasted some 20 min., during which time the weight of the legs remained steady. Shortly after this the limb weight began to increase in the normal manner. It is not unlikely that a proportion of the water given was then held back in the stomach, and the onset of absorption processes delayed.

Parallelism is evident between known changes in the water content of the body and changes in the weight of the legs and the abdomen. If the suggested precautions are observed this decrease in abdomen weight and increase in leg weight is determined mainly by the absorption and storage of water in the tissues. It must be emphasized that vaso-motor changes produced in many ways, but chiefly by alterations in room temperature or by drinking too cold or too hot water, may also cause appreciable alterations in limb weight.

The principle of weighing separately the arms, legs, abdomen and thorax has been used previously by Müller [1905] and by Mosso [1884] for determining gross changes in the disposal of blood about the body. The alterations in leg weight described by Müller are similar to the variations I have also obtained as a result of vaso-motor reactions induced by cooling other parts of the body and do not resemble the changes due to water absorption.

SUMMARY.

1. An apparatus has been described which records changes in the weight of the abdomen after water drinking.

2. An increase in the weight of the abdomen is observed at once followed by a gradual decrease. The fall in weight is produced by the absorption of water and ends when all the water is absorbed.

3. This observation may be used to determine the absorption time for water which has been 22–55 min. in six experiments on two subjects in which 1 litre of warm water was consumed.

4. An apparatus has been described which measures an increase in the weight of the legs after water drinking in man and a decrease as this water is excreted by the kidneys.

5. The increase in leg weight has usually attained its maximum value 25–55 min. after giving water, which represents in nine experiments on four subjects the times expended in the absorption of 1 litre of water taken at 37° C.

6. It is thought that this increased weight results mainly from the storage of water which has been absorbed from the alimentary canal. The average degree of increase (1·15 p.c. of leg weight) is a probable one in consideration of the dose of water administered (1·3 p.c. of body weight).

7. The rate of water absorption is such that most of the water has been absorbed before there is any great increase in the rate of urine formation; so that the maximum load of absorbed but as yet unexcreted water is attained before the maximum diuresis.

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