IS SALT INTAKE NECESSARY DURING EFFORT ?

by Dr. JEAN-PIERRE DE MONDENARD

Since the work of the Scandinavians, Hermansen and Saltin, we have known that water loss by perspiration leads to a significant loss in muscle power.

Habitual long-distance athletes are no longer unaware that the intake of water during effort, thanks to refreshment stations along the course, enables them to struggle effectively against the effects of dehydration, especially if it is hot, there is little wind, the hygrometer reading is high and the pace particularly sustained.

In contrast, however, the intake of mineral salt supplements, either in the form of tablets or salt, added to drinks, is recommended more on the basis of empirical data than truly scientific studies.

Often, in manuals, it is suggested that we "salt the soup" to guard against cramp, fatigue and even heat-stroke. It is also difficult for the athlete to distinguish between serious medical information and mere publicity.

On the other hand, knowledge in this field is advancing rapidly and numerous discoveries and studies have considerably modified the conventional wisdom.

Bearing in mind the implications of this issue, it seemed to us desirable to study the problems which arise from overconsumption of salt either during effort or outside racing.

A number of studies agree in showing that people eat too much salt and that this can have negative effects on the arteries and even cause cramps if a race takes place in great heat.

Professor Philippe Meyer, a French specialist in salt and high blood pressure, has just published his thoughts on the subject as a whole in his new book, Editions Fayard, "L'homme et le sel" (man and salt).

The individual, he believes, is not aware of how much salt he needs. For this reason, salt consumption is erratic, but always higher than it should be. The average requirement is 1 to 2 g every 24 hours. The average intake, however, is always around 10 grams.

Numerous studies have shown to what extent blood pressure is influenced by food intake. It will be observed that populations with a very low-salt diet tend to have much lower levels of blood pressure than those who regularly overindulge.

Professor H. Bour, another well-known specialist, in a recent article entitled "cardio-vascular risk factors and nutrition", is also concerned with the role of salt.

"There is an undeniable correlation between blood pressure and salt consumption. In populations with a low rate of salt consumption (4 to 6 g/day), blood pressure does not increase with age. This rise is therefore not physiologically determined as we were taught, but is linked with diet.

Interesting studies have shown that in Japan salt consumption per head per day varies considerably between the north (30 to 50 g per day) and the south (15 g per day). In this racially homogenous population, the difference in mortality rate due to heart and arterial disorders varies from 1 to 4 ; in all other respects, their diet is comparable."

A further example : among the Eskimos of the Great North, the intake is 3 g/day ; only 2% of the population has high blood pressure.

Specialists have calculated that if current salt consumption levels were at least halved, the number of people suffering from high blood pressure would also be reduced by 50 %.

There seems therefore to be a general consensus in pointing out the dangers of excess salt to the arteries. Does the same apply when the muscles become active for long periods as is the case with long-distance races ?

The physiology of effort teaches us that a hyperactive organism needs salt.

Salt deficiency can lead to dehydration, muscle cramps and chronic fatigue. However, it is not useful to "salt the soup" too much ; our normal food intake provides us with enough salt.

Excess salt consumption, encouraged by certain publicity articles which advise use of extra salt

at the least little effort, can lead to problems incompatible with prolonged physical activity.

In hot weather, excess salt causes dehydration, diminishes the blood flow and tires the heart ; all these things can lead to a serious sickness: heat stroke.

Too much salt furthers the elimination of potassium by the kidneys, with its corollary : chronic fatigue.

Salt tablets abuse the taste buds and the kidneys.

Numerous authors have observed better performances in hot weather by athletes on a low-salt diet.

Gabe Mirkin, a medical practicioner, cites the case of Tom Osler, marathon-runner and mathematician at Glassboro State College, a self-taught expert on foot-racing :

"Lou Casagnola was, in 1967, the great favourite to win the National AAU championship (a 30 km race). On the day of the race, it suddenly became very hot. To everyone's amazement, it was Tom Osler who won the day... Osler imputes his remarkable performance in hot weather to his diet, which contains almost no salt

I had read so many things about the risks of salt deficiency that I was sceptical. But this mathematics teacher had acquired knowledge which doctors did not possess. By observing the reactions of his body, Osler had noticed that, he was in much better form in hot weather if he eleminated salt from his diet.

Dave Costill performed tests on Osler, comparing the results with those of tests carried out on runners who did eat salt. Osler's temperature, heart rhythm and quantity of sweat were comparable with those of the other athletes. His blood contained the same amount of salt. There was one difference, however. Osler's sweat and urine contained much less salt, because his sweat glands were accustomed to retaining it."

Gabe Mirkin himself stopped salting his food ten years ago : "My sweat no longer tastes salty and does not sting when it falls into my eyes."

Variations in quantity and composition of sweat depend on acclimatisation, training, physical condition and the individual himself. Thus, sweat is more dilute during the race than in times of repose, and it becomes more and more dilute the higher the air temperature, the greater the intensity of the exercise and, in consequence, the more abundant the perspiration.

The concentration level of mineral salts in sweat varies a great deal from athlete to athlete.

It is much lower in athletes acclimatised to the heat. The difference may be as great as 48%

between a specialist and a beginner. This low-salt perspiration has a further advantage, in that it causes the drops of sweat to evaporate more quickly.

Thanks to these advantages acquired in the heat, the trained athlete loses proportionately more water than mineral salts.

Paradoxically, this explains the fact that during effort, the sodium concentrations in the extra-cellular fluid, i.e. the fluid in which the cells float, increase rather than decrease.

The fact that dehydration takes place proportionately faster than demineralisation means that the extra-cellular fluid becomes more concentrated... and it is this concentration that gives rise to "heat cramps" and other symptoms such as headaches, nausea... etc. in athletes who have lost large quantities of fluid and whose bodies contain too high levels of mineral salts.

Because, when we sweat, we lose more water than mineral salts, it is necessary to take in liquids more rich in water and less rich in mineral salts than the extra-cellular fluid. Ideally, the salt concentrations in the liquid drunk should correspond to the salt concentrations in the sweat, that is about 2.5 to 3.5 grams per litre.

In practice, 1 gram per litre proves adequate insofar as the kidney, in a rest situation, lets sodium pass, whereas under effort, this filtering organ puts up a "block" to restrict its elimination.

If the athlete eliminates between 3 and 4 litres of fluid during a training session or a competition, it is not useful to take in salt tablets during effort to compensate for the loss of sodium, especially as this loss is usually very small in comparison with the overall "mineral capital" of the body.

Generally speaking, in the climatic conditions of our regions, the addition of a little salt to our food is sufficient to make up for excessive losses. However, liquid drunk during effort should contain a small quantity of sodium (1 **g** per litre). This "supplement" is designed to facilitate the passage of glucose drinks from the stomach to the intestine, where they are rapidly absorbed. The point of an energy-giving drink is to deliver the glucose it contains to muscles in action.

To fully attain this objective, the drink should not remain in the stomach, but should pass rapidly into the intestine.

To clarify a little, it is nevertheless necessary to recall that the prescription of salt tablets to be taken during effort goes back to studies undertaken at the time of the African Campaigns when a man marched in the desert carrying heavy equipment and could lose as much as 11 litres of fluid an hour by perspiration.

In certain sports disciplines, dehydration can be considerable. At the Ohio State University, fluid-losses of up to 7 litres an hour have been noted in players of American football.

In such conditions, the replacement of lost minerals is imperative.

By way of comparison, we should point out that it is extremely rare in our latitudes for fluid loss via perspiration to reach levels higher than two or three litres an hour during extreme effort.

Francesco Moser, when he set his then world record on the track in Mexico at an altitude of 2,200, had not even lost three litres.

J.-P. M.

WHAT DO THE EXPERTS SAY?

"... During the race, the priority is not to replace lost mineral salts but to rehydrate the body... If the sweat loss is less than 5% of the body weight (3.5 litres per 70 kg), it is pointless to use salt supplements in the form of tablets." Francine Peronnet, physiology lecturer in the physical education department of the University of Montreal.

"... Several days of intense training in no way expose the runner to a risk of electrolytic deficiency... The significance of losses of mineral salts has been overestimated. In fact, as an effect of perspiration, the concentration of these electrolytic substances tends rather to increase ! Moreover, the kidneys enable the loss of mineral salts to be minimised, and it would never be greater than 2 to 3% of the total reserves of the organism. A normal diet provides them in sufficient quantities." - David L. Costill, doctor and director of the Laboratory of Human Performances at the Ball State University in Muncie (Indiana).

"... You should never, never, take salt tablets, because they increase the level of sodium in the blood and increase the risk of heat stroke. Perspiration allows the elimination of more water than salt, and leaves a higher concentration of sodium in the blood..." – Gabe Mirkin, doctor and marathon runner.

"... All athletes need a proper hydroelectrolytic balance; a water supplement is necessary, especially when the weather is hot and/or humid, and the sensation of thirst is not a reliable indication of the body's real water needs. The average fluid requirements for a young athlete are 2.5 litres per day, but caution is necessary in the use of electrolytic glucose solutions to replace water, since gastric draining is delayed by the relative increase in the electrolytic concentration which results from intake of such solutions.

TOO MUCH SALT

The potassium concentration in these solutions should be limited to 5 mEq/litre (195 mg) and the sodium chloride concentration to 10 mEq per litre (580 mg)." - K. Sherin, lecturer in family medicine, Rush Medical College, Chicago (Illinois).

Guy Drut, Olympic champion in Montreal in 1976 in the 110 m hurdles and Franz Klammer, Alpine skiing champion, both suffered from exhaustion due to dehydration at the superstars meeting in 1978.

Both athletes collapsed in the middle of the meeting, because they had swallowed a dozen salt tablets as a precaution.

The attendant Tommy Woodcock put them back on their feet by making them drink large quantities of a liquid rich in potassium and leaving them to rest with their feet up in a cool room.

(Doctor Gabe Mirkin ; La Médecine Sportive, Editions de L'homme, 1981)

MINERAL SALTS	EXTRA-CELLULAR FLUID	SWEAT		
		REST	RUNNING, NON ACCLIMATISED SUBJECT	RUNNING, ACCLIMATISED SUBJECT
SODIUM	3.25 g/l	1 85	1.38	0.92
CHLORINE	3.70 g/l	3 10	1.50	1.00
POTASSIUM	0.20	0 20	0.20	0 15
CALCIUM	0.10	0.04	0.04	0.03
MAGNESIUM	0.04	0.01	0.01	0.01
TOTAL	7.29	5.20	3.13	2.11

*Mineral salts in the extra-cellular fluid and in sweat in rest condition and during running in a non-heat-acclimatised and in a heat-acclimatised subject * (F. PERONNET. Edit. Vigot, 1981*

**The concentrations are given in grams per litre of extra-cellular fluid or sweat*