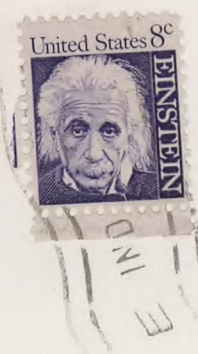


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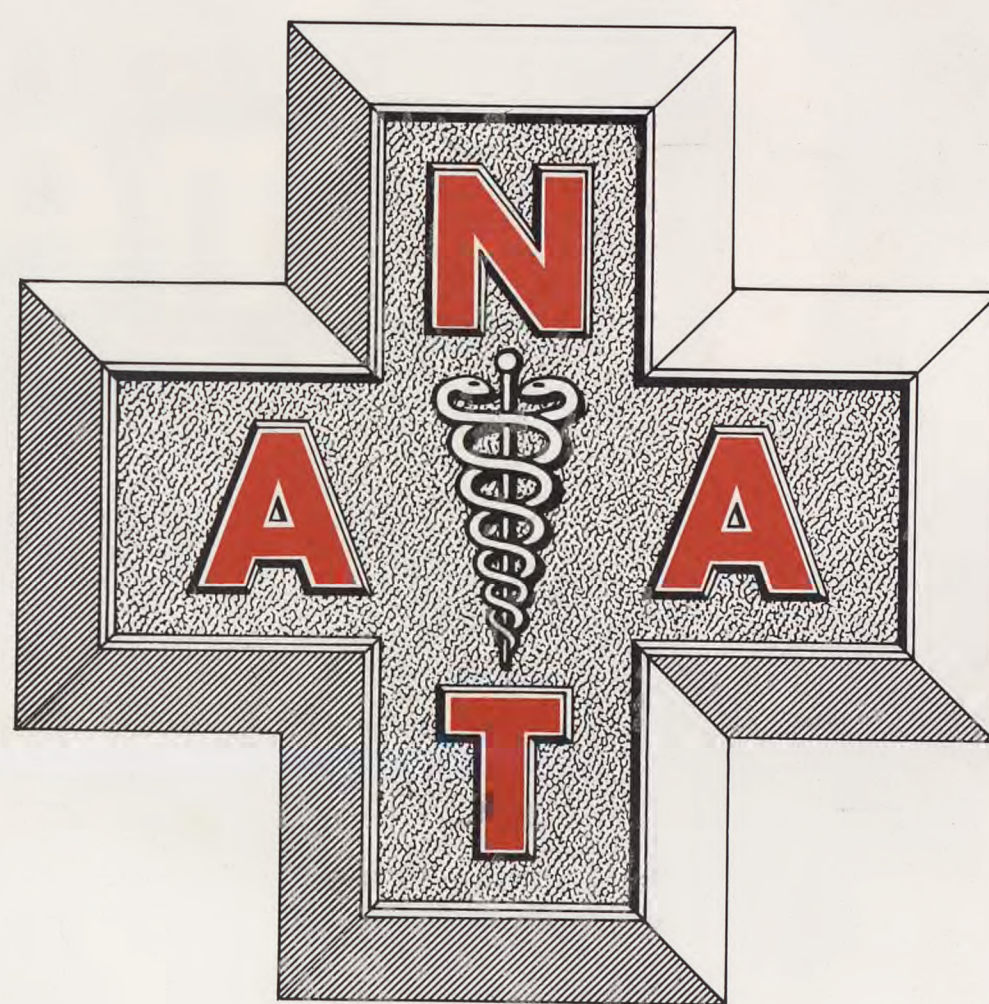
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THE JOURNAL

of the *National Athletic Trainers Association*

WINTER 1966





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Vitamin B12 in Athletics

A NEGATIVE REPORT

K. D. ROSE, M.A., M.D.*
S. MATHENA, B.Sc., M.T. (ASCP)†
G. SULLIVAN R.P.T.†

FOOD FACTS, fallacies, and fetishes are common apocalyptic associates of the sporting profession. Some practices are so deeply ingrained and perpetuated they seem to defy eradication. An example is the extensive use of vitamins as a mystic source of energy. The Committee on the Medical Aspects of Sports of the American Medical Association has undertaken to discredit this practice, suggesting that lack of evidence to support claims for the ergogenic qualities of vitamins indicates their use over and above a normal diet is redundant.¹ The evidence for this suggestion, however, though strongly supporting, is indirect, and based largely on comparative athletic prowess or stamina with and without vitamins.²⁻⁴ In recent years the use of Vitamin B12 in athletics has become prevalent. The author is aware personally of one professional and two university football teams where intramuscular injection of Vitamin B12 before each game is routine. Its use, apparently, is predicated on the known fact that Vitamin B12 is essential in the energy metabolism of muscle, functioning as a co-enzyme in the conversion of propionic acid to succinic acid, the latter being important as a hydrogen carrier in oxidative carbohydrate metabolism.⁵ Predicating routine use of B12 on such a vague correlation with known scientific fact was characteristic of the old sporting fraternity where straws were grasped to gain the elusive inch of advantage over the opponent. As Mayer and Bullen⁴ have aptly shown, the advantage is usually based on psychological grounds.

Recently, Kahn, *et al*,⁶ have shown that urinary methylmalonic acid is a sensitive indicator of B12 deficiency in man, appearing in the urine before there

is other evidence of deficiency, either in the blood or bone marrow, or a decline in the serum Vitamin B12 level. Conversion of propionic to succinic acid proceeds through the following pathway:

TABLE 1⁶

1. Propionic Acid + ATP + Coenzyme A \longrightarrow Propionyl Co A + ADP + Pyrophosphate
2. Propionyl Co A + ATP + CO₂ $\xrightleftharpoons{\text{Biotin}}$ Methylmalonic Co A + ADP + Pyrophosphate
3. Methylmalonyl Co A $\xrightleftharpoons[\text{B12}]{\text{Vitamin}}$ Succinyl Co A

KREB'S CYCLE

In the absence or deficiency of Vitamin B12, methylmalonic acid accumulates in the respiring tissue and is excreted in the urine via the blood stream. It seems reasonable to expect, therefore, that an exercising human would be most prone to spill methylmalonic acid in his urine in the presence of even the slightest Vitamin B12 deficiency. This report concerns an investigation of that hypothesis, using football players as experimental subjects.

METHODS

Twenty-two University of Nebraska varsity football players volunteered as subjects in the experiment during the spring practice session, 1966. A practice session consisted of ten minutes of pass patterns during which each subject ran four or five 35-yard sprints. This was followed by five minutes of calisthenics, twenty-five minutes of group work, fifteen minutes of offensive team work, fifteen minutes of defensive team work, and twenty minutes of basic

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plays, for a total of ninety minutes of exercise during which the subjects were moving at all times. This was followed by fifteen 40-yard "wind sprints" to end the session.

Urine samples were collected immediately before and immediately after practice, frozen, and stored in the frozen state until analyzed. Ether extracts of aliquots of the thawed specimens were analyzed for methylmalonic acid by paper chromatography according to the technique of Barness *et al.*⁷ A two-dimensional system was used, with alcoholic ammonium hydroxide solution as the first solvent and isopentylformate-formic acid solution as solvent number two. The resultant, dried chromatograms were stained with brom cresol green. An ether solution of methylmalonic acid* was chromatographed concomitantly with each run as a positive control. No quantitative analysis was done as we were interested only in the qualitative identification of methylmalonic acid.

RESULTS

A total of twenty-two subjects were tested before and after a strenuous ninety-minute practice session followed by fifteen 40-yard "wind sprints." Ether extracts of 50 milliliter aliquots of urine collected at these times failed in all instances to show the presence of methylmalonic acid. Figure 1 is a representative set of chromatograms with the location of methylmalonic acid superimposed for comparative purposes. The substances appearing on the chromatogram with RF's of .75:.53, 68:.33, .50:.18 and .28:.13 were not identified, but are probably succinate, fumarate, citrate, cis-aconitate,

or alpha-ketoglutarate.⁷ They are clearly not methylmalonic acid.

SUMMARY

In the absence of or deficiency of Vitamin B12, which serves as a catalyst in oxidative muscle metabolism, methylmalonic acid, an intermediary in the conversion of propionic acid to succinic acid appears in the urine. The urine test for methylmalonic acid, therefore, is a highly sensitive test for Vitamin B12 deficiency.⁶ Failure of methylmalonic acid to appear in the urine of football players exercising strenuously for a period of two hours suggests that they do not suffer from Vitamin B12 deficiency either before or as a result of this exercise and that Vitamin B12 supplementation prior to a game, therefore, is unnecessary.

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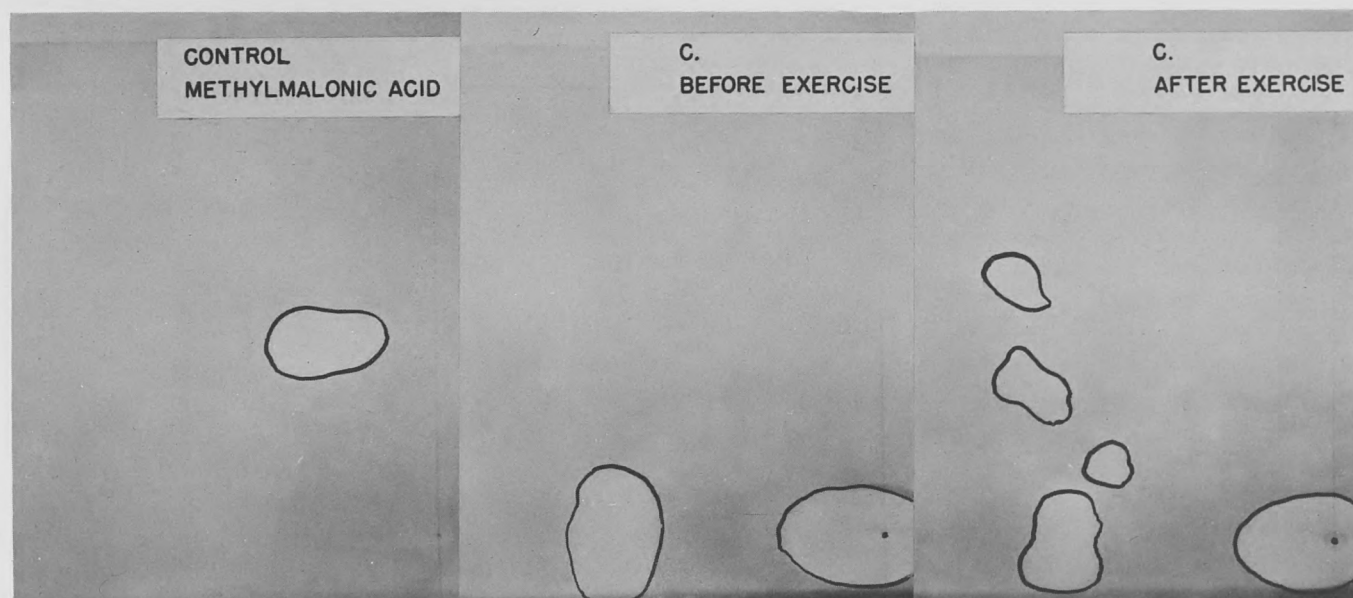
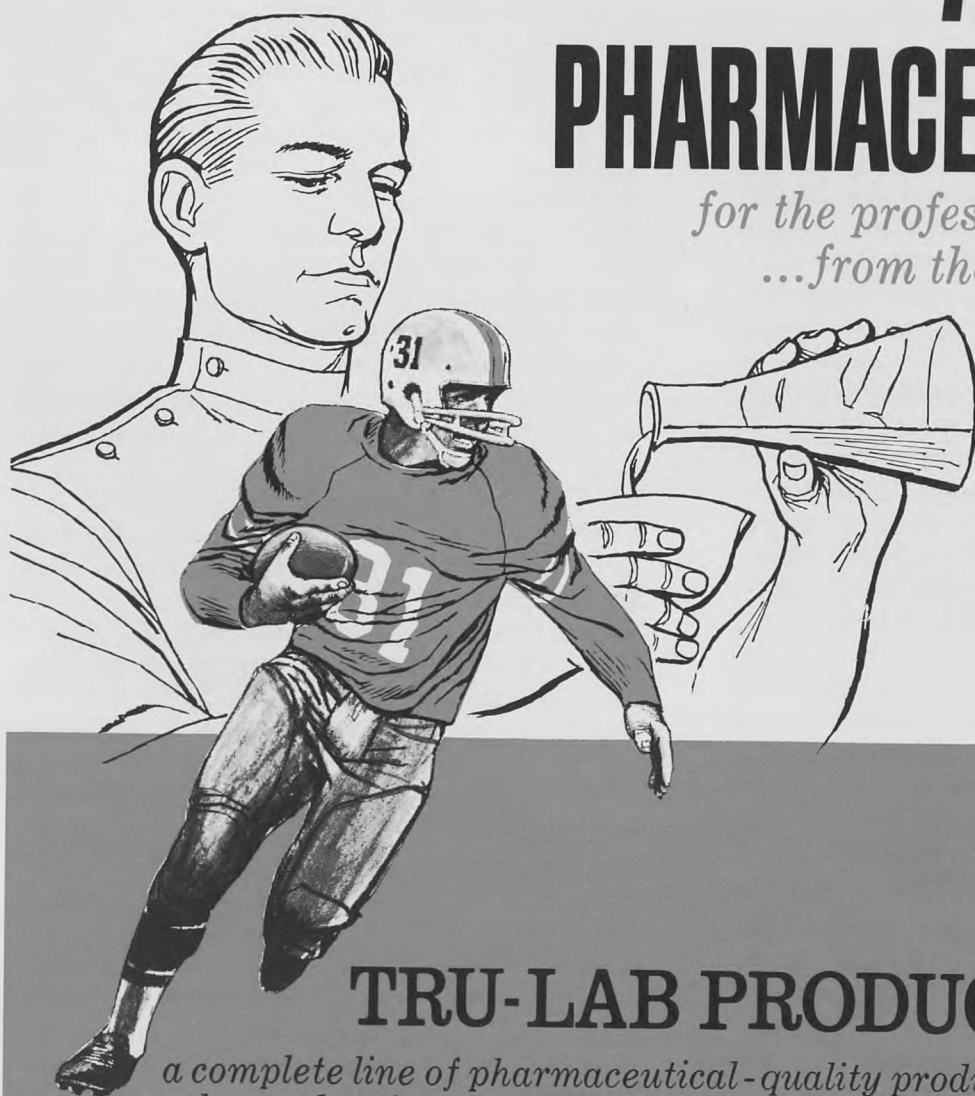


FIGURE 1

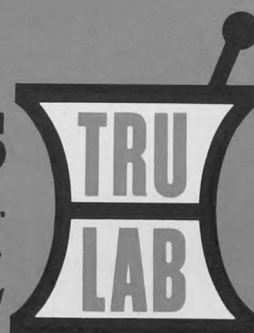
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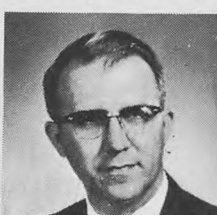
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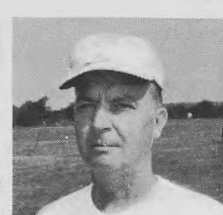
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Crash Diets and Wrestling

WILLIAM D. PAUL, M.D.

Iowa City

This article is reprinted by permission from the JOURNAL OF IOWA MEDICAL SOCIETY, August, 1966. Its significance to trainers extends, of course, beyond wrestling to any form of athletics in which "making the weight" becomes important to a competitor.

—The Editor

WRESTLING is an excellent sport, for it gives a wide range of boys an opportunity to engage in interscholastic athletic competition. Body size, though an important factor in other activities, excludes almost no one from wrestling, inasmuch as there are 12 weight classifications. The sport requires little equipment, and one coach can supervise many participants. Besides, it has become a very popular spectator sport.

The principal danger arises when, at the insistence of an adult or of his own volition, a boy attempts to starve himself temporarily, so as to reduce his weight and thus qualify for competition with normally smaller opponents.

PHYSIOLOGIC PRINCIPLES

Whenever one discusses weight reduction, he should recognize the difference between body stores and body reserves. Stores represent the amount of fats, carbohydrates or protein in the human or animal body that can be utilized without a disturbance of function. Reserves, on the other hand, are materials which can be lost during stress, illness or starvation, and which must be replaced quickly if normality is to be maintained.

Muscle tissue is the main working component of the body, but it also contains important reserves of protein and potassium. Adipose tissue is primarily a fuel depot, but it has an additional role as an insulator and conserver of heat, and it also can convert one fuel into another—namely, carbohydrate into fat. Bone is chiefly a supporting structure, but it also is a storehouse for calcium, phosphorus and sodium.

Man can survive for only a few days without water. His electrolyte reserves will last no longer than that length of time if he is exposed in a hot, dry climate, or incurs heavy losses from acute disease of the gastrointestinal tract. He can survive for weeks without food, provided that he has an ample supply of water, for his body contains considerable stores of available energy which pro-

tect him against a sudden cutting off of nutrient material.

Table 1 presents the values for the stores of available energy that are normal for an average man,¹ though most recent workers suggest that a total of 400 Gm. of body carbohydrate is more accurate. The exhaustion times are based on the assumption that the utilization is 1,600 cal. daily. Such an expenditure is slightly above the approximately basal rate for a bedfast man, and allows for only a small amount of activity. If hard work must be carried on, the daily expenditure will be much greater, and the stores will be exhausted rapidly.

The total carbohydrate content of the body is not high. It varies, according to most authors, between 400 and 500 Gm. The normal liver contains only 100 Gm. of glycogen, which represents just 6 per cent of the weight of the liver. During starvation there is no carbohydrate source from which an individual can restore his glycogen reserve, and the glycogen content of the liver falls rapidly. Under those conditions the supply of glycogen would last only six or seven hours.

Since the blood glucose concentration decreases only slightly during the first few days of starvation, it is obvious that glycogen is being reformed from other than carbohydrate sources. In starvation, the plasma amino-acid levels are slightly higher than in the usual post-absorptive period. The excess probably is the consequence of a more active breakdown of tissue proteins. This process, called gluconeogenesis, utilizes some of the amino acids from the body proteins and from the glycerol of the body lipids to form glucose. During continued starvation, the glycogen reservoir is never built up. As soon as some glycogen is made from a non-carbohydrate source—in fact as soon as any compound is built up to glucose phosphate—it is hydrolyzed into glucose by the liver phosphatase to maintain the blood glucose concentration. Actually, as starvation develops, gluconeogenesis slowly fails in its struggle to keep the blood glucose concentration normal.

Starvation tends to lower the blood sugar content. In most individuals the fall is not great, and it is most pronounced during the first 48 hours of fasting. Thereafter the blood sugar may rise somewhat, but it never reaches the normal post-absorptive level. In some reports of starvation, values as low as 37 mg./100 ml. have been noted. These low levels should be associated with severe symptoms, but starving patients do not die of hypoglycemia.

A physiologic fatty liver occurs when the demand for fat combustion is unusually great. It

TABLE 1
NORMAL STORES OF AVAILABLE ENERGY
IN A MAN WEIGHING 65 KG. (143 LBS.)

	Total Body Content (Gm.)	Available (Gm.)	Stores (Cal.)	Daily Utilization	Exhaustion Time (Days)
Carbohydrate	500	150	600	All used in 1 to 2 days	Less than 1
Protein	11,000	2,400	9,600	60	About 40
Fat	9,000	6,500	58,500	150	About 40

occurs predominantly in starvation and in uncontrolled diabetes. In starvation, the blood level of ketone bodies may reach 20 mg./100 ml., but that concentration seldom produces severe acidosis except in children. About 20 mg. of ketone bodies per day is normally excreted in the urine. In the ketosis of starvation, from 5,000 to 10,000 mg. of ketone bodies is excreted per day—more by women than by men. As total metabolism is reduced after three to five days of starvation, the excretion begins to diminish.

Usually the total rise in lipids is not very great during starvation. On the first and second days, triglycerides are increased, along with phospholipids and cholesterol esters. Later, triglycerides tend to fall to original levels, but phospholipid and cholesterol values may remain somewhat elevated (Table 2). With the present emphasis on low-cholesterol diets, these elevated levels may be considered another hazard to health. The free fatty acid concentration of the plasma rises rapidly at the beginning of starvation. Along with ketones, it is the chief source of calories for the peripheral tissues, and it may remain elevated even in cachexia.

TABLE 2
CHOLESTEROL VALUES IN STARVATION

	Total mg. %	Free mg. %	Ester mg. %	%as Ester
Normal	185	55	130	70
Starvation:				
Early	250	70	180	72
Late	130	50	80	62


Cellular breakdown occurs in starvation. The potassium of the destroyed cells is added to the extracellular fluid, often at a rate greater than that at which it can be removed either by excretion or by transfer to intact cells. This is especially true if oliguria is present. In this decrease of potassium stores, about 2.7 mEq. of potassium is released with every gram of protein nitrogen that is broken down. Thus potassium deficiency, accompanies protein deficiency, but if there is no other type of potassium loss, the intracellular and extracellular concentrations remain unaltered, unless restoration of protein is attempted without accompanying potassium. With normal food intake, the regrowth of cells produces equivalent retentions of potassium and nitrogen.

Deficiency of the B vitamins begins immediately if the diet is changed to one that is low in these vitamins. Complete starvation, however, produces little or no deficiency of vitamin B complex, for

the destroyed cells offer their vitamins to the remaining cells, and the destruction and excretion of the vitamins is greatly diminished. It is during realimentation that the need for the vitamin B complex and other vitamins becomes acute. Marked symptoms of vitamin deficiency occur during realimentation.

Carbohydrates exert an important "protein-sparing" action. When dogs have been fed a low-carbohydrate or low-fat diet, they reached nitrogen equilibrium only when five times the quantity of protein destroyed was replaced in their diet.² This finding points up the increased physiologic expense imposed when protein is used as the sole source of calories. When fat was given with the protein, the amount of protein required in establishing equilibrium was much lower—1.5 to 2.0 times the fasting level.³ When carbohydrate is the dominant food, nitrogen equilibrium can be established at a level of dietary protein far below that observed in the fasting state. Graham Lusk found that the sudden withdrawal of carbohydrate from the diet and its replacement by fat resulted in an increase in protein breakdown.⁴ This was shown by the change of urinary nitrogen from an average of 11.14 Gm. to 17.18 Gm./day. When the calorie needs of an individual are supplied by carbohydrates only, protein metabolism is reduced to the wear-and-tear quota. In these instances, very low values of total nitrogen excretion for 24 hours have been found, ranging from 1.75 to 1.58 Gm.⁵ Fat, on the other hand, does not replace carbohydrates similarly. Bartman fed fat at a level up to 150 per cent of caloric requirements, and found that the protein catabolism was lowered to a maximum of only 7 per cent.⁶ Cathcart suggested that the ketolytic effect and protein-sparing action of carbohydrate are intimately related, since ketosis is associated with increased protein catabolism.⁷ In individuals on a reducing diet who have a high intake of protein and a low calorie intake, one may want to know the level of calorie intake at which carbohydrates can exert their maximal sparing effect. There is a level below which no amount of protein in the diet can prevent a negative nitrogen balance. Apparently this critical level, above which protein metabolism can be spared maximally, lies somewhere between 1500 and 600 calories. This, of course, should contraindicate the use of starvation in wrestlers.

Excessive amounts of protein are an important factor influencing the volume of urine, especially



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in persons on a calorie-restricted intake. Gamble found that the volume of urine excreted is dependent to a great extent on the protein and electrolyte intake.⁸ In dehydration, the urine volume is largely governed by the amount of urea and other nitrogenous metabolites that must be excreted. At first, when the fluid intake is low, the body gives up its water for the excretion of waste products. It eliminates intra- and extracellular salts in the urine so as to maintain a normal solute concentration. When the body can spare no more fluid, there is an increase in the blood concentration of waste products, especially of urea nitrogen and the nitrogenous residues of protein metabolism. This is very important when an individual—say a wrestler—increases his protein intake, limits the amount of water he drinks, and loses a great deal of fluid by sweating.

SPECIAL CONSIDERATIONS

Thus far, we have been talking about the average normal or obese individual who reduces his calorie intake and engages in little or no physical activity. Wrestlers at the junior high school level range in age from 11 to 14 years, and at the high school level from 14 to 18 years. They still are in the growing stage, and require more nutrients than do the older and more experienced college wrestlers. A fact that is not well known, especially by lay people, is that calcium cannot be deposited in bone without an adequate supply of protein. The National Research Council recommends that males between ages 16 and 19 should have 3,600 calories per day and 100 Gm. of protein. For an adult 25 years of age, it suggests 3,200 calories and only 70 Gm. of protein. These allowances are intended for individuals who are in sedentary occupations and who engage in only moderate physical activity. The wrestler undergoes vigorous physical activity while in training, and must continue to work out prior to a bout. Whether he is on a high or low-calorie diet, he tries to reduce his fluid intake and wears rubber clothes to increase his sweating, or forces himself to vomit in an effort to lose weight.

Taylor, *et al.*, reported experiments on men starved for periods ranging from 2½ to 4½ days while performing work on a motor-driven treadmill, in amounts that resulted in a total calorie expenditure of between 3,500 and 4,000 per day. The 2½-day fast resulted in a 6.8 per cent loss of body weight, and the 4½-day fast produced an 8 per cent loss in body weight. On the 4½-day fast, with hard work, there was an 18 per cent decrease in plasma volume and an 8 per cent loss in extracellular fluid (thiocyanate space). This loss of fluid accounted for 27 per cent (5.5 Kg. or 12.1 lbs.) of the total body weight.

In another study of performance during starvation, it was shown that the average total calorie

deficit following the 2½-day fast was approximately 9,000, and following the 4½-day fast it was about 16,000.¹⁰ The subjects walked at 3.5 m.p.h. on a 10 per cent grade, with an average expenditure of 550 cal./hr., for four hours each day in the 2½-day fast and for three hours in the 4½-day fast. On the first day, there were no signs of loss of fitness, but on the morning of the second day, work pulse rates were increased by 10-15 beats per minute; work ventilation was increased; and the blood sugar in work decreased by 25 mg./100 ml. Only a small increase in work pulse rate (5 beats/min.) was noted during the remainder of the fasting period. In the short fast, the mechanical efficiency of grade walking decreased from 19.0 to 17.8 per cent. This decline was paralleled by a decrease in the non-protein R.Q. and an increased fat metabolism during work. The ability to perform exhausting 'anaerobic' work was definitely impaired after the first day of starvation. On the second day, the score on the Harvard Fitness Test was decreased to 70 per cent of normal, and on the fourth day it dropped to 40 per cent. It was concluded, however, that the physical deterioration associated with the loss of 40-50 Gm. of nitrogen under these conditions can be repaired during two or three days of refeeding.

Brozek studied the changes in psychomotor functions of men undergoing four days of starvation combined with hard physical work.¹¹ He found a dramatic decrease in endurance, as measured by having the subjects run on a treadmill to exhaustion. In tests of speed and of eye-hand coordination, deteriorations of statistically high significance were noted. Intellectual tests, however, showed little or no impairment.

Most of the studies that have been cited were done only once in any given individual, though Brozek repeated his studies in the same subjects after an interval of six months. What would happen if the starvation studies were repeated every week for a six- or seven-week period in the same subject? Would the young man be able to replace the 40-50 Gm. of nitrogen lost each week? What would happen to the carbohydrate stores and reserves? Yet wrestling coaches expect boys practically to undergo starvation for 2 or 2½ days prior to a bout. In the physiologic experiments cited above, the subjects were given water *ad libitum*, but wrestlers not only starve themselves but dehydrate themselves at the same time by limiting their fluid intake, wearing rubber clothes, remaining in hot, dry environments (hot boxes), or forcing themselves to vomit. No physiologist would attempt to carry on an experiment so violent as that in a normal young man.

Another factor that is often overlooked by wrestling coaches is that the average high school participant may appear heavier than he should be, and may weigh more than expected, yet may not be

obese. Using densitometry, Behnke *et al.* studied the specific gravity of football players, and found that it was erroneous to suppose that individuals who are overweight for their age are necessarily obese.¹² Brozek studied groups of active and inactive men over 50 years of age who had been matched for age and height,¹³ and found significant differences in body density and fat content in the two groups. The active men had smaller skinfold thicknesses of subcutaneous fat tissue, and more fat-free tissue. Parizkova found changes in the body composition of Olympic gymnasts of both sexes.¹⁴ During 16 weeks of intensive training, the body weight remained the same, but the subcutaneous as well as the total body fat fell rapidly. The increase in body density revealed that the fat-free mass increased, too. At the Seventh National Conference on the Medical Aspects of Sports, Novak reported the results of his studies of the differences between high school athletes and high school seniors who were not participating in any sport.¹⁵ The average ages of both groups was 17+ years, and the heights and weights were approximately identical. He found that physical activity has a profound influence on body composition. Adolescent boys who habitually participate in sports seemed to have significantly less total body-fat and skinfold measurements than did the adolescent boys who did not participate. A boy weighing 132.0 lbs. has only 9.24 lbs. of fat, amounting to 36,800 calories. If the daily requirement is about 3,500 cal. and he is placed on a starvation diet, he used up his body fat within 10 or 11 days, and thereafter must depend upon his body proteins as a source of energy.

CLINICAL SYMPTOMS OF STARVATION

The question arises whether or not any clinical symptoms result from the biochemical and physiologic changes which have been described. Fatigue is the first symptom noted when low-calorie diets are being used or during periods of starvation. Henschel *et al.* showed that aerobic work could be carried on with few signs of loss of fitness during the first day of starvation, but on the second day some loss of fitness was observed. Evidence of fatigue from fasting can be noted during wrestling matches, even at the college level. During the first three-minute period, the wrestler does fairly well; during the second three-minute period, his opponent scores points for reversals; and in the last three-minute period, he has to exert a maximal effort to prevent being pinned, and often is pinned.

With the onset of fatigue, one notices marked tension, irritability and a decreased ability to concentrate. The young man cannot concentrate on the holds that might win the bout, and cannot follow the instructions of his coach. Often he is so tense that he cannot move fast, and gives up points to his opponent. During starvation there is a tend-

ency to decrease all self-initiated activities, and the athlete would rather just sit on the bench than warm up before the match. It is not unusual for a young man to fall asleep while waiting his turn to compete.

Nausea and/or vomiting is seen often as a side effect of dieting or starvation. These symptoms are not very severe, and last only a short time. However, there is one symptom that causes the physician a considerable amount of worry. During a match, the athlete may suddenly develop pain in the abdominal wall, or over the chest. The wrestler, trainer or coach usually refers to this as a "stitch." If the pain is in the proper location, the physician must consider and try to rule out acute appendicitis, pleurisy, pericarditis, perforating ulcer, pancreatitis or even hepatitis.

POSSIBLE COMPLICATIONS

Taylor and his associates used 12 healthy young men to find out the effect that acute starvation accompanied by hard work can have on body weight, body fluids and metabolism.⁹ At the end of a 4½-day fast, one man showed unequivocal jaundice, and liver-function tests demonstrated definite malfunction of the liver. In 10 of the men, the mean one-minute serum bilirubin increased from 0.11 mg./100 cc. before the fast, to 0.27 mg./100 cc. at the end of starvation, and the total bilirubin rose from 0.76 to 1.96 mg./100 cc. The four-hour bilirubin excretion increased from 1.13 to 2.96 mg. Only by the third day following the end of the fast, did all liver-function tests return to normal.

McDermott *et al.* described a case of acute pancreatitis in a young man 18 years of age.¹⁶ This athlete weighed 133 lbs. and wanted to wrestle in the 123 lb. class. After 12 days of severely restricted fluid and food intake, he weighed 123 lbs. Thirty minutes after realimentation, he was stricken with severe abdominal pain, and he spent 10 days in the hospital before he recovered. We have seen an intensification of ulcer or ulcer-like symptoms in athletes who have tried to lose weight.

Another aspect of crash diets cannot be overlooked. In Wisconsin last year, 270 high schools participated in interscholastic wrestling. Approximately 11,000 boys were on the mats there. During 1965 in Iowa, 200 high schools participated in interscholastic wrestling. We have no exact figures on the number of participants, but it is estimated that there were between 8,000 and 9,000. Among these adolescent males, totaling about 20,000 in the two states, one might expect to find a few who have had rheumatic fever or other streptococcic infections such as scarlet fever, with some residual in the kidneys. Also in a group as large as this, one might expect to find a few carrying a hereditary trait of either gout or diabetes mellitus.

As noted previously, the volume of urine excreted is dependent to a large extent upon the protein and inorganic electrolyte intakes. In crash dieting or starvation, especially with a limited intake of water and salt, the urine volume decreases, and as oliguria ensues there may be evidence of renal irritation. Albumin, showers of red blood cells and casts are found in the urine. If the athlete has had a previous kidney infection from one of the streptococcic diseases, he may develop an intensification of the kidney lesion and finally a chronic nephritis.

In a fasting subject, the amount of uric acid excreted in the urine diminishes on the very first day. The normal increase in uric-acid excretion that occurs during the late forenoon and early afternoon disappears completely if the morning and noon meals are omitted. A decreased excretion of uric acid can be detected within 12 hours after the start of a fast. For at least 24 to 48 hours, the serum concentration of uric acid is not significantly altered by this retention. However, there is considerable evidence to indicate that there is a correlation between ketones in the blood and their excretion, on the one hand, and the excretion of uric acid by the kidneys, on the other. The rate and amount of uric acid excreted appear to bear a close reciprocal relationship to the rate and amount of ketones excreted in the urine.¹⁷ Ketones are increased by a low carbohydrate intake or by a high-fat diet. Six years ago, a football player who joined the professional ranks was told to lose weight. He went on a low-carbohydrate diet, and within a few weeks had an acute attack of gout. Examination two weeks later revealed redness and swelling of a great toe (podagra), synovitis of the corresponding ankle, and a blood uric acid of 9.0 mg./100 ml. Treatment with colchicine and probenecid controlled the symptoms. After he returned to a normal diet, his symptoms quickly subsided. During the ensuing years he played professional football, he had no symptoms, and his uric-acid levels were within normal limits. It is of interest that he had no family history of gout.

Young people with family histories of diabetes, or those who may be potential diabetics, can develop clinical diabetes from starvation or crash diets. As the ketones increase, they may develop keto-acidosis during starvation. The symptoms are most likely to occur during realimentation, when the pancreas secretes a diminished amount of insulin. Recently, a wrestler reported that he was tired, that he wakened at night to void urine, and that he was unable to concentrate on his studies. He had been examined before the wrestling season began, and nothing abnormal had been found. Subsequently, he had had difficulty in making weight, and each week he had had practically to starve himself and to reduce his fluid intake. Glucose and a trace of acetone were found in the urine, and

his fasting blood sugar was 190 mg. per cent. Obviously, he performed very poorly during the wrestling season.

Last, one must mention the effect of short bouts of starvation on the heart. As protein is broken down for energy, potassium is released and taken up in the extracellular fluid. The increase in this electrolyte will cause premature beats and T-wave changes in the electrocardiogram, and may even cause changes in the cardiac rhythm. These phenomena disappear shortly after realimentation, but if the athlete has had rheumatic fever previously, they can be of some consequence.

CONCLUSION

Since increasing emphasis is being placed on wrestling at the junior high school and high school levels, it is necessary for physicians to help coaches select boys for the proper weight classifications, to supervise their diets, and above all, to teach their parents that athletic prowess does not require an excessive food intake.

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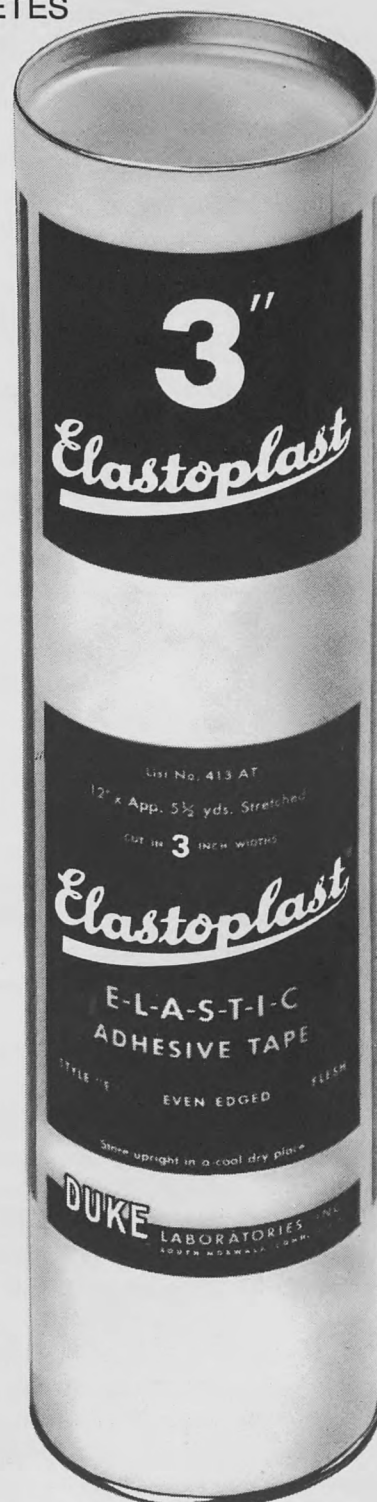
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Sports Medicine in Perspective

JAMES Z. APPEL, M.D.*

Worth repeating is this address given by Dr. Appel and published as part of the Proceedings of the 7th National Conference on the Medical Aspects of Sports, Chicago: American Medical Association, 1966. Dr. Appel re-emphasizes some principles and responsibilities which are becoming ever-stronger parts of the lexicon of team physicians, coaches, and trainers, but which still are occasionally abused. The breadth and wisdom of Dr. Appel's remarks should be strong encouragement and inspiration to members of the National Athletic Trainers Association. Space requirements forced abridgement of article. —The Editor

A PHYSICIAN'S CONCERN with sports is not a recent development in the history of medicine. The interest of physicians in sports, games, and exercise has been traced back to the contemporaries of Hippocrates in the 5th century B.C. While this interest has continued through the centuries, a new perspective has emerged. It is only in our lifetime that men have had the time, the means, and the energy to participate in organized sports activities on a widespread scale. Moreover, to play has become in our time a *respectable* activity. In many respects, to play now can be justified in the name of health.

Fundamentally, sports medicine has the same purpose and aim as does the practice of medicine itself. There are risks involved in leading an active productive life, and we are dedicated to providing the safest possible conditions and environment to this end for every individual. Sports medicine not only has become a consequence requiring a perspective but should be considered as a perspective in itself.

A CONCEPT OF SPORTS MEDICINE

While sports medicine is more readily discussed than defined, I think it is necessary that I offer my concept of it now for a common denominator in our thinking.

At the center of sports medicine, it seems to me, are the natural laws that govern man as an active being. If we understand these natural laws correctly, man is not intended to be sedentary. Sports, because of their motivational appeal, provide an advantageous tool for medicine in utilizing natural laws for bettering health. But this tool is not the province solely of the physician.

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Sports medicine also involves the more empirical evaluation of how we can apply these laws in the safest possible manner to the many sports pursuits in which man engages. Here the coach, physical educator, and athletic director team up with the physician.

Sports medicine, of course, must then involve the repair of injuries and constitutional stress that occur to some so that their participation can continue unimpaired in life as well as in sports. Again, in this realm, the whole medical team and the athletic trainer are allied with the team physician. It is most advantageous that the athletic trainer has become a valuable member of the team. The high standards that are being established for and by this profession have resulted in better service for all concerned.

EDUCATION OF THE ATHLETE

It is not enough to describe sports medicine as sound research, supervision, and treatment. Sports medicine also involves educating the athlete. If he is to derive the values that we assume to accrue from sports, he needs to understand what goes into readiness.

No one disagrees that a high degree of conditioning is a safeguard as well as a prerequisite for optimum performance. This is one of the most advantageous aspects of our sports medicine perspective. This puts every one of us on the same team.

BENEFICIAL, UNNECESSARY, OR HAZARDOUS?

If we are to put sports medicine in perspective, we must learn to categorize the practices and products promoted for readiness into "beneficial," "unnecessary," and "hazardous." That this categorization is no simple matter provides justification for high standards for anyone who wishes to assume responsibility in sports supervision.

There is a need to begin categorizing the promotions reaching the coach, trainer, athlete, and physician. Considerable confusion exists across the nation when it comes to such matters as the use of vitamins, sugar pills, and the like. A few persons are even enabling misguided athletes to acquire drugs in their impatient search for athletic success. Some feel that these so-called ergogenic aids provide true biological assistance. Others admit that they are intended only for psychological lifts to their athletes.

(Please turn to page 16)

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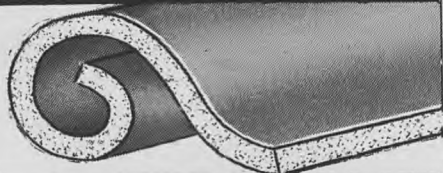
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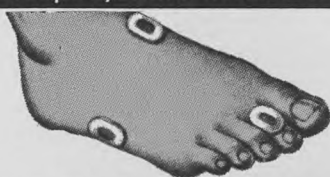
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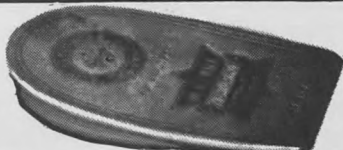
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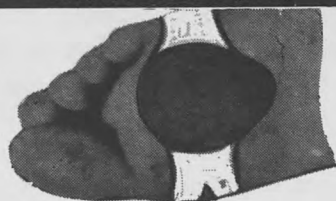
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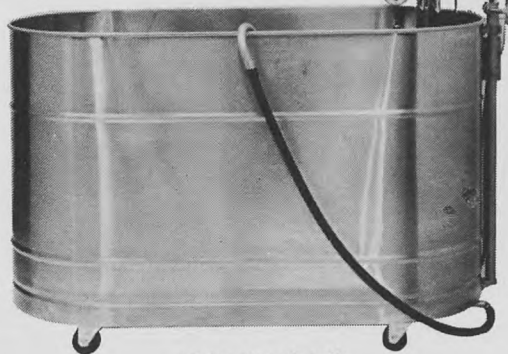
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We would all condemn the *hazardous* ergogenic aids, but why condone the *unnecessary* when performance and health (and, with respect to many schools, limited budget) are at stake? Why, for example, should we push vitamin supplements because of our youth's alleged poor dietary practices when good nutrition education will suffice for athletics and for life?

Let us explore further our philosophy of the unnecessary. By doing so, our total categorization process may be simplified.

To begin with, I shall substitute for *unnecessary* the word *gimmick* since its definition, "a device to deceive," makes it something of a synonym. Then, as an illustration, consider an inquiry sent recently to the AMA Committee on the Medical Aspects of Sports regarding the use of Vitamin B₁₂ in supplement form as an athletic ergogenic aid. The AMA Department of Foods and Nutrition reviewed the research on this vitamin and found no studies to support claims for this purpose. Its use as a supplemental aid in sports is consequently unnecessary, and such use can be classified as a gimmick.

A recent article in *Today's Health* on isometrics offers another perspective with respect to this categorization. Isometrics, like some other practices, cannot be categorically lumped as beneficial, unnecessary, or hazardous. The category would depend on the purpose for use plus skill of administration. Many claims have been presented for isometrics, but this article focused on the limitations of isometrics and by so doing strengthened their usefulness. By judiciously assaying the relative values and limitations of isometrics, coaches can utilize what may be helpful as an adjunct to a conditioning program, while avoiding undue reliance.

GOOD COACHING

The importance of sound coaching in every sports program cannot and must not ever be underestimated. Good coaches respect allegiance to fundamentals and are leery of the gimmick that could be confused with the fundamental. In guiding young people in the various sports activities in schools and colleges across our country, they have taken on an immense responsibility. Today, I am happy to say, most of them carry out this responsibility mindful of the fact they are dealing with impressionable young human beings who have a lifetime ahead of them. Coaches have become increasingly aware of the fact they can help or they may hinder the physical, intellectual, and emotional development of their charges.

The most learned and dedicated coach by himself, however, does not constitute quality supervision. He needs help—help from assistants who can be responsible for first aid care and emergency procedures, help from medical and health personnel.

The decision to offer a sports program should hinge on the availability of this help.

The high school level, perhaps, is where the educational qualities related to sports are most important. It is therefore almost a paradox that the closest medical supervision is usually at the collegiate level where the coach and trainer staff are more abundant. In this connection, I am gratified and encouraged to see the excellent and mutually rewarding relationships our Committee on the Medical Aspects of Sports enjoys with the National Federation of State High School Athletic Associations.

BY-PRODUCTS OF SPORTS

The preservation and promotion of health through sports is basic to—but only one potentially desirable outcome of—sports experiences. The by-products of a well supervised and sensitive sports program go beyond the acquisition of a healthful physical efficiency.

Many factors in life as in sports contribute to a person's happiness or lack of it. For example, much has been written and much more said about the effects that competition has on adults, and on growing youngsters. Competition is a part of life. Within limits, there is certainly nothing wrong with competition. However, I want to stress the importance of the qualifying words, within limits.

To a large degree, we owe our superior standard of living to our freedom to compete. Much of our progress in science and in industry can be attributed to it. But cooperation is an equally important and comparable factor. The success of many ventures depends on cooperative effort. In our democratic way of life, we depend to a great degree upon the judicious mixture of both competition and cooperation. Participation in a well organized sports program gives our younger people an opportunity to learn not only how to compete but also how to cooperate in accord with a set of rules. This requires the admirable quality of self-discipline.

More and equally valuable lessons may be learned while participating in sports, lessons that can be applied and remembered long after graduation day. These lessons add up to an understanding by the athlete of what it takes for him and others not exactly like him to have satisfying experiences in sports. If sports medicine helps to accomplish this, it has deepened a perspective involving attitudes and concepts that are good for a lifetime of living.

In the years to come, sports medicine must take in perspective a host of specific and unspecific, tangible and intangible, conquered and unconquered problems. In addition, sports medicine must relate these problems to the ethical and educational foundations inherent to and unremovable from sports experiences. We are making formidable strides in this direction.



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