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**LACK OF VITAMINS IN THE WAR-TIME ARMED MIGHT DIET**

BY

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The vitamin content of soldiers' food has received careful consideration during the last war, but vitamin deficiencies were still seen. This paper was written with the purpose of drawing attention to this fact, and it is hoped that comprehensive investigations will be stimulated. The observations were based on over four years' experience with the Army abroad, in India, Iraq, Persia, Palestine, Syria, Egypt, Sicily, Italy, Belgium, Germany, and on board H.M. Troopships. Nearly all this time was spent with one Infantry Division, mostly as Regimental Medical Officer. Gross deficiency diseases were not a problem in these areas, but mild varieties, often overlooked and sometimes suggesting neuroses or malingering, were prevalent. These were mostly seen in Regimental Aid Posts and Field Ambulances. Those better qualified for such studies did not have opportunities of observing them, and this is perhaps a sufficient excuse for writing this paper. It is a somewhat incomplete account, and inaccuracies may have crept in, for few publications were available when the observations were

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made, and it was necessary to rely on scanty notes and memory when medical literature became accessible.

It is intended, firstly to point out difficulties in estimating the real vitamin intake of soldiers, secondly to point out difficulties in estimating the real vitamin requirements of soldiers, and thirdly to describe signs and symptoms suggesting vitamin deficiency.

Lack of the Vitamin B complex appeared to be the most conspicuous shortage. Vitamins often occur together in food, and avitaminoses are usually caused by the lack of several of them; but Army rations form a very artificial diet, and it is quite possible that certain vitamins in it were adequate to requirements, while others were not.

THE VITAMIN CONTENT OF FOOD

Soldiers seldom take in all the vitamins theoretically contained in their food. Fads and fancies exist in the Army the same as everywhere else, and few soldiers eat everything that is put before them. In civilian life and in certain base areas natural instincts and appetites often help to balance an otherwise inadequate diet, but under active service conditions this is seldom possible.

In hot climates appetite generally decreases. According to Rush (1944), only 2,281 calories were ingested on average by a group of soldiers in the tropics, although 3,200 calories were provided; and there was suggestion of deficiency of Vitamin B₁, Vitamin C, calcium, and perhaps riboflavin.

Transporting, preserving, cooking, and storing of food often causes serious loss of vitamins.

1. Vitamin B₁ and Vitamin B₆ are destroyed by alkali (Martindale, 1943). Yeast preserves these vitamins, owing to its faint acidity, but alkaline baking-powders destroy them. The latter are more easily available to Army cookhouses than yeast (although Army bread is made with yeast), and bicarbonate of soda, or even alkaline "health salts," are often used by Army cooks for baking.

2. Riboflavin is reduced by strong light and ultra-violet rays (Martindale, 1943). On active service fresh food is often stored in the open, and such destruction may take place, especially in tropical and subtropical countries.

3. Vitamin C oxidizes in the presence of heat and light, and it is unstable in alkaline media (Martindale, 1943). Much of it can be destroyed not only by storage in the open, but also by cooking in open containers in the sun.

4. Tinned food loses some of its vitamins. Tinned bacon (Report, 1944) and corned beef probably contain much less of the Vitamin B complex than fresh products. According to Bicknell and Prescott (1942), 22–67 per cent. of riboflavin is lost in "canning." Thompson et al. (1944) found considerable variations in the riboflavin and pantothenic acid content of various samples of the same tinned fruit; and their figures for the riboflavin and pantothenic acid content of tinned food are on average about 30 per cent. below those given by Bicknell and Prescott for the same food in fresh condition.

5. Fresh fruit and vegetables are often damaged in transport. During the
winter and spring of 1944 in Italy, apples or oranges were provided daily; but they were carried in sacks, and they were often uneatable and always unattractive when they arrived in forward areas.

6. Vitamins are often poured away. Brush et al. (1944) found that the liquid and solid matter in tinned fruit and vegetables contained roughly proportionate amounts of Vitamin B₁ and riboflavin. Hinman et al. (1945) found that 30–40 per cent. of Vitamin B₁ and riboflavin was lost when liquids were discarded in small scale preserving. Most Army cooks pour away the liquid contents of tinned vegetables, and some do so with the liquid used for cooking fresh vegetables. Much of the juice of tinned fruit is also wasted.

It is doubtful whether allowances were made for all the above factors when soldiers’ rations were planned.

**Vitamin Requirements**

Vitamin requirements vary considerably even under normal conditions, and there are discrepancies in the average daily requirement figures or “safe” intake levels given by different authors. Furthermore, these “safe” levels were arrived at by calculating averages of many estimations, and there is reason to believe that the assumed vitamin content of Army rations was considered satisfactory by comparison with such figures (Report, 1944). This means that all those whose vitamin requirements were for physiological or pathological reasons well above the average were from the start doomed to receive less than they needed.

The discrepancies in dietetic requirements of Vitamin B₁ were explained by Najjar and Holt (1943), who have shown that production of Vitamin B₁ by bacteria takes place in the human bowel, that this vitamin is absorbed from the bowel, and that some individuals produce more of it than others. They have also shown that sulphonamides destroy the vitamin-producing bacteria. (Sulphonamides were extensively used in the treatment of war wounds, infections, diarrhoea, dysentery, etc., and they may have had an adverse effect of the Vitamin B₁ balance of some patients.)

Vitamin B₁ requirements increase with a raised intake of carbohydrates (Reinhold et al., 1944). During the war the Army diet always contained much carbohydrate, and in cold weather or at high altitudes above sea-level, additional sugar, chocolate and bread were provided.

Fever and prolonged muscular activity increase the Vitamin B₁ requirements of the body (Beaumont and Dodds, 1943). Malaria, sandfly fever, diarrhoea, and dysentery were frequent in tropical and subtropical countries, whilst respiratory infections were common in colder climates.

According to Booher (1939) riboflavin requirements are closely related to the amount of active tissue in the body; muscular activity may have thus contributed to the production of an adverse riboflavin balance.

Generally speaking, Vitamin B₁, nicotinic acid and riboflavin are all concerned with the continuous processes of cellular nutrition; one of their functions
is that they are components of co-enzymes which are used up, and therefore, they require continuous replacement (Sydenstricker, 1941). But the vitamin reserves of the body are small. There is, thus, on purely theoretical consideration, reason to believe that the vitamin intake of many soldiers must at times have been inadequate to their requirements.

**Signs of Vitamin Deficiency**

Let us now consider the signs and symptoms which suggest that there was a deficiency of vitamins, especially those of the B complex.

**The Diet**

In view of what has been said above, figures as to the assumed vitamin content of the Army diet would be of no use here. The picture is further confused by the fact that at times local restaurants were in easy reach and local fruit could be bought. It was, of course, impossible to determine the actual vitamin intake under active service conditions, but it is intended to contemplate the relationship between external conditions (dietetic and others), and the appearance of features suggesting mild avitaminoses.

In certain base areas, and on rare occasions in action, the diet contained fresh meat, some fresh fruit and vegetables, and occasionally fresh eggs and butter. Under active service conditions (even if there was no fighting, as in Persia), and during long road and train journeys (some of which lasted two to three weeks), the diet usually consisted entirely of the following:

- White bread or biscuits
- Flour
- Rice
- Porridge
- Tinned or dried potatoes and vegetables
- Tinned or dried fruit
- Chocolate (sometimes with added Vitamin A)
- Jam or syrup
- Sugar
- Corned beef
- Tinned sausage-meat
- Tinned bacon
- Tinned meat and vegetable stew
- Tinned processed cheese
- Tinned fish
- Tinned margarine
- Condensed milk
- Tea
- Salt and condiments

"Compo" rations, containing a variety of cooked, tinned, food, but hardly any fruit and vegetables, and no fresh food of any type, were issued at certain times.

The diet always had a high protein value and, a few brief periods excepted, it always had a high calorie value (about 3,200-3,600 calories). Very rarely, small quantities of Vitamin C, Vitamin B₁, riboflavin, and nicotinic acid were issued in tablet form. Fresh fruit and vegetables were seldom issued in abundance.

Outbreaks of conditions suggesting vitamin deficiencies invariably occurred when—

1. all, or nearly all, the food was tinned;
2. local procurement of food was limited or impossible; and
3. vitamin tablets were not supplied or not taken.
Such a diet will be called a “poor diet” in the following paragraphs; a diet containing an abundance of fresh fruit and vegetables with some fresh meat and milk products will be called a “good diet.”

The Clinical Picture of Vitamin Deficiencies

A large number of minor conditions seen in Medical Inspection Rooms abroad appear to be connected with lack of vitamins in the diet. Such minor conditions are, epidemic outbreaks and battle casualties apart, often the chief concern of Medical Officers. They are either connected with objective signs, especially from the skin, or else they consist of vague subjective symptoms without physical signs. As a rule the former are accepted with stoic indifference by patients, doctors, and orderlies, as an inevitable affliction of war; the latter are treated with sedatives and reassurance, light duties, iron and arsenic tonics, threats, or red ink, according to the Medical Officer’s disposition. The fact that both groups show definite up and down trends is generally recognized; it was observed, however, that these trends were generally parallel with changes of the diet. Whenever the food was good, the troops were fit, though other factors may have contributed; when food was poor, these conditions appeared, even whilst troops were housed in good billets and having an easy time (as in the early part of 1946 in Germany).

Skin conditions.—Not counting parasitic diseases like scabies or ringworm, these were chiefly—

(i) Superficial purulent conditions.
(ii) Desert sore.
(iii) Dermatitis.

Dirt, insect bites, cactus thorns, and abrasions caused by working with weapons and vehicles, all played a part in producing superficial purulent conditions, but there was also a definite connection with the diet. “Everything turned septic” when the diet was poor, though some men showed more resistance than others. When food was good, even dirty cuts healed up rapidly.

Boils formed a distinct group. Nearly everybody had a few small furuncles at one time or another. In the course of eighteen months, about 100 out of about 700 men in one regiment had definite outcrops of furuncles, lasting weeks or months, and often associated with severe carbuncles.

Boils were first observed on a large scale in Persia. Rations were extremely poor, and living conditions not much better than those of nomads. For about six weeks any amount of fruit, nuts and vegetables could be obtained from local sources, and there were few boils. Their incidence began to increase within about a fortnight of a move to another part of the country, where living conditions were almost identical (though the weather had turned colder), but where local purchase was restricted to a small quantity of eggs and nuts and large quantities of sticky sweets.

The problem with these boils was not their immediate treatment, for they mostly healed up, whatever was applied to them, but it was difficult to prevent patients from getting one boil after another. Rest, daily showers, and a reduction
of the carbohydrate intake were all helpful, but seldom practicable. Untreated boils often developed into desert sores. In a search for some general "tonic," yeast was finally resorted to, following a patient's report that a Casualty Clearing Station had successfully cured his boils with it.

About 10-15 grains of chopped and dried baker’s yeast were given three times daily for fourteen to twenty-one days. Local dressings (mostly fomentations with sodium sulphate or kapatoma kaolini) were continued. Oral administration of yeast was sometimes followed by an initial outcrop of boils, but complete cure followed in all cases within about three weeks; and, generally, boils seemed to soften up quicker, producing thinner, cleaner-looking pus, as soon as the treatment was begun. Some fifty patients were treated with yeast by mouth, and no failures can be recalled (unless memory or scanty notes are playing tricks). There were some relapses, perhaps 30 per cent., after several weeks or months, but all these were again easily controlled by further administration of yeast by mouth.

Desert sore has been widely discussed, and the opinion that it is caused by Vitamin C deficiency was widespread in the Middle East. [Others, like Bettley (1943), disagree with this view.] The incidence of desert sore, however, definitely increased whenever the diet was poor, suggesting that lack of vitamins did play a part in its etiology. Other factors must have contributed, for desert sore did not appear outside tropical and subtropical countries.

An unusually large number of men suffered from symmetrical patches of red, occasionally desquamating, dermatitis, suggesting nicotinic acid deficiency, and of seborrheic accumulations at the naso-labial folds, the alae nasi, or the vestibule of the ear, suggesting riboflavin deficiency. Dry, rugose, desquamating skin on the scrotum was also often seen, and this is one of the more frequent pellagrous manifestations (Bicknell and Prescott, 1942). At times there were four or five such fresh cases every week, out of a total of about 600 men. Fissures near the angle of the mouth, another sign of riboflavin deficiency (Beaumont and Dodds, 1943), were also seen. Finally, the frequency of contact dermatitis in the Army may perhaps also be connected with a Vitamin B complex deficiency.

Conjunctivitis.—There was every reason for men to develop conjunctivitis in this war—the sun, dust, wind, and smoke all contributed. But at times so many men were complaining of itching and burning of the eyes, a sensation of roughness of the conjunctiva, lacrimation and photophobia as to suggest the possibility of other causes. At other times, in spite of dust and wind, there were few cases of conjunctivitis. All these symptoms frequently appear with riboflavin deficiency (Bicknell and Prescott, 1942), and lack of this vitamin may have played a part in causing them. More definite ocular signs of riboflavin deficiency, blurred vision and inability to see in dim light, were also seen, but it cannot now be recalled whether they always appeared after the diet had been bad for a while.

Diarrhoea was so frequent that it is impossible to make definite deductions from its incidence. All men suffering from diarrhoea without blood and mucus were treated as infectious cases; if they failed to recover with saline purges and
kaolin, or sulphaguanidine tablets, they were sent to Medical Units for further investigation. Some of these whose stools were bacteriologically negative and who recovered after rest in hospital, and all those who continued to have mild diarrhoea for weeks and months, in spite of repeated negative endoscopic and microscopic examinations, may have suffered from undetected Vitamin B₁ and nicotinic acid deficiencies.

**Acute Ulcerative Gingivitis.**—It has been suggested that this is a result of nicotinic acid deficiency (King, 1940). The worst, and only important, outbreak observed was in Germany in spring and summer, 1945. It appeared when the diet was unusually good, and it almost disappeared at the beginning of 1946, when the diet became poor. This improvement seems to have been a result of energetic hygienic measures. The conclusion reached by Coulson et al. (1945) that nicotinic acid amide deficiency plays no part in the development of acute ulcerative gingivitis seems to have been thus borne out.

**Mild Subjective Symptoms.**—All observations were made among men whose morale was consistently good. Malingering was rare, and its presence, as well as its causes, were usually easily detected after a certain amount of friendly cross-questioning. At any rate, few soldiers are so stupid as to report sick with vague symptoms; if they do stoop to feigning disease, they usually manage to think up something intelligent, like a one-sided acute conjunctivitis caused by putting a little cigarette-ash into one eye. Neuroses seldom take the shape of isolated mild symptoms, and they are again easy to detect among men whom one knows. It is, therefore, thought that the familiar complaints of loss of appetite and strength, vague abdominal pain, muscle cramps when heat was not excessive, intercostal neuritis and other nerve pains, burning sensations, numbness and tingling of the limbs, palpitations, dyspncea, dizziness, nervousness, depression, absent-mindedness, and vague apprehensions, were more often than not due to vitamin shortage. They were certainly the most common after periods on a poor diet, and they have all been frequently described as early signs of various vitamin deficiencies, especially of the Vitamin B complex.

The therapeutic effect of yeast was not tried in more than a handful of these cases, but these were improved by it. Yeast could only be obtained from field bakeries by much persuasion; and it was reserved for boils, the most serious problem of all, and one known to benefit from it.

**Contributing Factors.**

The impression was gained that the following conditions were also associated with an increased incidence of the above-mentioned symptoms:

- Intense cold.
- Intense heat.
- Physical hardships and lack of sleep.
- Convalescence from febrile diseases.
- Diarrhoea, especially mild, chronic, cases.

All these conditions are usually connected with an increase of vitamin requirements, or a reduction of their intake, or both.
Lack of Vitamins in the War-Time Army Diet

Troopships

Troopships were generally overcrowded. There was every reason for Other Ranks to get "run down" on long journeys, as they lacked exercise and entertainment, and their food was usually monotonous and unappetizing; but there was always a fair proportion of fresh fruit and vegetables (stored on ice), and the calorie value of the diet was lower than on land. A reduction of vitamin requirements owing to lack of exercise can also be assumed. On shorter trips, lasting ten to fourteen days, all the above conditions improved towards the end of the journey, and on long ones (one of which lasted ten weeks) they were almost non-existent.

Comment

Nearly all the signs and symptoms described above are commonly associated with being "run down." Food was often the least satisfactory when general conditions were worst, and exertion, fear, and disease may have contributed by increasing the vitamin requirements of the body. But there must be some mechanism causing the "running down" of the body, and "fatigue" is hardly a less vague term. If we could say that the body has exhausted its scanty reserve of vitamins (known to last only seven to fourteen days in the case of some of them), we might get nearer to understanding the effect of prolonged hardships.

"Neurosis" is sometimes another convenient and vague label. Its existence and importance are not denied, but it is thought that many tropical neuroses and neuroses of convalescence are simple deficiency diseases, and that vitamin lack may have played some part in many neuroses of war. Especially the mild cases, which recover on "rest, sedation, and good food," suggest this. After all, rest and sedatives reduce the metabolism of the body, and therefore its vitamin requirements, and good food implies an adequate vitamin intake.*

A reduction of their vitamin requirements may have helped patients suffering from dermatitis, diarrhoea, septic conditions, etc., to recover when they were put to bed. Hospital food is often better cooked, too, with less destruction of vitamins.

Unless we assume some obscure curative powers, the fact that boils improved after oral administration of yeast suggests that a Vitamin B complex deficiency may have contributed to their development. The use of yeast in furuncles and carbuncles is only briefly mentioned in a few text-books on diseases of the skin, and only a single reference could be found to the effectiveness of vitamins, "consequential to their lack" (Sutton and Sutton, 1939). Perhaps under civilized conditions boils are seldom caused by vitamin lack. A careful search of the medical literature of the last ten years revealed the existence of only two papers on the use of yeast in purulent processes, both of which were published in Russia, and are not accessible. It is open to conjecture which of the vitamins contained in yeast is effective in the treatment of boils. Experiments on this subject might be instructive.

Bettley's (1943) assumption that lack of vitamins played no part in the develop-

* Note added in 1952. Selye's "general adaptation syndrome" (The Practitioner, 1949, 163, 393) may have played a part in causing the signs and symptoms described in the present paper.
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ment of desert sore was based on the facts that desert sores existed in the Middle East before the war, and that clinical evidence of known vitamin deficiency was not common in the Middle East army. This is not conclusive. Vitamin deficiencies might have existed, and probably did exist, before the last war; and a thorough search for the milder and earlier symptoms of vitamins deficiency may have shown these to be prevalent in the Middle East army even in the absence of definite disease complexes.

Finally, it may be worth mentioning that the United States Army in Italy and North Africa was in no comparable way afflicted with desert sore and boils, although personal hygiene in the field was undoubtedly better among British troops. As far as it could be ascertained in Italy, the United States Army diet was prevalently tinned, with a very high carbohydrate content; but lemonade powders with added Vitamin C, sweets including Vitamin B complex, and large amounts of peanut butter, which contains much Vitamin B complex, were provided.

Summary

1. There is reason to believe that during the last war the British Army received insufficient vitamins.

2. This is thought to be due to fallacies in estimating the actual vitamin intake, as opposed to theoretical vitamin contents of the diet, and to considerable variations in individual vitamin requirements under varying conditions.

3. Features, suggesting the existence of mild vitamin deficiency among soldiers and appearing when the vitamin content of the diet was persistently low, are described.

4. Curative properties of dried baker's yeast in boils are described and discussed.

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Lack of Vitamins in the War-Time Army Diet

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