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Famine and Infection in War-Time

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Abstract: The belief that nutrition has an effect upon susceptibility and resistance to infection seems logical and reasonable. The recorded history of mankinds demonstrates repeatedly the close association between war, famine and infection. Unfortunately, however, it must be admitted that the factual evidence supporting a causal relationship between poor diets and susceptibility to infectious diseases is far from satisfactory. However, there is no doubt that malnourished soldiers in war conditions often have a low resistance to an infection once it is established. Before considering these problems a brief summary of the defenses of the body against infection is given.

Key words: Famine, infection, war-time

There are four main lines of defence against infection. The skin and mucous membranes are the natural barriers that restrict the entrance of organisms into the tissues of the body. They include the skin, the cornea of the eye and the epithelial linings of the respiratory, gastrointestinal and genito-urinary traces. The integrity of these barriers naturally depends on the maintenance of a healthy and unbroken surface.

Any dietary deficiency that will vitiate the health of epithelial cells and restrict their powers of recovery from normal wear and tear might be expected to facilitate invasion by infective organisms (Davidson and Passmore, 1963).

Once the invading organism has gained a foothold within the body it then encounters the second line of defence which includes:

Phagocytes: The polymorphonuclear white corpuscles of the blood and the sedentary cells of the reticulo-endothelial system are able to ingest bacteria and remove them from the circulation. Furthermore, the uptake of bacteria (phagocytosis), which is crucial for an efficient defence against infection, was enhanced. Thus, recognizing and responding to 3OC12-HSL not only attracts the PMN to the site of a developing biofilm, but also reinforces their defence mechanisms and hence could be a means to control the infection in an early stage and to prevent biofilm formation (Wagner *et al*., 2006).

Antibodies: These protect the body against bacterial or viral invaders by combining with the proteins of the infecting microbes, interfering with their metabolism, causing them to clump together or die and neutralizing their toxic products. These antibodies circulate in the blood and are found in the gamma globulin fraction of the plasma proteins.

General systemic responses: The body often reacts to infection by developing fever.

The raised temperature indicates an increase of metabolic activity and may sometimes, in itself, create an environment unfavourable to the invading organisms (Davidson and Passmore, 1963).

An overview of the nutrition-immune response connection underscores the role of nutrition as a deterrent to infection. Malnutrition enhances the propensity to and heightens the intensity of infections by weakening the various host defense mechanisms. Thus: 1. Deficiencies of vitamin A, niacin, riboflavin, folic acid, vitamin B12, pyridoxine, ascorbic acid, iron and protein disrupt the tissue barriers to infection. 2. Protein-calorie, folate, iron, pyridoxine and zinc deprivations markedly depress the cell-mediated immune system. 3. Deficiencies of protein, pyridoxine, folic acid, pantothenic acid, thiamine, biotin, riboflavin, niacin-tryptophan, vitamin A and ascorbic acid inhibit humoral antibody formation in mammalian systems. 4. Vitamin A lack prevents the formation of lacrimal, salivary and sweat gland lysozymes. 5. Complement, properdin, interferon and transferrin concentrations are reduced in those nutritional deficiencies that interfere with protein synthesis. 6. Protein-calorie, iron and folate deficiencies impair phagocytosis by interfering with phagocyte microbial killing power or with phagocyte production. 7. Protein, ascorbic acid and zinc deficiencies retard wound healing that prevents spread of infectious lesions (Dreizen, 1979).

Wars have been directly responsible for many famines throughout history. Food shortages are an inevitable result of all wars and these can readily lead to famine conditions.

Starving soldiers rarely develop fever to the same degree as healthy soldiers, as it was mentioned also in Russia in 1943, in the Second World War among the

soldiers of the 2nd Hungarian Army (personal experience of T.P. survey officer 2nd Hungarian Army).

The onset of famine in nineteenth-century India resulted in the breakdown of normal social relations and produced a series of often dysfunctional behavioural responses. Survival strategies like the use of 'famine foods' and migration in search of food and work facilitated the spread of such epidemic diseases as cholera, dysentery, malaria and smallpox. Although many of these diseases are not normally thought of as having a synergistic relationship with malnutrition and hunger, they were linked to it (as the Madras famine of 1876-78 illustrates) through abnormal social and environmental conditions created by drought and an extreme crisis of substance (Arnold, 1993).

Trench fever, a louse-borne disease caused by Bartonella quintan, is reemerging in homeless persons. Epidemic typhus is another life-threatening louse-borne disease caused by Rickettsia prowazekii and known to occur in conditions of war, famine, refugee camps, cold weather, poverty, or lapses in public health. Badiaga S and al. reported the first case of seroconversion to R. prowazekii in a homeless person of Marseilles, France. This was associated with B. quintan bacteremia. Although no outbreaks of typhus have been notified yet in the homeless population, this disease is likely to reemerge in such situation (Badiaga *et al.*, 2005).

The rapid spread of infectious diseases among starving soldiers is attributable to the ease with the infecting organisms can pass from person to person as a result of overcrowding and the breakdown of normal sanitary arrangements. In the absence of all hygienic precautions that is responsible for epidemics rather than an increased susceptibility of the starving body to infective micro-organisms.

Whereas the relationship between poverty and infectious diseases is well established, the evidence that dietary deficiencies are important factors in protecting the body against infections is confusing and difficult to interpret.

Although there was a marked increase in tuberculosis during the Second World War, in general the widespread scarcity of food was not associated with epidemic diseases. In Greece in 1942 and in Holland in 1944-45 (Davidson and Passmore, 1963) and in Russia in 1943 among the soldiers of 2nd Hungarian Army were famine conditions (personal experience of T.P. survey officer 2nd Hungarian Army). After the war in Germany there was a marked deterioration in the available food supplies. Yet in none of these countries did epidemics of common infectious diseases arise.

Conclusion: It may be stated that a poor diet does not necessarily reduce the efficiency of the body's protective mechanisms against invasion by micro-organisms and so lead to increased susceptibility to infections. Poverty is closely associated with infectious diseases because overcrowding and the poor sanitary services greatly increase the risk of cross-infection.

These factors, together with a low level of natural or acquired immunity, appear to be usually more important than a lack of sufficient suitable foods in causing the spread of infectious diseases in soldiers.

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