



IMAGE AWARENESS WELLNESS INSTITUTE

The B3 Story: Pellagra

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August 2014

Volume 10: Issue 8

INTRODUCTION

Vitamin B3 or niacin is associated with one of the most horrible nutrient deficiency diseases. About three million Americans contracted pellagra and 100,000 died of the disease between 1907 and 1940.

Through the strenuous efforts of Dr. Joseph Goldberger the disease was conquered. Foods were fortified with niacin and the medical profession relegated this important vitamin to a place in the history books. Some researchers feel that failure to obtain optimal intake of this nutrient is more common than most imagine.

Physician Francesco Frapolli called it “pellagra” which means rough skin in Italian. This description does not even begin to describe the severity of the condition which came to be identified with the four “D’s”—diarrhea, dermatitis, dementia, and death. Pellagra so frequently began with digestive symptoms that one individual wrote, “Pellagra begins in the stomach.”

The dermatitis included scaling, hardening, peeling, and reddening of the skin, especially in areas exposed to sunlight such as the neck (called Casal necklace) and hands. Gasper Casal first described the skin lesions of pellagra in 1762.

Note carefully that severe deficiency of vitamin B3 is associated with skin conditions, intestinal problems,

and mental problems. This suggests that some of these conditions which are not as severe as what is seen in pellagra may benefit from supplementation with the nutrient.

Pellagra was associated with the adoption of corn, a new world plant, as a dietary staple. Corn became so popular that people gave up other foods such as fruits, vegetables, and dairy products. In 1786 Johann Wolfgang Goethe, a well-known German writer and naturalist, wrote “I believe the cause of this sickly condition is found in the continued use of Turkish and heath corn.” Corn is deficient in niacin, but it is also deficient in the amino acid tryptophan which the body can convert into niacin. A diet high in corn readily induced pellagra.

Pellagra was not a problem among the Aztec and Mayan peoples where corn originated. The corn (or maize) was soaked and cooked in an alkaline solution, usually limewater. The hull was also removed. This process was called nixtamalization. It increased the availability of niacin, improved the flavor and aroma of corn, and reduced fungal toxins.

Several individuals identified pellagra as a nutritional problem. Some thought it was tied to a corn poison or moldy corn. Others observed that a more varied diet would eradicate the disease. Explosive outbreaks of pellagra began to take place in the United States after 1905.

The cure for pellagra was actually discovered by Casimir Funk, a Pole, at the Lister Institute in London about 1911. Funk isolated the cure for beri-beri (thiamine) from rice and suggested that these new substances which caused diseases when they were missing in the diet should be called “vitamines.” Vitamins are not really amines, but the name stuck. The “e” was later dropped. Funk discovered nicotinic acid, the cure for pellagra, while seeking to isolate the cure for beri-beri. He set it aside because it was not the focus of his interest. Nicotinic acid or niacin would not be identified as the cure for pellagra for another quarter century!





Goldberger, Mary Farrar, "Dr. Joseph Goldberger: His Wife's Recollections," in *Essays on History of Nutrition and Dietetics*, ed. Beeuwkes, Adelia, Todhunter, E. Neige, and Weigley, Emma Seifrit, Chicago: American Dietetic Association, 1967, 284-287.

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<https://en.wikipedia.org/wiki/Nixtamalization>

JOSEPH GOLDBERGER

Joseph Goldberger was born in Giral, Hungary. He was the son of sheep herders. His parents emigrated to the United States after their sheep were decimated by illness. They opened a grocery store in New York. Goldberger was the fourth of seven children born to the family. He began his college education with the plans of becoming an engineer. In 1892 He heard a lecture by Dr. Austin Flint, Jr., that resulted in his enrollment in medical school.

Goldberger began his medical career in private practice in Pennsylvania, but he was soon drawn to the United States Marine Hospital Service which later became the U.S. Public Health Service. The Hygienic Laboratory for which Goldberger worked would later become the National Institutes of Health.

Goldberger's first government task was to inspect immigrants coming into New York for diseases. He earned the reputation of being a clever and unrelenting fighter of epidemics.

Goldberger became well-known for the way in which he addressed a serious problem with typhoid fever in Washington about 1902. This success was followed by work with other infectious diseases. Between 1902 and 1906 he battled yellow fever in the southern part of the United States,

contracting the disease himself. Here he met and married the love of his life, Mary Farrar who was the daughter of a wealthy New Orleans attorney.

Goldberger studied typhoid fever. He was then sent to Texas to deal with an outbreak of dengue fever. He contracted the disease. He then was sent to Mexico to fight typhus. He contracted this disease as well. Goldberger was in Detroit in 1914 battling diphtheria when he was asked by the surgeon general to turn his attention to pellagra.

An associate, Dr. Russell M. Wilder, wrote, "Every disease he studied, he acquired himself. He almost died from yellow fever in Tampico. He developed dengue fever in Texas, and diphtheria in Detroit. I knew him first when he was desperately ill with typhus fever in Mexico..."

Goldberger knew nothing about pellagra. He wrote his wife that he had never faced a task with greater reluctance. He had four young children and had been separated from his wife for six months.

He immediately set about learning what was known about the condition. He spent his days visiting orphanages, insane asylums and hospitals in the Southern United States where the disease was epidemic. He studied what was known about the disease at nights in hotel rooms and aboard trains.

Goldberger learned that 10,000 people died from the disease every year and more than 200,000 suffered with the condition. Goldberger noted staggering rashes, discoloring and irritation of parts of the skin exposed to sunlight, and insanity including one woman running along a country road as if pursued by demons. This last observation inspired Abram Hoffer to experiment with niacin as a treatment for schizophrenia.

The medical establishment of Goldberger's day was heavily influenced by the germ theory of disease

demonstrated by Louis Pasteur. Pellagra was generally considered an infectious disease. Goldberger had a mind of his own. By July of 1915 he had concluded that pellagra was a nutritional disease. Young babies who drank milk were protected and those who cared for sick children never contracted the disease. But how was Goldberger to persuade the medical establishment that lack of a nutrient could cause the disease?

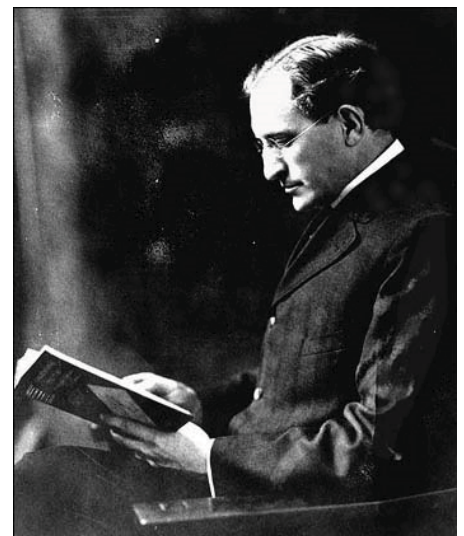
THE EXPERIMENTS

The Orphanage Experiment

A key turning point in Goldberger's understanding of pellagra resulted from an experience at a Baptist orphanage in Jackson, Mississippi. The children between the ages of 6 and 12 were consumed with pellagra. Older and younger children were free of the disease. Children over 12 were allowed to do odd jobs in the neighborhood. They spent the money they earned on better food. Goldberger added eggs, milk, lean meat and vegetables to the diets of the children. Pellagra disappeared in a few months.

The Prison Experiment

The medical community was unimpressed by Goldberger's ability to cure pellagra in an orphanage. For this reason he set himself the task of inducing pellagra in prisoners at the Rankin Farm Prison in the Mississippi State Penitentiary. The state gov-





ernor was persuaded to offer twelve prisoners a pardon if they were willing to participate in an experiment to induce pellagra over a six month period of time. These prisoners required courage as the disease was considered incurable and a terrible way to die at the time.

The prisoners were shocked when they learned that their diet was to consist of corn meal, grits, rice, white flour, cane syrup, sugar, sweet potatoes, pork fat, and small quantities of cabbage and collards. The prisoners thought the experiment was some sort of colossal joke. When the prisoners learned of the diet they fought for the opportunity to be part of the experiment and earn their freedom so easily.

Seven of the twelve prisoners developed pellagra within three months on this diet. Goldberger had demonstrated that he could induce pellagra by a nutritionally deficient diet. He then cured all of the prisoners with supplements of 30 grams of yeast, 200 grams of lean beef, and a quart of milk a day.

Goldberger was filled with excitement. He wrote his wife, "You have had a mighty tough time of it for two years now, but you have the satisfaction of knowing that your sacrifice has not been without return, for the work I have done, or better that you and I

have done, will be a milestone in the history of preventive medicine. The knowledge we have gained will be sure to save thousands of lives annually—thousands of lives of your own Southern people, not to mention the misery of many years of suffering and ill health of thousands of others."

Disbelief

Old medical ideas die a slow and difficult death. Goldberger was viciously attacked by his medical colleagues. One physician accused him of concocting "half-baked experiments. A professor of medicine accused him of faking his prison experiment. Goldberger did not respond publically to the criticism, but he wrote his wife of "the blind, selfish, jealous, prejudiced asses....braying forth their so-called criticisms."

To make matters worse on November 19, 1916 the prestigious Thompson-McFadden commission announced that pellagra was an infectious disease spread by the bite of the stable fly with no connection whatsoever to nutrition. The prominent medical men on the commission had each contributed \$15,000 of their own to conduct this research.

Filth Parties

Goldberger was faced with a dilemma. He was convinced pellagra was a nutritional issue, but the majority of the medical establishment was now convinced the disease was infectious. The lives of 10,000 people a year were at stake, not to speak of the hundreds of thousands of others who experienced the less serious symptoms of the disease.

Goldberger took drastic action. He announced to the news media that he would infect himself and his associates with the disease if such a thing were possible.

The researchers would swallow pills made of the skin scrapings, blood, feces, and urine from pellagra patients. Cotton swabs were run over

the nose and naso-pharynx of pellagra patients and transferred to the researchers.

Mary Goldberger begged her husband to allow her to participate in the experiment. The men refused to allow her to take the pills, but she was allowed to receive an injection of the blood of a woman dying of pellagra.

The results made headlines. No one died. No one even became ill. With one bold experiment Goldberger buried the concept of the infectious origin of pellagra. Even with this proof, however, some physicians remained staunch opponents of the dietary theory of pellagra, but Goldberger had turned the tide of the debate.

ACCEPTANCE

Pellagra was caused by poor diet. The greatest obstacle to dealing with the epidemic was the social conditions which existed in southern states. Tenant farmers and mill workers lived in grinding poverty producing and processing cotton. The price of cotton dropped dramatically in 1920 leading to a dramatic drop in income among these poor people. The cases of pellagra exploded.

President Harding secured appropriations for aid to the poor. Southerners denounced the aid fearing it would create a negative impression of the south and decrease tourism and investment.

Goldberger felt that land reform was necessary to eliminate pellagra. Ironically, it was the boll weevil that destroyed the cotton fields and forced the south to diversify its agriculture. The boll weevil first appeared in southeastern Alabama in 1909 and by the mid-1920's it had penetrated all cotton growing regions in the United States. Farmers who continued to grow only cotton were likely to go broke, while those that added other crops like peanuts were more likely to survive. Cotton would not be economically feasible until the introduc-



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tion of DDT following World War II.

Goldberger was keenly aware of the fact that faulty nutrition predisposed people to disease. This awareness of the relationship between diet and disease was largely lost after World War II and the development of antibiotics. The principle still holds true, however. Malnutrition not only leads to outright nutrient deficiency diseases, but it also weakens the immune system and makes individuals susceptible to microbial infections.

Recognition

Mary Goldberger longed for her husband to receive recognition for his achievement during his lifetime, but the medical community still refused to honor him for his achievement. A few weeks before his final illness his wife complained about his lack of recognition. He gave her a smile and said, "I know what I have done, and it is a satisfaction to my soul which no one on earth can take from me." On January 17, 1929 he died of cancer at the Naval Hospital next to his Hygienic Laboratory. His ashes were spread over the Patomac River in a ceremony presided over by a rabbi.

Goldberger received the recognition due him after his death. During

World War II the Merchant Marine named a ship after him. His portrait hangs in the Director's Building at the National Institutes of Health as an inspiration to the organization and a reminder of the need to correctly identify the cause of a problem.

Conrad Elvehjem

Dr. Conrad Elvehjem was a professor at the Agricultural College of the University of Wisconsin. He was inspired by Goldberger and chose to carry on his work after the death of the great pioneer. In 1937 he isolated the factor that cured pellagra. It proved to be the nicotinic acid discovered by Casmir Funk in 1911.

Elvehjem found that an extract from liver could cure diet-induced pellagra in chicks. He called the extract the vitamin G fraction after Goldberger. He induced black tongue in dogs, a condition similar to pellagra in humans, and cured the dogs with his vitamin G fraction. (Humans with pellagra often have a red swollen or cracked tongue.) Elvehjem later isolated vitamin B3 from the fraction.

Elvehjem's first graduate student in 1931 was Fredrick Stare who founded the department of nutrition at the Harvard School of Public Health.

The work of Goldberger and Elvehjem laid the foundation for significant future discoveries about the importance of vitamin B3. These discoveries will be discussed in a future newsletter.

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