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Vandenbroucke JP. Adolphe Vorderman's 1897 study of beriberi among prison inmates in the Dutch East Indies: an exemplar of scrupulous efforts to avoid bias

Commentary on: Vorderman AG (1897). Onderzoek naar het verband tusschen den aard der rijstvoeding in de gevangenissen op Java en Madoera en het voorkomen van beri-beri onder de geïnterneerden. Batavia: Jav. Boekh. & Drukkerij.

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The story of the detection of the cause and cure of beriberi, a debilitating neurologic disease due to vitamin B deficiency, is briefly described on this website in a commentary on the 1905 experiment by [William Fletcher](#), reported in the Lancet in 1907. Almost a decade earlier, Adolphe Vorderman, a Dutch physician working as a government health inspector in the Dutch East Indies, was interested in the problem of beri-beri in prison inmates. He was one of the first to set up a systematic study of beriberi in humans, and although his work was observational, it stands out because of his scrupulous attempts to avoid biases, even the bias of his own memory.

Vorderman described how in 1895 he had spoken with Christian Eijkman, just before the latter's departure for Europe due to ill health, who told him about his strange observations that chickens fed polished rice developed a neurological disease that might resemble beriberi, which disappeared when they were fed unpolished rice. This reminded Vorderman of a fleeting idea that he once had: that beriberi was never seen in some prisons but a lot in others. He thought that this might coincide with the type of rice that the inmates received: "whole" or unpolished "red rice"; or "peeled" or polished "white rice".

In order not to rely on his own observations and memory, Vorderman wrote to all of the prison medical officers on two large islands of the Dutch East Indies, including those at prisons that he had never visited himself. He asked them (i) whether they had seen beriberi in the prisons for which they were responsible, and (ii) what type of rice was being given to the inmates. (see page 2)

"My remark, that in accordance with the results of his (Eijkman's) experiments with poultry, I recalled never to have seen Beri-beri in prisons where red rice was used as the main nutrition but that I had always seen white rice given as the main nutrition in prisons where Beri-beri occurred, prompted Dr Eijkman to ask me whether he might use this at some point in time. For my part, there was no objection. Only, I wished first to have data from all prisons of Java and Madoera, not only for the sake of completeness, but also to verify whether this peculiarity was also present in the prisons that I had not so far visited."

"Therefore, I wrote a letter to all Heads of the Local Governments, with questions about the main type of nutrition of the prisoners, and about the occurrence of Beri-beri among these people, without, however, mentioning any possible relation between these two factors."

As the results of his survey confirmed his impression, he requested and was granted permission to proceed to a more extensive investigation. He visited all prisons on several islands in the Dutch East Indies, to collect specimens of the food given to the inmates, and to personally check records of the occurrence of beriberi. The latter was often documented quite well since beriberi in its end stages was grounds for release from prison (hence, some simulated disease also prevailed!).

Vorderman was much preoccupied with the possibility of bias - even if he did not use the word, or refer to any theoretical textbook describing the notion. His mission had the official aim of "looking into the health status of

prison inmates". However, the element that had to do with the food sampling was kept an official secret (!), to prevent the possibility that rumours about the investigation might lead the local suppliers of the food to the prisons to change the kind of rice that they provided. (see page 3)

"Mention of this special part of the aim of the visit was kept secret, however, to prevent it becoming known, and so that the Chinese suppliers who delivered the food would show types of rice other than the one they usually provided." (page 3)

In each prison he visited, he went personally to the food supply, sampled it and mailed it under seal to the capital, Batavia, for further analysis. To keep the mission secret he refrained from making any comment about whatever he found locally, even if the condition of the food was appalling.

"Even if the rice was of inferior quality, or if there were other remarks to be made about the food, these were temporarily withheld, to prevent the Chinese suppliers guessing the special aim of the mission, and warning each other about my visit." (page 5)

In each prison, he obtained statistics of beriberi relating to the year before his visit. Several experts had to analyse and classify the rice samples by origin and composition. Laboratory assistants removed impurities, checked chemical composition, and used the services of a local Chinese rice vendor with a good knowledge of the types of rice for analysis of the samples. However, all were kept unaware of the origins of the samples by marking the bottles only with letters.

"The expert [who assessed the rice, transl.] did not know anything about the places where the samples were taken, because they were presented to him by the dozen, in small bottles marked only by a letter or number. His brief was: determine whether the rice came from Saigon, Rangoon or Siam." (page 5)

After initial verification, each batch of 20 samples was shown to a European rice vendor who sat on a committee with the acting medical director of the laboratory, Dr Roll, and a local officer of health of Batavia, Dr Grijns (who had taken over Eijkman's work when Eijkman had to retire). It soon dawned on Vorderman that many mixtures of rice were present, not just a contrast between "white polished" and "red unpolished", so he developed a finer classification. He also went one step further in his attempts to be as "unpartisan" as possible (as he called it himself): only after the finer classification of the rice samples had been applied, and each prison assigned to one of the categories of rice, did he communicate his findings about the statistics on beriberi among the inmates in each prison to his medical colleagues.

"Only after the categorisation of the different prisons according to the types of rice had been established were the statistics that I had collected about Beri-beri sufferers and prisoners given to the above named medical doctors, to be ordered in the columns of appendix 10." (page 58)

The results of his analysis were eventually in his report, showing the strong association between type of rice and frequency of Beri-beri.

Although Vorderman's 1897 report mentions that beriberi had disappeared in prisons and the army when the type of rice had been changed, it attracted severe criticisms. His critics suggested that he had not ruled out an infectious cause of the disease, superimposed upon malnutrition; that other nutritional factors might be playing a role; and so on. These criticisms led to more experimental studies in chickens (amongst others by Grijns) and more investigations in humans.

A controlled trial of mung beans among mental patients was published by Hulshoff Poll in 1902 - showing that there was no beriberi in the pavilions where patients were given mung beans, in contrast to the inmates pavilions where the rice had been disinfected (as a precaution against infection!), where 42% had beriberi. Strangely, the author of these observations concluded that the cause of the disease was infectious nevertheless, reasoning that the addition of mung beans had led to better nutrition and therefore less infection. This incorrect inference might be why this interesting experiment has not survived in medical memory.

Others who believed in a nutritional origin of beriberi included Baron Takaki, who blamed the beriberi in the Japanese army in 1882 on a diet with too high a proportion of carbohydrates. In 1906 he reported that a subsequent change of nutrition in the army had virtually wiped out the disease. However, experimental work by Eijkman and his successors clearly pointed to an anti-beriberi factor in unpolished rice - and maybe also in some other nutrients. Experimental evidence in humans came with the results of the controlled trial done by [William Fletcher](#), reported in 1907. As described in the commentary attached to Fletcher's report, this work ultimately led to the discovery of vitamin B1, and the award of a [Nobel prize](#) to Eijkman and Frederick Gowland Hopkins, a biochemist in Cambridge, UK.

Further reading:

Carpenter KJ (2000). *Beriberi, white rice and Vitamin B: a disease, a cause, and a cure*. Berkeley: University of California Press.

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