

Kanehiro Takaki and the control of beriberi in the Japanese Navy

Yoshifumi Sugiyama¹ and Akihiro Seita²

¹The Jikei University School of Medicine, Tokyo 105-8461, Japan

²United Nations Relief and Works Agency for Palestine Refugees in the Near East, Amman 11814, Jordan

Corresponding author: Yoshifumi Sugiyama. Email: h19ms-sugiyama@jikei.ac.jp

Introduction

Kanehiro Takaki (1849–1920) was a Japanese naval medical officer at the end of the 19th and the beginning of the 20th centuries. At that time, beriberi – a feared and often fatal disease – was prevalent throughout Japan and in many Southeast Asian countries.^{1,2} Takaki used an epidemiological approach – which was then unfamiliar in Japan – to study the disease. He showed that it was caused by a nutritional deficiency and demonstrated how it could be prevented and treated. Takaki's research led to the eradication of the disease in the Japanese Navy more than 30 years before the specific cause of beriberi was shown to be a deficiency of vitamin B₁.

Apart from his epidemiological research, Takaki worked hard to promote what we would today call 'patient-centred' medicine. In 1881, he founded the Sei-I-Kwai Koshujo (the Sei-I-Kwai Medical Training School), not only to impart medical knowledge and skills but also to teach students to empathize with patients, an approach continued to this day in the Jikei University School of Medicine. The following year Takaki founded a charitable hospital – the Yushi Kyoritsu Tokyo Byoin – to serve the poor, and this was the predecessor of today's Jikei University Hospital. Recognizing the key role played by nurses in good healthcare, Takaki also founded the first nursing school in Japan – the Kangofu Kyoiku-jo (now the Jikei Training School for Nurses).

Early life

Who was this remarkable man? Kanehiro Takaki was born in Takaoka-cho, Miyazaki Prefecture, on 15 September 1849. He was the first son of Kisuke and Sono Takaki. Kisuke was a lower-class samurai serving the Satsuma Domain and made a living as a carpenter in peace time. As a child, Kanehiro Takaki

admired the local village doctor, and this made him aspire to study medicine. In 1866, he began to study medicine under Ryosaku Ishigami, who practised Western medicine introduced to Japan from the Netherlands, and thus known locally as 'Dutch medicine'. Two years later, Takaki served as a medical officer with Ishigami in the Boshin Civil War. It was during this war that he witnessed an English doctor, William Willis, operating on the wounded, and he became drawn to aspects of British medicine. The following year, under Willis, he began to study the English and Latin languages as well as British medicine.^{3,4}

In 1872, Takaki became a medical officer in the Japanese Navy. Apart from treating the sick and wounded, he became aware of the large number of sailors suffering and dying from beriberi. On an average, members of the Japanese Navy developed the disease more than four times a year. The cause of the disease was unknown however, and no effective treatment had been identified. Takaki decided to address these serious problems, and thought that study abroad would help him to do so. In 1875, he entered St. Thomas's Hospital Medical School in London, and spent five years studying there.

Epidemiological studies of beriberi

In 1880, when Takaki (now aged 31) returned to Japan, beriberi was still prevalent: one in every three members of the Navy suffered from it. Using the epidemiological methods he had learned in the UK, Takaki researched the relationship between beriberi and living conditions in the Navy. He documented the frequency of the disease among officers, petty officers, sailors and prisoners, and found that the rate was highest among prisoners, lower among sailors and petty officers and lowest among officers.⁵ He found the same social pattern among the civilian

population⁶: students and shop-boys suffered most and the upper classes were rarely affected.

Takaki thought the fact that fewer people were diagnosed with beriberi in the wealthier social classes indicated that the disease might be associated with the quality of their diets, so he examined the content of meals served in the Navy, analysing them nutritionally.^{5,6} Although the ratio of nitrogen to carbon in the diets of healthy adults was 1:15.5, he found that it ranged between 1:17 and 1:32 among sailors,⁶ and that a ratio of greater than 1:28 was almost always associated with beriberi.⁷ Based on these findings, he hypothesized that beriberi was caused by a diet insufficient in nitrogenous elements, what we would now call protein. Takaki proposed that meals richer in protein should be provided by the Navy to prevent and treat beriberi, and his proposal was adopted in 1884.

The voyages of the *Ryujo* and the *Tsukuba*

At around the same time, an event occurred that would support his hypothesis. The training ship *Ryujo* had sailed from Shinagawa on 19 December 1882 and returned there on 15 October 1883, after calling at New Zealand, Chile, Peru and Hawaii. During the voyage, 169 (44.9%) of the 376 crew members had developed beriberi and 25 (6.7%) of them had died. The *Ryujo* had to stop over in Hawaii because too many of the crew were unfit to continue the voyage. The nitrogen to carbon ratio had been 1:28 in the meals of sailors, 1:25 in those of petty officers and 1:20 in those of officers. After taking on meat and vegetables, however, those who had been ill had recovered.

After learning of the experience of the crew of the *Ryujo*, Takaki learned that another training ship – the *Tsukuba* – was due to sail from Shinagawa to Hawaii, Russia and Korea before returning home. He saw an opportunity to do a controlled comparison of the new, protein-rich naval menu on the *Tsukuba*, with the former diet on the *Ryujo*. To hold other factors as similar as possible, he persuaded senior government officials to order the *Tsukuba* to follow exactly the same course as the *Ryujo* had used. The ratio of nitrogen to carbon in the meals was set to be 1:15, which, according to Takaki's hypothesis, would protect the crew from beriberi.

The *Tsukuba*, which had left Shinagawa on 3 February 1884, returned there on 16 November 1884. During the voyage only 14 (4.2%) out of the 333 crew members had developed beriberi and none of them had died. Furthermore, it turned out that these 14 patients had not taken meals based on the new menu. The comparison of results of the two ships

revealed the relationship between the frequency of beriberi and dietary protein intake.

The elimination of beriberi in the Japanese Navy

After the new naval menu had been adopted, the number of beriberi patients in the Japanese Navy decreased dramatically, and the disease was finally eliminated within a few years. The increase in protein intake had eliminated beriberi because the amount of protein in the diet correlates with the amount of vitamin B₁. Although Takaki was not aware that beriberi is caused by deficiency of vitamin B₁, he had shown that the cause of the disease was a nutritional deficiency and had established empirically how to prevent and treat it.

After this great achievement, Takaki was appointed Navy Surgeon General in 1885, received the degree of Doctor of Medical Science (the first person to do so in Japan) in 1888, and was elevated to the peerage in 1905. The following year, Baron Takaki returned to St Thomas' Hospital in London to give three lectures on 'The Preservation of Health amongst the Personnel of the Japanese Navy and Army'. These were subsequently published in *The Lancet*.^{6,8,9} It was in the second of these papers⁸ that Takaki refers to the comparison between the *Ryujo* and the *Tsukuba*, stating that he was 'greatly satisfied with the results, as shown in Table I'. However, there is no Table I comparing the frequency of beriberi in the two ships in this *Lancet* article, or in either of the other two articles.^{6,9} The missing Table was added to Japanese translations of the *Lancet* articles published in 1985,¹⁰ and a scan of this Table has been added in the James Lind Library.

In 1915, Kanehiro Takaki received the 'Grand Cordon of the Order of the Sacred Treasure', one of the highest decorations in Japan. He died in 1920, and received posthumously the 'Grand Cordon of the Order of the Rising Sun' in that year. In 1959, a peninsula in Antarctica – The Takaki Promontory (65° 33' 0" S, 64° 34' 0" W) – was named after him.

Declarations

Competing interests: None declared

Funding: None declared

Ethical approval: Not applicable

Contributorship: YS reviewed the literature and drafted the manuscript; AS refined the manuscript.

Acknowledgements: The editor of the James Lind Library is grateful to Masamichi Kitagawa, Main Library, Jikei University School of Medicine, for his assistance.

Provenance: Invited contribution from the James Lind Library

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