

# Investigation of unknown deaths linked to Vitamin B1 Deficiency in Khammouane Province, Lao PDR, 2018

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## Abstract:

Vitamin B1 deficiency (beriberi) is a significant public health issue, manifesting in cardiovascular, neurological, and other systemic symptoms. This investigation was prompted by reports of patients presenting with symptoms such as fever, stomachache, and headache, followed by sudden deaths. Active case finding and retrospective data collection through patient records from various health facilities across the province were conducted between 1 June 2018 and 19 September 2018. A total of 224 cases were identified, including 8 deaths (CFR = 3.57%). Most patients (51.3%) were female, although all deaths occurred in males. Ages ranged from 1 to 75 years, with a mean age of 33 years. The most affected age group was 10-20 years (24.1%), followed by 30-40 years (17%). Common symptoms included paraesthesia in legs and/or hands (100%), oedema in legs (36.36%), nausea (18.75%), and chest tightness and fatigue (13.39%). Affected individuals predominantly consumed rice, salt, and bamboo shoots, with limited dietary diversity. Poor sanitation and recent flooding likely exacerbated the outbreak. The investigation concluded that the unknown deaths were primarily due to Vitamin B1 deficiency. These findings highlight that immediate actions, including Vitamin B1 distribution, nutritional interventions, and health education, are essential to prevent future outbreaks.

**Key words:** vitamin b1 deficiency; beriberi; epidemiological investigation; lao pdr

## Introduction

Thiamine was the first vitamin identified (vitamin B1) many years ago. It functions as a catalyst in the generation of energy through decarboxylation of branched-chain amino acids and alpha-ketoacids and acts as a coenzyme for transketolase reactions in the form of thiamine pyrophosphate. Thiamine also plays an unidentified role in propagating nerve impulses and taking part in myelin sheath maintenance.[1]

Thiamine deficiency can affect the cardiovascular, nervous, and immune systems, as commonly seen in wet beriberi, dry beriberi, or Wernicke-Korsakoff syndrome. Worldwide it is most widely reported in populations where polished rice and milled cereals are the primary food source and in patients with chronic alcohol use disorder. Dry beriberi presents as symmetrical peripheral neuropathy, while wet beriberi presents with high-output heart failure. Wernicke-Korsakoff syndrome (WKS) can

manifest with CNS symptoms such as gait changes, altered mental status, and ocular abnormalities.[2]

Globally, thiamine deficiency remains a significant health issue, particularly in regions with high rates of food insecurity and diets predominantly consisting of polished rice or highly refined carbohydrates<sup>1</sup>. It is most prevalent in areas where dietary intake of thiamine is low, and among populations with increased physiological needs or impaired absorption, such as those with alcohol use disorder. [3]

In France, from September 2013 to July 2014, a Vitamin B1 deficiency outbreak occurred among gold miners, resulting in 42 cases and 1 death. The affected individuals experienced symptoms including oedema, heart problems, and other combined symptoms, often exacerbated by dietary issues, overwork, and infectious diseases. Of the 42 cases, 30 showed

improvement after receiving a 500 mg dose of Vitamin B1 intravenously or intramuscularly. [4]

In Southeast Asia, thiamine deficiency is a persistent problem, particularly in Lao PDR and Thailand. Outbreaks of beriberi have been documented among specific populations, such as fishermen and gold miners, due to their limited dietary diversity and high physical demands. [3]

In Thailand, an outbreak of Vitamin B1 deficiency disease affected 28 fishermen, with 15 cases meeting the case definition and resulting in 2 deaths, an attack rate was 53.6%. All affected individuals were men, with ages ranging from 20 to 45 years, and an average age of 28 years. Laboratory sampling confirmed 3 cases. The patients presented symptoms such as oedema (60%), chest tightness (54%), and dyspnea (27%). Their diet primarily consisted of seafood and rice. [6]

In Lao PDR, thiamine deficiency has been a recurring issue, particularly among vulnerable populations. Finding from a study in 1990 highlighted significant cases of beriberi. More recent studies have shown that thiamine deficiency remains prevalent, especially among infants and breastfeeding mothers. For instance, a study found that a significant proportion of sick infants admitted to hospitals had biochemical markers of thiamine deficiency, contributing to high mortality rates. Another study in northern Lao PDR reported high infant mortality rates linked to thiamine deficiency among ethnic groups [5]

In August 2018, the provincial epidemiological team of Khammouane Province, Lao PDR, reported unknown deaths among individuals aged 16-20 years with symptoms such as fever, stomachache, and headache, followed by sudden deaths. The national and provincial investigation team was formed to conduct an outbreak investigation. The objectives of this study were to investigate the unknown death cases, collect and analyze data to identify the cause of deaths, and implement primary prevention and control measures.

## Methods

An active case finding and retrospective data collection were conducted in six affected districts reporting cases and deaths. Cases were defined as individuals presenting with paraesthesia in the legs and/or hands, oedema, combined with fever or no fever, and/or nausea, vomiting, stomachache, or chest tightness, along with facial paraesthesia and paraesthesia in both hands and legs, reported in any health service facility in Khammouane Province from 1 June 2018 to 19 September 2018. Data collection tools involved structured questionnaires for interviews with medical personnel, affected families, and village leaders. A medical record review at health facilities was conducted for the same period. Data were entered into Excel and analyzed for demographics, mean age, percentage distribution of symptoms, attack rates, and case fatality rates.

## Result

A total of 224 cases were identified, including 8 deaths (CFR = 3.57%). Females were more affected than males, accounting for 51.3% (115/224) of cases. Ages ranged from 1 to 75 years, with a mean age of 33 years. The most affected age groups were 10-<20 years (24.1%, 54/224), 30-<40 years (17%, 39/224), and 40-<50 years (17%, 38/224) 1.

The distribution of cases and deaths was as follows: Boualapha District had 86 cases with 6 deaths; Mahaxay District had 68 cases with 2 deaths;

Xaybouathong District had 39 cases; Xebangfay District had 30 cases; and Thakeak and Nhommalath Districts each had 2 cases 2.

The initial 6 death cases were reported in 5 villages in Boualapha District. Most presented symptoms such as paraesthesia in the legs, concave oedema, and after 5-6 days, digestive symptoms like nausea, excessive vomiting, abdominal pain, but no diarrhea, followed by fatigue, anxiety, chest tightness, and death. All deceased were male. Rapid tests for malaria pathogens in the 8 deceased cases were negative. None of the deceased had pre-existing conditions, except for one case from Xoy village with a history of asthma. In addition, findings from personal health interviews revealed that most deaths occurred after patients presented late to health facilities in critical condition

Symptoms included paraesthesia in the legs and/or extremities (100%), oedema in the feet and/or legs (36.36%), nausea (18.75%), fatigue (13.39%), and paraesthesia (7.14%). Some patients showed improvement after receiving Vitamin B1.

The main occupation was farming, and affected individuals lived in unclean village environments. They predominantly consumed rice, salt, and bamboo shoots, with limited dietary diversity. Patients did not drink alcohol. There was no information on narcotic drug use, consumption of mushrooms, wild animals, toads, or insects, and no injuries upon hospital admission. No village events such as weddings or ceremonies were reported. Flooding in July 2018 may have contributed to food insecurity, leading to a nutritional health situation.

## Discussion

The symptoms and mortality patterns strongly suggest Vitamin B1 deficiency compounded by infectious diseases. Blood specimens were not collected, and diagnoses were based on clinical symptoms. Testing to confirm Vitamin B1 deficiency was limited in affected areas. Many patients arrived at health facilities too late, leading to severe conditions and delayed diagnosis and treatment. This finding underscores the need for improved health education and early presentation at appropriate healthcare facilities

Dietary patterns consisting of rice with salt and bamboo suggest a lack of nutritional diversity, contributing to the deficiency. The flooding in July 2018 in affected areas may have exacerbated the situation by causing food insecurity as well as water and food-borne diseases, further complicating the health landscape

The findings are consistent with previous studies on Vitamin B1 deficiency and Beriberi. The demographic distribution and symptoms align with known clinical manifestations. The public health implications underscore the importance of Vitamin B1 supplementation and nutritional education to prevent future outbreaks. Comparisons with other studies highlight the need for timely diagnosis and treatment to reduce mortality rates

## Conclusion

This study identified Vitamin B1 deficiency as a significant cause of unknown death cases in Khammouane Province in 2018. The findings emphasize the need for improved surveillance, timely diagnosis, and treatment to prevent severe outcomes. Immediate actions, including Vitamin B1 distribution, nutritional interventions, and health education, are essential to prevent future outbreaks. Addressing dietary deficiencies through raising community awareness and improving access to diverse

and nutritious foods are crucial steps. Limitations of the study include the retrospective nature of data collection and the reliance on symptomatology for diagnosis. Future studies should focus on prospective data collection and the use of blood specimens to confirm diagnoses.

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