Toward the Construction of a Knowledge Graph from Japanese Food Ontology for the Prevention of Frailty

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Abstract

Food is an important component of human health. We are working on a prototype of a Japanese food ontology to study the intake of nutrients through diet. As an application of this ontology, a knowledge graph contributing to the prevention of frailty was studied. Although traditional diagnostic methods for preventing frailty have been established, more accurate prevention of frailty is expected to be possible by taking into account variations in intestinal bacteria, genes, and proteins due to food intake, as well as individual differences in genetic polymorphisms.

Keywords

Knowledge graph, Ontology, Food ontology, Frailty, Sarcopenia

1. Introduction

Nutrition is a key component of good health. However, many individuals may face challenges in obtaining sufficient nutrition due to factors that affect their health, such as allergies. To conduct nutritional research that yields reliable and comparable results, it is necessary to use uniform terminology and appropriate food descriptions. Consequently, there is a demand for a computer-readable Japanese food ontology that can accurately represent the characteristics and relationships of various foods. We therefore developed a prototype ontology of Japanese food (Figure 1) based on the food groups listed in the National Health and Nutrition Examination Survey published by the Ministry of Health, Labour and Welfare of Japan. This ontology can be used for various health-related research topics, one of which is the prevention of frailty.

Frailty is a condition of vulnerability and decreased physiological reserve in older adults. Sarcopenia is a disorder characterized by the loss of muscle mass and strength. A survey of

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middle-aged and older adults aged 40 and over living in Settsu City, Osaka Prefecture, revealed that a certain proportion of them had frailty or sarcopenia even in their 40s and 50s. Since frailty and sarcopenia may affect not only the elderly but also the working-age population, early prevention is necessary. To prevent frailty and sarcopenia, it is important to improve lifestyle habits such as diet and exercise. People who perceive themselves as heavier than they actually are may have low muscle mass, which should be taken into account.

A knowledge graph with guidelines derived from previous frailty prevention studies is expected to contribute to more accurate frailty prevention. Genome-wide association studies (GWAS) have identified single nucleotide polymorphisms (SNPs) associated with frailty. The presence of SNPs suggests that individual differences in frailty prevention may occur. It has also been reported that the gut microbiota environment, which is influenced by food intake, is involved in the expression of messenger RNAs (mRNAs) and microRNAs (miRNAs), and vice versa, the expression of mRNAs and miRNAs, which are influenced by food intake, affects the gut microbiota environment. This suggests that the possible knowledge graph for frailty prevention can be very complex with other factors.

2. Result

The constructed knowledge graph schema is Figure 2.

The red dashed line represents the conventional diagnosis of frailty. This figure shows the various factors that influence frailty, including food and other diagnostic criteria. Food is divided into different nutrients by using an ontology that we are developing. Food intake affects the changes in genes, proteins, and gut microbiota. There are also interactions among genes, proteins, and gut microbiota, which can vary depending on the individual. For example, genetic polymorphisms can cause individual differences in genes, which can affect the susceptibility to diseases and the other components of frailty diagnosis.

3. Discussion

This study only prototyped a knowledge graph for preventing frailty, and whether this one will be effective or not needs to be demonstrated using various data from the actual cohort.

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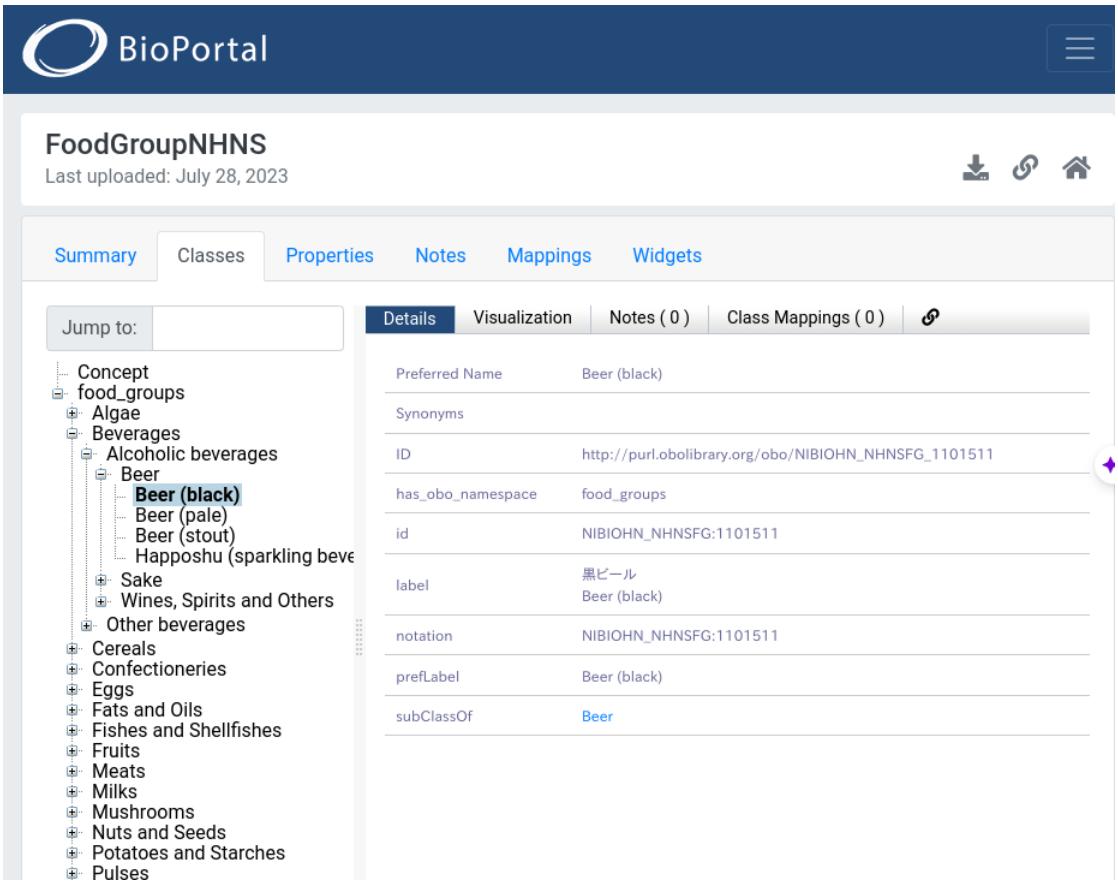

Figure 1: Classes view of FGNHNS registered on BioPortal. (https://bioportal.bioontology.org/ontologies/FGNHNS).

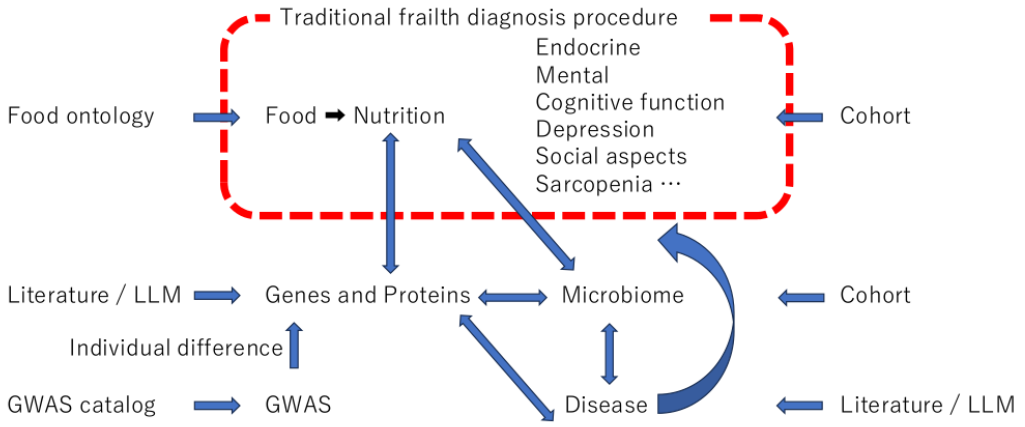

Figure 2: Developed a knowledge graph schema to prevent frailty