博士論文題目

Analyzing health status using questionnaires:
Assessment of glucose metabolism status and water intake

質問票による健康状態の分析：糖代謝状態および水分摂取量の評価

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（論文内容の要旨）

Increasing national medical expenses in a super-aging society is a severe issue. Therefore, everyone should monitor their own health status and prevent disease. Then, a simple method to assess health status is needed. This study addressed the following two challenges. The first was water intake assessment. Maintaining adequate water intake is essential for physical and mental health. Then, a previous study validated a descriptive dietary record method to assess water intake. However, the challenge with this method was that it took much time to fill out the dietary survey and re-input the written text data into numerical data. Therefore, we aimed to establish a simpler method: the selective recall method. In a clinical trial, participants recorded the food and beverages consumed via a multiple-choice questionnaire. Then, we multiplied the obtained data by the water conversion factor for cooking to calculate water intake. At the same time, we assessed the same water intake by the descriptive dietary record method. As a result, there was a strong correlation between the water intakes by the two methods ($r = 0.94$, $p < 0.0001$). In addition, water intakes by the two methods from non-alcoholic beverages ($r = 0.94$, $p < 0.0001$), alcoholic drinks ($r = 1.00$, $p < 0.0001$), and food ($r = 0.72$, $p < 0.0001$) were also strongly correlated. Therefore, the selective recall method was shown to assess water intake accurately. The second was identifying glucose metabolism status. Worldwide, 463 million people have diabetes. It is necessary to understand one's glucose metabolism status to take appropriate measures to prevent diabetes. Therefore, we aimed to identify the glucose metabolism statuses using a questionnaire. In a clinical trial, participants underwent an oral glucose tolerance test (OGTT) and completed a lifestyle and physical characteristics questionnaire. In the OGTT, participants intake 75 g glucose solution. Then, blood glucose and insulin levels were measured before and 30, 60, 90, and 120 minutes after glucose intake. We classified them into four

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（論文審査結果の要旨）

The thesis proposed two methods to analyze health status using questionnaires. The first contribution is a development of a simpler water intake assessment method: the selective recall method. In a clinical trial, participants recorded the food and beverages consumed via a multiple-choice questionnaire. As a result of the trials, it was shown that there was a strong correlation ($r = 0.94$, $p < 0.0001$). between the water intakes by the selective recall method and the descriptive dietary record method. The second contribution is a development of a method identifying glucose metabolism status. The thesis aimed to identify the glucose metabolism statuses using a questionnaire. In a clinical trial, participants underwent an oral glucose tolerance test (OGTT) and completed a lifestyle and physical characteristics questionnaire. The glycometabolic types are classified into four categories based on the OGTT results: Category 1: best glucose metabolism, category 2: low insulin sensitivity, category 3: low insulin secretion, and category 4: low insulin sensitivity and secretion. The proposed machine learning model using questionnaire responses successfully identified the glycometabolic category in 0.68 (95%CI: 0.62–0.75), 0.66 (0.58–0.73), 0.61 (0.51–0.70), and 0.70 (0.62–0.77) for category 1 and others, 2 and others, 3 and others, and 4 and others, respectively.

The thesis research has a strong potential to contribute to health status monitoring. A series of research resulted in two high-quality peer-reviewed international journals, and two peer-reviewed international conference papers. As a result of the discussion in the thesis committee, the thesis is sufficiently qualified as a Doctoral thesis of Engineering.