CREATIVE SCIENCE

CREATIVE SCIENCE

Journal home page: csj.snru.ac.th

Development of beverage nutritional assessment application; sugar, fat and sodium for diabetes mellitus

Sujitranan Mungklachaiya [a] Naruwan Yusamran [b*] and Suradech Chaitokkia [c]

[a] *Information Technology Department, Science and Technology Faculty, Loei Rajabhat University, Loei, 42000, Thailand*
[b] *Computer Science Department, Science and Technology Faculty, Loei Rajabhat University, Loei, 42000, Thailand*
[c] *Food and Nutrition Department, Science and Technology Faculty, Loei Rajabhat University, Loei, 42000, Thailand*

Article history:

Received: 09-05-2025
Revised : 30-05-2025
Accepted: 31-05-2025
Published: 09-06-2025
DOI : 10.55674/cs.v17i3.262068

Keywords:

computer application;
beverage nutritional assessment;
diabetes mellitus;

Abstract

The purpose of this research was to the development of beverage nutritional value assessment application for diabetes mellitus risk group. The nutritional information was collected for 422 popular beverages in the THAT-Tambon Municipality, Chiang Khan District, Loei Province. This included 392 items from convenience stores with Guideline Daily Amounts (GDA) labels that an overview of the nutritional content as the percentage of energy and key nutrients like energy, fat, saturated fat, sugar, and salt/sodium as a percentage of what an average person should consume in a day, and 30 from local cafes, with nutritional content determined by food and nutrition experts through ingredient analysis. The beverages were categorized into 11 groups, including milk and dairy drinks, juices, carbonated drinks, grain-based drinks, coffee, tea, herbal drinks, and others (e.g., Oleang, Plum Lemon, Jelly Shake). The average sugar content was approximately 15.6g per serving, indicating high-moderate sugar levels that require cautious consumption. The application comprises three modules: (1) an administrator module for managing beverage and user data, (2) a general user module for searching beverages, viewing nutritional information, assessing dietary intake, and planning daily consumption, and (3) a member module with additional features for saving and retrieving personal beverage records. The application was developed using HTML5, CSS, JavaScript, PHP, and connected to the relational database using MySQL. Research tools included questionnaires and nutritional analysis based on standard methods. A preliminary evaluation by five software experts showed high effectiveness ($\bar{X}$= 3.84, S.D. = 0.15), and user satisfaction from a group of 14 target users was also high ($\bar{X}$= 4.10, S.D. = 0.37). The application is expected to support health awareness and help reduce the risk of diabetes by promoting informed beverage choices.

*** Corresponding author** : naruwan.yus@lru.ac.th
© 2025 Creative Science Reserved

1. Introduction

Diabetes is a global problem in public health with an increasing trend that is an important cause of death and disability. This problem affects people of all ages and genders worldwide. If it is not properly managed, it can lead to serious complications such as heart disease, chronic kidney disease, vision loss and organ amputation. In 2021, it was reported that approximately 529 million people worldwide have diabetes, and it is expected to increase to 1.31 billion by 2050 [1]. Especially in regions with low to medium Social Demographic Index (SDI) that are affected by population growth and epidemiological changes. In Asia, the diabetes situation is alarming as it has the highest number of patients in the world. The main risk factors include urbanization, changing lifestyles and unhealthy dietary habits. Many countries in this area are facing the challenge of managing the rapidly increasing number of patients which has a direct impact on healthcare systems and economies in the long term [2]. Diabetes mellitus is classified into four main types: Type 1, Type 2, Gestational Diabetes Mellitus, and other specific forms. Among these, Type 2 diabetes mellitus (T2DM) predominates globally, largely attributable to lifestyle factors, notably excessive dietary sugar consumption, underscoring its critical public health impact [3].

Consumption of foods and beverages high in sugar, fat and sodium is a significant risk factor affecting the development and control of T2DM especially among those with unstable blood sugar. Excess energy intake from such nutrients is associated with central obesity and insulin resistance which exacerbates the disease. A study by Ismawanti et al. [4] found a correlation between sugar, salt, and fat intake and waist-to-hip ratio that is an indicator of obesity related to diabetes risk. Meanwhile, it has been reported that high-sugar beverages are the cause of chronic inflammation and significantly increase the severity of disease in diabetic patients. These effects not only directly affect health but also create a burden on the healthcare system in the long term [5]. Therefore, prioritize sugar content when choosing beverages such as a study by Sridonpai et al. [6] categorized drinks into four levels based on amount of sugar per 100 mL: Extreme High Sugar-Sweetened Beverages (SSB) (over 24g), High SSB (13-24g), High-moderate SSB (7-12g), and Healthier Choice (≤6g). Meanwhile, the amount of drinking each person per day varies depending on gender, age, weight, height, occupation, and underlying diseases such as diabetes [7].

In Thailand, the 6th National Health Examination Survey (2019–2020) reported an increase in the prevalence of diabetes among individuals aged 15 years and older, rising from 8.9% to 9.5%. More recently, data from the Health Data Center of the Ministry of Public Health (2023) revealed that approximately 371,000 new diabetes cases are diagnosed annually, with a cumulative total of over 3.4 million patients. Alarmingly, about 70% of these patients are unable to control their blood sugar levels effectively. This trend highlights significant public health challenges, including the growing burden of chronic disease, inadequate glycemic control, and the need for effective diabetes prevention and management strategies. These issues underscore the urgency of developing context-specific innovations and health interventions to support sustainable disease control in Thai communities.

Many countries have therefore implemented control measures such as taxation, nutrient restriction legislation and promotion of the reduction of sugar, fat, and salt in food products to create a health-promoting food environment and reduce complications in diabetic patients [9]. Although, there are currently effective prevention and treatment methods for diabetes to control blood sugar levels and prevent diabetes-related complications but most patients do not receive care according to recommended guidelines. Therefore, implementing effective care strategies in real-world situations is important to improve the efficiency of delivering comprehensive and modern diabetes care [10]. The use of digital technologies in the prevention and management of T2DM with a variety of tools such as mobile applications, websites, messaging apps, wearable devices, and telehealth can allow patients to conveniently and continuously monitor health behaviors such as blood sugar levels, exercise and dietary intake. The obtained data can be used to provide personalized advice to adjust health behaviors and effective communication with medical personnel [11].

Currently, there are many types of applications and web applications that support self-care in diabetic patients by providing nutritional advice, glycemic control and promoting exercise which are effective in changing behavior and significantly reducing Hemoglobin A1C (HbA1c) levels. For example, the use of applications with advice from nurses and dietitians helps patients understand food classification and reduce Fasting Blood Sugar (FBS) and HbA1c values, and the development of web applications has been shown to promote systematic self-care among diabetic patients [12-13]. In addition, health information systems have been designed specifically to support elderly individuals with T2DM [14]. However, existing applications still lack the function of evaluating the nutritional value of drinks, especially the amount of sugar, fat, and sodium, which are important components that affect blood sugar levels and complications [15]. Importantly, current tools are not tailored to Thai users in terms of accessibility, language, and local dietary patterns.

Of course, there are many beverages to chosen in Thailand. The type of beverage may be classified by their primary ingredients such as alcoholic or non-alcoholic beverages, water, tea, coffee, milk, cocoa, carbonated drinks, fruits and vegetable juices, herbal juices, nuts, bean, and grain-based beverages. Sometime, its type was classified by the intended purpose such as soft drink, energy drink, sports drink, dairy drink, health drink [16-17]. There is a clear need for a culturally relevant application that enables users to evaluate beverage nutrition effectively. A tool that supports healthier drink choices can empower individuals, especially those at risk of T2DM, to better manage their dietary intake and reduce long-term health risks.

Therefore, this research aims to study and develop an application that can comprehensively assess the nutritional value of beverages, especially nutrients that affect diabetes, such as sugar, fat, and sodium. This application will be developed as a web application using HTML5, CSS, JavaScript, PHP, and connected to the MySQL database. It can be used on a variety of devices. The target group is the general people or people who are at risk of diabetes in THAT-Tambon Municipality, Chiang Khan District, Loei Province. This group was selected due to the rising prevalence of diabetes in the area and the availability of diverse beverage options. The sample group and local context are therefore appropriate for developing and testing a practical, community-based digital intervention. The objective of this study is to design, implement, and preliminarily evaluate the effectiveness of a culturally relevant web application. It is expected that this tool will help users choose appropriate beverages, reduce risks and serve a long-term quality of life.

2. Materials and Methods

This research is applied research by technology and nutrition knowledge. The objectives are (1) the development of beverage nutritional value assessment application for diabetes mellitus risk group, (2) test the efficiency of the application by experts and (3) evaluate the satisfaction of the application by users in the THAT-Tambon Municipality, Chiang Khan District, Loei Province.

For nutritional information of popular beverages consumed in this area, a total of 422 items were collected. The data is divided into 392 beverages that are sold in convenience stores which have nutritional information listed on the packaging called GDA Label as a guideline daily amount for consumption per package and 30 beverages that are sold in cafes which have had their nutritional information listed by food and nutrition experts who can calculate energy of drink based on ingredient analysis. This data will be entered into the application database that will store 20 nutritional data points for beverages: name, brand, package size, serving size (oz or mL), servings per package, total energy (kcal), energy from fat (kcal), total fat (g), trans fat (g), protein (g), carbohydrate (g), fiber (g), sugar (g), sodium (g), cholesterol (mg), and five supporting images. Total energy was calculated as show in equation (1) and energy from fat was calculated as show in equation (2);

$$\text{Energy (kcal)} = (\text{Protein (g)} \times 4) + (\text{Carbohydrate (g)} \times 4) + (\text{Fat (g)} \times 9) \quad (1)$$

$$\text{Energy from Fat (kcal)} = \text{Total Fat (g)} \times 9 \quad (2)$$

From equation (1) represents the total energy content of a food item, calculated based on the energy contributions of macronutrients. Each gram of protein and carbohydrate provides approximately 4 kcal, while each gram of fat provides approximately 9 kcal. From equation (2) calculates the amount of energy derived specifically from fat. This helps assess how much of the total energy comes from fat, which is important for nutritional evaluation and dietary planning.

The population and sample used in this study were divided into two groups. The first group is the population in the research area which includes the population in THAT-Tambon Municipality. The researcher determined the sample group used in this study by a purposive selection consisting of 30 people who were either diagnosed with prediabetes or presented risk factors such as obesity or family history. Diabetes risk was identified using fasting blood sugar (FBS) criteria ($\geq$100 mg dL^{-1} but <126 mg dL^{-1}), consistent with national guidelines. The second group is a group of software analysis experts consisting of 5 lecturers from courses related to computer science or related fields and food and nutrition. The research methodology was divided into 5 steps using the software development process model of SDLC as a guideline for the research process consisting of 1) data collection, 2) system analysis and design, 3) system development, 4) testing and evaluation, and 5) system installation and maintenance [18].

Data collection

This research was conducted with prior permission obtained from relevant authorities. Before data collection, participants were informed about the research objectives, procedures, and their rights. Participation was entirely voluntary, and individuals could withdraw from the study at any time without providing a reason. Data collection was conducted using focus groups. Basic data such as occupation, consumption behavior, and community health promotion processes were collected by holding meetings with relevant parties including representatives from THAT-Tambon Municipality, village health volunteers (VHVs) and the diabetic risk population aged 30 years and over to be used in the analysis and design of the application. In the meeting, data on the nutritional value of popular beverages in THAT-Tambon Municipality were collected which will be entered into the application database.

System Analysis and Design

This research conducted an application scope analysis using use case diagram and designed a database system in a relational database model as Entity-Relationship (ER) model.

Application Development

This application is developed in responsive web format with HTML5, JavaScript and PHP. It connects to a relational database using My SQL.

Testing and Evaluation

After the application was developed, the application was evaluated by software analysis experts and the users were asked to evaluate their satisfaction with the application using a questionnaire developed by the researcher. The questionnaire was checked for quality by 5 experts before being used. The questionnaire was divided into 2 sets. The first set was the application performance evaluation form, which was evaluated by a group of software analysis experts, divided into 4 areas: 1) Conformity to the needs of the system users, 2) Correctness and reliability of the system, 3) Ease of use of the system, and 4) Data security of the system, which was in line with the ISO/IEC 9126 software quality standard criteria [19]. The second set was the user satisfaction evaluation form, divided into 3 areas: 1) Conformity to the needs of the system users, 2) Correctness and reliability of the system, and 3) Ease of use of the system.

Both assessments are 5-level multiple choice scales: most, much, moderate, little, and least. The analysis of application performance data and satisfaction with application usage used descriptive statistics, including mean, standard deviation, and divided the efficiency and satisfaction level scores using the absolute criteria from the exact limits as the evaluation criteria, which will be interpreted into 5 levels: (1) score 4.51 - 5.00 means very high level, (2) score 3.51 - 4.50 means a high level, (3) score 2.51 - 3.50 means medium level, (4) score 1.51 - 2.50 means low level, and (5) score 1.00 - 1.50 means very low level.

System installation and maintenance

The application is installed on a prepared server which users can access online along with a user manual and training. If there are any errors during use, the research team will correct the errors caused by user feedback throughout the use.

3. Results and Discussion

Results of Data collection

From basic data collection using focus group discussions, it was found that most of the population in this area are farmers. Their behavior is consuming food and beverages more than the amount needed each day. Especially beverages such as tea and coffee from both home-brewed beverage shops and semi-prepared beverages. The process of community health promotion assigns village health volunteer groups to be representatives in receiving health care policies and regularly goes to the area to provide knowledge on food consumption. For 422 nutritional information of popular beverages is divided into 11 types as shown in Table 1.

Table 1 shows the analysis of beverage types sold in convenience stores and cafes, considering the number of samples and the average sugar content of each type to assess the sugar level. It was found that most beverages are in the "High-moderate" group while health drinks have an average sugar content as 13.16 g mL^{-1} which is in the "High" level. Herbal beverages and beverages made from nuts and grains have a low average sugar content and are in the "Healthier Choice" group with an average sugar content of 4.37 and 5.54 g mL^{-1} respectively. It was also found that the milk and dairy product group had the most samples followed by vegetable and fruit juices and soft drinks with 96, 84 and 62 items respectively which shows their popularity and widespread consumption in the Thai market.

Although most beverages are in the "High-moderate" group overall, there are some types of sugar-free beverages such as vegetable and fruit juices, soft drinks, nuts, beans and grain drinks, coffee, herbs, and health drinks which have the highest average sugar content. This means that beverage manufacturers have produced sugar-free beverages to provide consumers with an alternative. This information reflects the trend of moderate to high sugar consumption of beverages and can be used to inform health control planning or nutrition policy.

Results of System Analysis and Design

From the results of the problem survey and data collection by interviewing a sample group of users, consisting of village health volunteers and general interested people, the system was analyzed according to the needs of the users using an use-case diagram to show the scope users and needs of the system as shown in Fig 1.

Table 1 Information on the sugar content of each type of drink.

Beverage Types	Amount of data		Total	Amount of Sugar ($g\ mL^{-1}$)			Sugar Level
	Stores	Café		Min	Max	Mean	
Milk and dairy drinks	90	6	96	1.67	18.33	8.51	High-moderate
Fruits and vegetable juices	84	4	88	0.00	20.00	7.79	High-moderate
Carbonated drinks	62	1	63	0.00	14.29	7.87	High-moderate
Nut, bean, and grain-based beverages	50	1	51	0.00	14.44	5.54	Healthier Choice
Health drinks	38	0	38	0.00	22.00	13.13	High
Coffee	30	8	38	0.00	13.13	5.20	Healthier Choice
Tea	8	5	13	3.18	12.41	8.93	High-moderate
Cocoa	8	3	11	4.71	13.25	8.91	High-moderate
Herbal juices	10	0	10	0.00	9.43	4.37	Healthier Choice
Sports drink	9	0	9	6.00	12.00	8.90	High-moderate
Others	3	2	5	2.92	11.48	6.17	High-moderate
Overall.	**392**	**30**	**422**	**0.00**	**22.00**	**7.76**	**High-moderate**

From Fig 1, the system users are divided into 3 groups:

Group 1: Administrators refer to village health volunteers or those assigned to take care of the system. They are required to log in every time they want to use the system. Administrators can manage beverage information, manage user information, search for beverage information, and view the nutritional information of added beverages.

Group 2: Members refer to people at risk of diabetes or the public who have already registered. When logging in, they must log in every time and will be able to search for beverage information, view the nutritional information of

beverages, assess their own nutritional status, plan their drinking, and record their drinking plans for history, edit personal information such as weight, age, and types of work that can be done.

Group 3: General users refer to people at risk of diabetes or the public who log in without registering. General users can search for beverage information, view the nutritional information of beverages, assess their own nutritional status, plan their daily drinking, and can register as members.

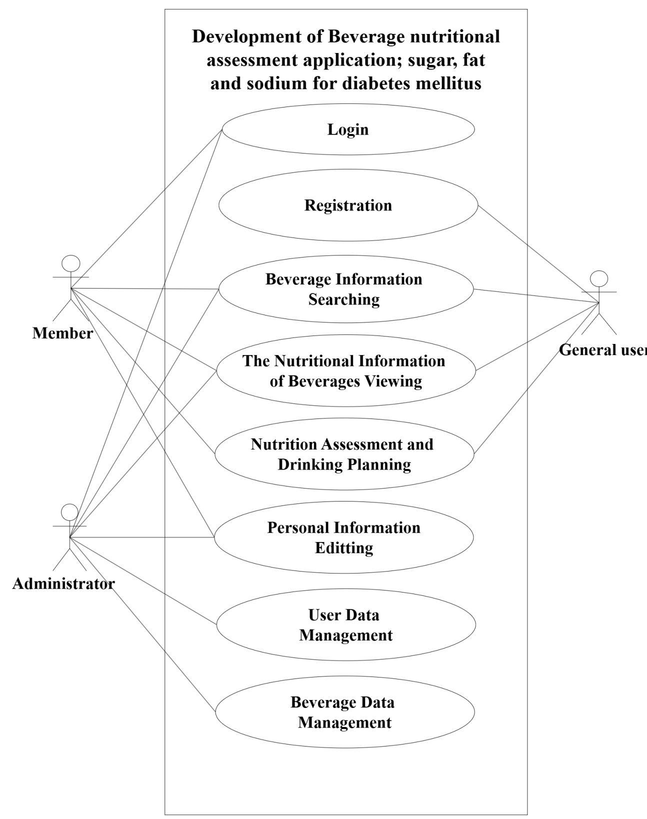

Fig. 1 Presents a use-case diagram illustrating the main functionalities of the application.

Classifying system users into three main groups facilitates efficient and secure management of data access rights through clearly defined roles and permissions, particularly in health information systems employing Role-Based Access Control (RBAC). The hierarchical role structure enhances management flexibility and accommodates the specific needs of each user group appropriately, resulting in improved system security, smoother operation, and greater overall efficiency [20].

From the requirement analysis, this research uses ER model to show the data storage design based on relational database theory, which stores data in 4 tables: 1) login_admin table used to store administrator and member data, 12 columns; 2) occupation_data table used to store work type data to be used in calculating drinking plan, 3 columns; 3) nutrition_drink_data table used to store beverage nutritional data, 21 columns; and 4) member_drink_data table used to store member drinking plan data, 13 columns as shown in Fig 2.

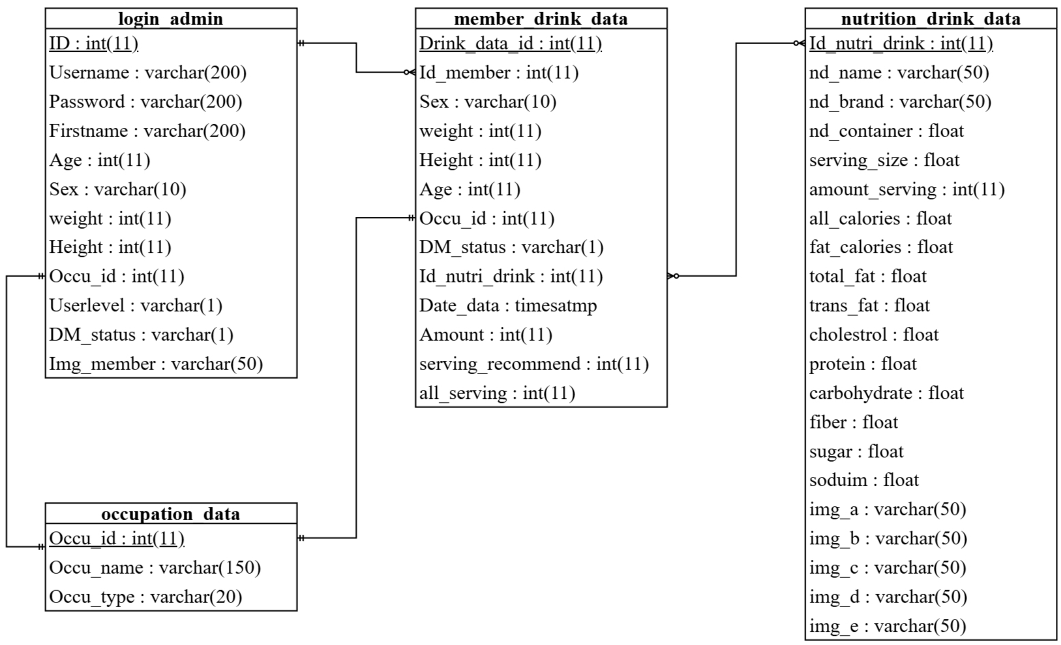

Fig. 2 An entity relationship diagram showing the structure of the application database.

Results of Application development

The developed application has a user interface that all types of users can access a web browser. URL: http://www.khamaon.com/banntatdrink/

When users enter the application home page, three menu bars will appear:

First, the home menu is a menu that links to the home page of the application to assess the nutritional value of sweet, salty, and fatty drinks for people at risk of diabetes. It is divided into 2 parts: the beverage search section and the beverage information display section. Users can search for beverage information by beverage name or ingredients. In this module, the system will display the nutritional value of the drink directly from the database as shown in Fig 3. The nutritional data consists of name, brand, package size, serving size (oz or mL), servings per package, total energy (kcal), energy from fat (kcal), total fat (g), protein (g), carbohydrate (g), fiber (g), sugar (g), sodium (g), cholesterol (mg) and the image on the middle and the right of page. In the case that the administrator does not upload a beverage image to the database, the system will retrieve the image data indicating the sugar level of the drink as Sridonpai et al. [6] categories to display instead. In addition, at the bottom of the page, there is a calculation showing the percentage of sweetness, saltiness, and creaminess of the drink. This page helps users to know the nutritional information of beverages which helps them to make a decision on their consumption.

Fig. 3 An example of a nutrition information page developed in the Thai language version, displaying the nutritional details of the sample.

Second, the nutrition assessment and drinking plan menu is a menu that links to the nutrition assessment and drinking plan page. Users must input their weight, height, age, type of work, gender, and diabetes status to calculate the amount of energy from drinks they should receive per day by Brouns [7] method. In this function, the system will display the amount of energy and main nutrients they should receive, including carbohydrates, protein, and fat. In addition, users can search for information on drinks that are suitable for them from 422 drink lists that are the data collected in the database by inputting a keyword in search bar like the drink name. The search results will automatically appear. Users can immediately select the drink they want to add to the drink list and can view the drink information before adding it to the drink list. When users select a drink to add to the drink list, the system will calculate the remaining energy that the user can drink. However, if the drinking plan exceeds the amount they should receive, the system will display a message as "Exceeded the amount". In addition, users can change, delete, or add a drink list and then display the drink selection results again, as shown in Fig 4. In the case of users who are registered as members of the system, they will be able to save the nutritional assessment and drinking plan. The administrator will be able to view the history of the recording of such information for all members but they must log in every time which is different from general users who can use it immediately but cannot save the information.

The last, the about research project menu is a menu that links to the About Research Project page which shows the name of the research project, the origin and the importance of the research project

The development of a web browser-based application interface that is easily accessible to diverse user groups aligns with research indicating that a simple UI/UX design, supporting multiple device types, enhances user acceptance and engagement. Furthermore, allowing users to modify and manage their own lists fosters a sense of ownership and promotes active participation in personal health management, consistent with findings by Piwein et al. [21]. However, limitations regarding data saving for unregistered users may affect the continuity of health monitoring, representing an important area for future improvement.

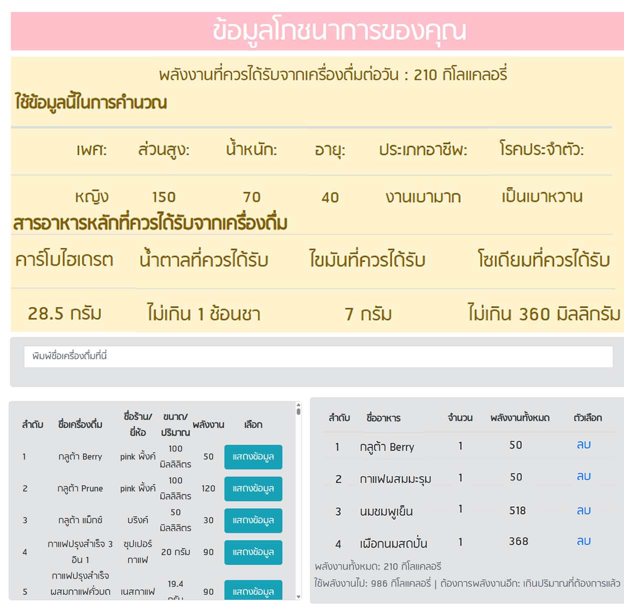

Fig. 4 Displays the nutrition assessment page of a beverage sample and the corresponding beverage consumption plan for consumers, generated by the program developed in the Thai language version.

Evaluation results

The application performance evaluation results by a group of 5 software analysis experts found that the overall evaluation results were at a high level with an average value of 3.84 (S.D. = 0.15). The system performance in terms of consistency with user needs was at a high level with an average value of 3.84 (S.D. = 0.20). The system performance in terms of accuracy and reliability was at a high level with an average value of 3.84 (S.D. = 0.16). The system performance in terms of ease of use was at a high level with an average value of 3.96 (S.D. = 0.08). The system performance in terms of data security in the system was at a high level with an average value of 3.72 (S.D. = 0.16) as shown in Table 2. The evaluation results of the application's performance indicated a high overall rating, reflecting a system design and information presentation that comprehensively meet user requirements in terms of accuracy, reliability, and ease of use. Consequently, the system effectively and reliably addresses user needs. Furthermore, these findings are consistent with the study by Reamrimmadun et al. [22], which demonstrated that a web application for blood sugar control operates efficiently and received similarly high expert evaluation scores.

The results of the satisfaction assessment of the application were assessed by 16 village health volunteers, diabetes risk groups, and an interested audience. The results of the assessment of the overall satisfaction of the application were at a high level with an average value of 4.10 (S.D. = 0.37). The satisfaction of the needs of the system users was at a high level with an average value of 4.10 (S.D. = 0.37). The satisfaction of the accuracy and reliability of the system was at a high level with an average value of 4.10 (S.D. = 0.37). The satisfaction of the ease of use of the system was at a high level with an average value of 4.10 (S.D. = 0.37) as shown in Table 3. User satisfaction evaluation results indicated a high overall level of satisfaction with the application, consistent with findings from the development of diabetes management applications reporting high user satisfaction. The application demonstrated ease of use and potential for development into a large-scale database for diabetic patients [23]. Moreover, the study Development of a Web-Based Diabetes Prevention Program for Chinese Americans reported significantly positive user feedback, with focus group participants highlighting the program's usefulness and accessibility, particularly emphasizing convenience across various platforms [24].

Table 2 Application performance evaluation results.

Performance evaluation issues	$\bar{X}$	S.D.	Results
A consistency with the user needs	3.84	0.20	High
An accuracy and reliability	3.84	0.16	High
An ease of use	3.96	0.08	High
A data security in the system	3.72	0.16	High
Mean.	3.84	0.15	High

Table 3 Results of the evaluation of satisfaction with the use of the application.

Satisfaction assessment issues	$\bar{X}$	S.D.	Results
A user requirement of the system	4.10	0.37	High
An accuracy and reliability	4.10	0.37	High
An ease of use	4.10	0.37	High
Mean.	4.10	0.37	High

4. Conclusion

Thailand is experiencing escalating health concerns associated with the increasing consumption of sweetened, high-fat, and salty beverages, which are recognized as significant contributors to the rising prevalence of diabetes. In response to this issue, the present study aimed to develop a web-based application designed to evaluate the nutritional content of such beverages, specifically targeting individuals at risk of developing diabetes. Prior to the development phase, a total of 422 beverage samples were collected, comprising 11 categorized types. Of these, 392 items were sourced from convenience stores, with nutritional information obtained from Guideline Daily Amount (GDA) labels, while 30 items from local cafés within THAT-Tambon municipality were analyzed by nutrition experts based on ingredient composition. The compiled data were systematically organized into a relational database containing 20 nutritional attributes per item. The application was developed using HTML5, CSS, JavaScript, PHP, and MySQL, with core functionalities supporting users in assessing personal nutritional intake, planning daily beverage consumption, and managing personal profiles. Most of the analyzed beverages exhibited moderate to high sugar levels, although some sugar-free alternatives were identified. The application offers dietary recommendations aligned with individual nutritional needs, serving as a preliminary guideline for diabetes prevention and management. Administrative functions were also integrated, allowing for the management of beverage data and user information to ensure continued accuracy and relevance. The application's performance was evaluated by software experts, yielding a high efficiency score ($\overline{X}$ = 3.84, S.D. = 0.15). Additionally, user satisfaction was assessed using a researcher-developed questionnaire, with results indicating a very high level of satisfaction ($\overline{X}$ = 4.10, S.D. = 0.37). In conclusion, the developed application shows promise as a digital health tool to support informed beverage choices, mitigate health risks, and promote sustainable lifestyle changes, especially among individuals at risk of diabetes. However, the application currently requires internet access and is limited to beverages commonly available in the study area. Future development should consider expanding its coverage to food intake assessment and mobile platforms to increase accessibility and impact.

5. Suggestions

From this research, the needs were studied, the program was designed, and the program was developed according to the context of the needs in the community which is different from other areas. It only requires beverage planning and users must use the web application. Therefore, there are limitations for users who must use the internet signal only. The data collection from the village health volunteers and some groups of people at risk should be promoted to make the public and family members in every household aware of appropriate beverage consumption and continuous use of the application.

In the future, if anyone is interested in developing a nutritional assessment application, this research can be used as a prototype by developing it to assess the nutritional value of both food intake and beverage consumption to support comprehensive use for controlling the risk of diabetes more.

6. Acknowledgement

We would like to thank the Health Promotion Foundation (Thai Health) for supporting the research budget under the Sustainable Local Community Well-Being and Well-Living Research and Development Project, the sample groups, the individuals and agencies involved, and Loei Rajabhat University, the main agency for directing and managing the research project to its successful completion and Loei Rajabhat University, the main agency for directing and managing the research project to its successful completion.

7. References

[1] GBD 2021 Diabetes Collaborators. (2023). Global, regional, and national burden of diabetes from 1990 to 2021, with projections of prevalence to 2050: A systematic analysis for the Global Burden of Disease Study 2021. *The Lancet*, *402*, 203–234. https://doi.org/10.1016/S0140-6736(23)01301-6

[2] He, K. J., Wang, H., Xu, J., Gong, G., Liu, X., & Guan, H. (2024). Global burden of type 2 diabetes mellitus from 1990 to 2021, with projections of prevalence to 2044: A systematic analysis across SDI levels for the Global Burden of Disease Study 2021. *Frontiers in Endocrinology*, *15*, 1–13. https://doi.org/10.3389/fendo.2024.1501690

[3] Harreiter, J., & Roden, M. (2023). Diabetes mellitus – Definition, Klassifikation, Diagnose, Screening und Prävention (Update 2023). *Wien Klinische Wochenschrift, 135*(Suppl 1), S7–S17. https://doi.org/10.1007/s00508-022-02122-y

[4] Ismawanti, Z., Nurzihan, N., & Permatasari, O. (2022). Relationship of sugar, salt, and fat consumption to ratio of waist to hip and blood glucose levels in type 2 diabetes mellitus patients. *Jurnal Gizi Prima*, *7*(1), 48–54. https://doi.org/10.32807/jgp.v7i1.358

[5] Tseng, T. S., Lin, W. T., Gonzalez, G., Kao, Y. H., Chen, L. S., & Lin, H. Y. (2021). Sugar intake from sweetened beverages and diabetes: A narrative review. *World Journal of Diabetes*, *12*(9), 1530–1538. https://doi.org/10.4239/wjd.v12.i9.1530

[6] Sridonpai, P., Sridonpai, P., Puwastien, P., Nakngamanong, Y., & Sirichakwal, P. (2019). Sugar content in sugar-sweetened beverages sold in and surrounding university: Case study at Mahidol University, Salaya Campus. *Journal of Public Health*, *4*(9), 32–44.

[7] Brouns, F. (2015). WHO sugars guideline raises some questions. *Agro Food Industry Hi-Tech*, *26*(5), 8–10.

[8] Health Data Center of the Ministry of Public Health. (2023). *Guidelines for managing diabetes patients toward remission service*. Ministry of Public Health.

[9] Dittmann, A., Luft, T., Mendoza Pardo, C., & Storcksdieck, S. (2023). Measures to reduce sugar, fat, and salt content of food and beverages in selected European countries. *European Journal of Public Health*, *33*. https://doi.org/10.1093/eurpub/ckad160.278

[10] Green, J. B., Crowley, M. J., Thirunavukkarasu, S., Maruthur, N. M., & Oldenburg, B. (2024). The final frontier in diabetes care: Implementing research in real-world practice. *Diabetes Care*, *47*(8), 1299–1310. https://doi.org/10.2337/dci24-0001

[11] Nguyen, V., Ara, P., Simmons, D., & Levi Osuagwu, U. (2024). The role of digital health technology interventions in the prevention of type 2 diabetes mellitus: A systematic review. *Clinical Medicine Insights: Endocrinology and Diabetes*, *17*, 1–11. https://doi.org/10.1177/11795514241246419

[12] Manmee, C., Niramitmahapanya, S., Sickamann, O.-A., & Srithong, H. (2021). Development of nutrition knowledge-based learning model by information technology for blood sugar control among diabetic patients. *Journal of Department of Medical Services*, *46*(1), 52–63.

[13] Meenasantirak, A., Siripitakchai, C., & Suriya, N. (2024). Development of a web application for controlling blood sugar levels in diabetic patients. *Nursing and Health Education Journal*, *7*(1), 1–14.

[14] Reamrimmadun, D., Jaidee, W., & Wattanaburanon, A. (2024). Development of a blood glucose monitoring web-based application for elderly people with type 2 diabetes. *VRU Research and Development Journal Science and Technology*, *19*(2), 1–15.

[15] Harimahardika, G. S., Agustini, N. L. P. I. B., Megayanti, S. D., & Sari, N. M. C. C. (2023). Diabetes self-management education (DSME) methods using web-based and application. *Babali Nursing Research*, *4*, 796–812. https://doi.org/10.37363/bnr.2023.44246

[16] Arora, P., Ansari, S. H., & Arora, S. (2020). Nutritional beverages. *American Journal of PharmTech Research*, *10*(3), 186–203.

[17] Riley, M. D., Hendrie, G. A., & Baird, D. L. (2019). Drink choice is important: Beverages make a substantial contribution to energy, sugar, calcium and vitamin C intake among Australians. *Nutrients, 11*(6), 1389. https://doi.org/10.3390/nu11061389

[18] Adulkasem, S., & Noppornchrenkul, W. (2017). *Database systems* (Revised ed.). Top Publishing.

[19] Dugalic, B., & Mishev, A. (2012). ISO software quality standards and certification. *In Local Proceedings of the Fifth Balkan Conference in Informatics,* Faculty of Sciences, University of Novi Sad, Serbia, 113–116.

[20] de Carvalho Junior, M. A., & Bandiera-Paiva, P. (2018). Health information system role-based access control current security trends and challenges. *Journal of Healthcare Engineering, 2018, Article 6510249*, . https://doi.org/10.1155/2018/6510249

[21] Piwein, P., Hunsom, K., & Liewtrakul, P. (2021). Application design and development to support healthy food menu for decision-making. *Journal of Bansomdej Engineering and Industrial Technology*, *2*(1), 54–69. https://ph04.tci thaijo.org/index.php/ JEITB/article/view/4776

[22] Reamrimmadun, Y., Jaidee, W., & Wattanaburanon, A. (2024). Development of a blood glucose monitoring web-based application for elderly people with type 2 diabetes. *VRU Research and Development Journal Science and Technology*, *19*(2), 1–15.

[23] Dokduang, K., Totum, B., & Kosapan, P. (2021). A development of diabetic patient healthcare application for elderly people in Ubon Ratchathani Province. *Journal of Industrial Technology Ubon Ratchathani Rajabhat University*, *11*(2), 53–65.

[24] Yeh, M. C., Lau, W., Gong, Z., Horlyck-Romanovsky, M., Tung, H. J., Zhu, L., Ma, G. X., & Wylie-Rosett, J. (2023). Development of a web-based diabetes prevention program (DPP) for Chinese Americans: A formative evaluation approach. *International Journal of Environmental Research and Public Health, 20*(1), 599. https://doi.org/10.3390/ijerph20010599