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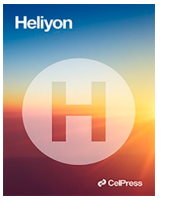

Development of a tool to estimate sugar and caloric contents in alcoholic beverages for a diabetes self-management program in Thailand

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ABSTRACT

Diabetes self-management education and support (DSMES) is recommended as a standard of care for patients with diabetes worldwide. Alcohol consumption is one aspect mentioned within the DSMES program in Thailand where alcohol consumption is the highest among Southeast Asian countries. Many diabetes guidelines suggest limiting alcohol intake to not more than one standard drink per day for adult women and two for adult men if they cannot abstain from drinking. In practice, however, the conversion of alcohol consumption into standard drinks, and nutritional information about the calorie and sugar contents of alcoholic beverages, especially domestically produced spirits, are not commonly available in Thailand. By reviewing the diabetes guidelines internationally and the Thailand alcoholic beverage industry, a visual health education tool to help convert different alcoholic beverages into standard drinks and to provide the calorie and sugar content of alcoholic beverages was developed as a part of the DSMES program. It was finalized following pilot testing and focus group discussions with policymakers, healthcare providers, and type 2 diabetes patients. The personalized counseling tool, integrated with guidelines and culturally tailored to the Thai setting is distributed to counselors/educators. It is a potentially useful tool for patients to make informed choices for their self-management of diabetes.

1. Background

Self-management is the cornerstone of diabetes care, and it is necessary to reduce the burden of diabetes on the individual and

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society [1]. Diabetes self-management education and support (DSMES) is one of the essential components of care for all patients with diabetes, and the facilitation of their knowledge, skill, and ability is necessary for diabetes self-care [2,3]. Effective diabetes education in conjunction with effective medical management can improve glycemic control, reducing hospital admissions and subsequent adverse outcomes of diabetes [4,5]. Therefore, DSMES is recommended as a part of standard care for patients with diabetes worldwide. It is a patient-centered approach that comprehensively addresses the clinical, educational, psychosocial, and behavioral aspects of management to improve self-care with positive outcomes [6].

Alcohol consumption is one aspect that is usually mentioned within DSMES as it has a casual impact on the burden of non-communicable diseases (NCDs). NCDs are the number one killer in Thailand, responsible for 74 % of all death in the country [7]. It significantly negatively impacts the Thai economy as the annual health costs for NCDs amounted to 9.7 % of its 2019 gross domestic product, amongst them, risk factors: harmful use of alcohol accounts for the economic burden of about 93.2 billion Thai Baht [8]. Drinking alcohol is one of the behavioral risk factors attributable to NCDs and it is evident that excessive alcohol consumption is related to cancer, cardiovascular diseases, and diabetes, on the other hand, moderate consumption of alcohol, particularly in the form of wine and in the appropriate dietary pattern, is associated with reduced mortality and morbidity risks [9–11]. The World Health Organization's global status report on Alcohol and Health 2018 recorded that alcohol per capita consumption (20.3 L of pure alcohol per annum among drinkers only and 8.3 L amongst 15years and above population), the prevalence of alcohol-related disorders (5.4 %), and alcohol-attributable fractions for deaths from all causes (7.4 %) in Thailand were the highest among the Southeast Asia countries. The most common alcoholic beverages in Thailand are spirits (69 %), followed by beer (28 %), and others (3 %) [12]. Thailand's Drinking and Smoking behavior survey 2017 noted that drinking popularity varied across the regions, where consumption of spirit (local alcohol) was higher in the Northern and North-eastern regions than in other regions. In contrast, Bangkok and the Central region preferred to drink beer over other alcoholic beverages [13].

Alcoholic beverages may also contribute excess sources of calories and added sugar, and heavy alcohol drinking can worsen blood sugar control, mediated by different metabolic and hormonal responses. Despite the addition of moderate amounts of alcohol to the diet did not lead to an increase in body weight, heavy drinkers are at increased risk of weight gain and obesity [14–17]. The different alcoholic beverages may have different effects on type 2 diabetes parameters, for example, both fasting and post-prandial glycemia and serum insulin levels are not negatively affected by moderate amounts of red wine whereas beer and sweetened mixed alcoholic drinks can raise blood sugar levels. Therefore, it is recommended that patients with diabetes avoid or limit alcohol intake to the minimum when consuming. The American diabetes association suggests that patients with diabetes should minimize the consumption of food and drink with added sugar [18]. Individualizing dietary plans to reduce caloric intake may be needed, especially for those with obesity. Many guidelines suggest that patients should limit alcohol (not more than one standard drink per day for adult women and two for adult men) [19,20]. However, in practice, it is quite challenging to know about standard drinks, and the conversion of alcohol consumption into standard drinks is not readily available. Food and nutrition labeling with the display of the name and type of food, food recipe registration number, name and location of the manufacturer, manufacture date, quantity, and ingredient list has been practiced in Thailand since 1979 under the guidance of the Ministry of Public Health. Nonetheless, nutritional information (on calorie and sugar contents) of common alcoholic beverages is not common in Thailand, especially for locally made spirits whose consumption is the highest among alcoholic drinks [21]. To address this, we have developed a visual health education tool to help convert common alcoholic beverages in Thailand into standard drinks and also provide the calorie and sugar content of alcoholic beverages as a part of our DSMES program [22].

1.1. A standard alcoholic drinks conversion tool development

The development of the standard alcoholic drinks conversion tool followed the three phases for the development of toolkits for evidence-based interventions [23]. These three phases were 1) literature review and preparation, 2) tool development, and 3) readiness assessment and tool refinement.

1.1.1. Phase 1) literature review and preparation

The initial step in developing this standard alcohol drink conversion tool was done by reviewing existing literature about guidelines for alcohol consumption among people living with diabetes. In this study, the guidelines of alcohol consumption in diabetic patients were searched on Google scholar using keywords 'diabetes guideline'. We only considered clinical guidelines that made explicit recommendations on the amount of alcohol consumption in patients with diabetes mellitus. The Thai Clinical Practice Guideline for Diabetes 2017 followed the American Diabetes Association guidelines and recommendations [6,18]. In general, the Thai guideline recommends limiting the amount of alcohol to not more than one standard drink per day for women and two standard drinks per day for men. It also states that calorie and sugar intake should be limited while maintaining a balanced diet [24]. Thai Food and drug administration recommends that adults should not eat more than 24g of sugar per day (6 teaspoons), even without any other chronic diseases or diabetes [25]. Other guidelines from organizations such as the European Society of Cardiology [26], Diabetes UK [27], and the National Diabetes Service Scheme Australia [28] also make similar recommendations stressing the importance of moderation of alcohol consumption. These guidelines emphasize the importance of understanding caloric intake for weight management. Furthermore, the guidelines acknowledge that some alcoholic beverages such as beers and sweetened mixed drinks can be a rich source of carbohydrates and raise blood sugar levels which may make diabetes self-management more difficult. The summary of recommendations across the different guidelines and organizations for alcohol consumption among people living with diabetes is summarized in "Table 1".

After that, we reviewed the common types of alcoholic beverages consumed in Thailand. Beer, spirits, rice wine (home-made

distilled alcohol made of rice), wine, whisky, whisky mixed with soda, brandy, white liquor, herbal spirit, and fruit juice mixed with alcohol (fruit cocktail) were common types of alcoholic beverages consumed in Thailand [29–32].

1.1.2. Phase 2) tool development

There are different communication needs of health information for different individuals, and visual communication resources can narrow the gap in understanding health information and improving health risk behaviors [33]. According to a Thai health literacy survey in 2019 and a survey conducted among older adults in Thailand, about one-third of Thais felt difficulties in assessing and understanding reliable health information [34,35]. Literature suggests that picture-based health education materials may help overcome barriers for people with low health literacy [36]. Our research team discussed how to deliver this information best and decided to use a visual health education tool to provide health information about alcoholic beverages. The visual standard alcoholic drinks conversion tool was previously developed in 2018 and was led by one of the co-authors (KT), and it is freely available to download [37]. It was developed by examining common alcoholic beverages, multiplying the percentage of alcohol by volume (alcohol %) with the actual volume of the container (or unit of consumption) to estimate the 'grams of ethanol' per container (or unit of consumption) [38]. In Thailand, one standard drink is regarded as it is equivalent to 10 g of ethanol [30]. For our DSMES program, we additionally examined the sugar and caloric contents of alcoholic beverages. According to the Thailand industry outlook for 2019–2021: beverage industry, beer was the most common alcoholic beverage, having the most important market share both in terms of market share by volume and by value, followed by spirits, wine, and others [39]. Therefore, nine different types of alcoholic beverages (24 brands in total), including five lager beers, rice wine (home-made distilled alcohol made of rice), wine, whisky, whisky mixed with soda, brandy, white liquor/spirit, herbal spirit, fruit juice mixed with alcohol (fruit cocktail) were sent to the central laboratory in Thailand for analysis. Total sugar (grams per 100 mL) and calories (kcal per 100 mL) were calculated by using the compendium of methods for food analysis 2003 [40]. The laboratory investigation results of the total sugar and calorie content of common Thai alcoholic beverages are summarized in "Table 2".

Lastly, the visual health education tool, consisting of alcohol, calorie, and sugar information about standard drink conversion of

Table 1
Summary of literature review about the recommendation to adults with diabetes for Sugar, Calories, and Alcohol consumption.

	Sugar	Calories	Alcohol
Thai guideline 2017(24)	Sugar <5 % of total calories/day (3–6 teaspoons/day) divided into 2–3 meals	Limit calories, sugar, and fat intake while maintaining a balanced diet.	Avoidance of alcohol. Not more than one standard drink per day for women Not more than two standard drinks per day for men.
American Diabetes Association 2021(18)	To control glycemia, and weight gain, and reduce the risks for cardiovascular diseases and fatty liver, people with diabetes and those at risk are advised to replace beverages (both sugar-sweetened beverages and fruit juices) with water as much as possible. They should minimize the consumption of foods with added sugar which can displace healthier, more nutrient-dense food choices.	Meal plans of people with diabetes should be individualized by keeping total calorie and metabolic goals in mind, as there is no single ideal recommendation about calorie distribution among carbohydrates, fats, and proteins.	Alcoholic adults with diabetes should drink alcohol in moderation (not over one drink per day for adult women and two drinks per day for adult men). (One drink is equivalent to a 12-oz beer, a 5-oz glass of wine, or 1.5 oz of distilled spirits).
European Society of Cardiology 2019(26)		Weight reduction by reducing calorie intake is recommended in obese patients with diabetes. There is no ideal calorie distribution from carbohydrates, protein, and fat for people with diabetes.	Taking moderate alcohol (>100 g/week) to protect against CVD should not be promoted.
Diabetes UK(27)	- Avoid low-sugar beers and diabetic drinks, which may contain less sugar but more alcohol content. - Avoid low-alcohol wines, which may contain more sugar than normal ones, and you better limit to a glass or two. Limit drinks that contain a lot of sugar, like sweet sherries, sweet wines, and liqueurs. - Some drinks like beers, ales, and ciders will increase your blood sugar initially as they contain carbohydrates.	Depending on what you like to drink, there can be a lot of calories in alcohol. So, if you're trying to lose weight, you may want to drink less.	To minimize the health risks from alcohol, not regularly drink alcohol more than 14 units a week, both for men and women. It is recommended to spread over at least three days to drink alcohol 14 units a week.
National Diabetes Service Scheme Australia [28]	Drinking alcohol can cause both hypoglycemia and hyperglycemia, making diabetes control difficult. Low carbohydrate (low carb) beers may not offer any advantage over regular beers.	All alcoholic drinks are high in calories and can cause weight gain. Too much alcohol can increase the risk of putting on weight, increase triglycerides, and hypertension. Low-alcohol or lite beers are better than regular or diet beers. Dilute alcoholic drinks by mixing with diet mixers such as diet cola or diet lemonade.	No more than two standard drinks per day for both men and women are recommended.

common alcoholic beverages, was developed based on the results of common alcoholic beverages in "Table 2". The earlier version of visual standard alcoholic drinks conversion tools, developed by KT contained the alcohol information, described by the figure and the final version developed by the DSMES program included alcohol, calorie, and sugar information about the standard drink conversion of common alcoholic beverages. The final version included pictures of common alcoholic beverages, measured in a standard drink, describing the alcohol concentration, calorie, and sugar content information, illustrated with the usual measuring containers such as peg/mug/glass/can or bottles (Fig. 1). For example, in our picture, it can be seen that one glass of wine (12 % alcohol) would provide approximately 22.2 kcal and 7.4 g of sugar. One peg/tong/gong of whisky (50 ml, 40 % alcohol) would provide 9.4 kcal and 0.5 g of sugar. A standard can of beer labeled "lager beer 3″ in "Table 2" (320 ml, 5 % alcohol) would provide 65.0 kcal and 0 g of sugar. As shown in the figure, one bottle of fruit juice mixed with alcohol (275 ml, 5 % alcohol) would provide 66.7 kcal and 27.4 g of sugar. Patients could also identify the amount of volume they usually drink per sitting by identifying how many alcoholic drinks are left in the container after the usual sitting. The number to the left corresponds with the total energy (kcal) consumed, and the number to the right corresponds to the total grams of sugar consumed.

1.1.3. Phase 3) readiness assessment and tool refinement

We held focus group discussions with policymakers, healthcare providers, and patients living with diabetes on the potential use of the tool as a part of the Thai DSMES program. Four healthcare providers also piloted the tool on 20 patients living with diabetes and the readability and comprehensiveness of the tool if they perceived its efficiency in the management of sugar intake among the potential study participants were assessed. Policymakers and healthcare providers provided additional feedback on the tool with minor requests to adjust the fonts and colors of the tool. The font sizes of the figures were adjusted to be as large as they could be for consideration of diabetic retinopathy, presbyopia, and other visual impairments. The bright colors and different color contrasts were selected for easy identification of our tool. Then, the conversion tool is now used as a part of the cluster randomized controlled trial to examine the different models for delivery of the DSMES in Thailand [22]. The trial aimed to recruit over 650 recently diagnosed patients with type 2 diabetes. Embedded in the trial will be a process evaluation which will examine how the overall DSMES program is implemented and identify difficulties in adoption, readiness to learn by the targeted study population, and the delivery of the tool to provide clear, adequate, and easy comprehension of standard alcoholic drinks conversion tool [41].

1.2. The strengths and limitations of the tool

The strength of this tool is that it can be used as a personalized counseling tool to provide necessary information for people with type 2 diabetes who need not only to control sugar but also limit the calorie and alcohol content of alcoholic beverages in case, they can't avoid it. Moreover, it is not a standalone tool but integrated with the Thai diabetes guidelines [24]. It could provide the average

Table 2
Summary of the laboratory investigation results of the total sugar and calorie content of common Thai alcoholic beverages.

No	Type	unit	Alcohol by volume	Total Sugar (g/100 ml)	Calorie (kcal/100 ml)
1	Lager beer 1	Can (320 ml)	5 %	not detected	11.1
2	Lager beer 2	Can (320 ml)	5 %	not detected	10.5
3	Beer[a] (Lager beer 3)	Can (320ml/490 ml) Bottle (320ml/620 ml)	5 %	not detected	20.3
4	Lager beer 4	Can (320 ml)	5 %	not detected	12.8
5	Lager beer 5	Can (320 ml)	5 %	0.41	13.4
6	Thai craft white ale beer	Can (320 ml)	5 %	not detected	15.8
7	Sato (Thai traditional beer)	Bottle (330ml/640 ml)	8 %	5.3	19.7
8	White wine	Bottle (750 ml)	9.5 %	0.7	25.8
9	Red wine	Bottle (750 ml)	13.5 %	0.8	6.8
10	Wine[a] (Rose, strawberry, and red berries wine)	Bottle (750 ml)/Glass (100 ml)	12 %	7.4	22.2
11	Mixed fruit wine	Bottle (275 ml)	5 %	6.33	21.6
12	Wine cooler[a] (Grape and fruit sparkling wine)	Bottle (275 ml)	5 %	8.43	19.9
13	Fruit juice mixed with alcohol[a] (Red-grape sparkling wine)	Bottle (275 ml)	5 %	10.0	24.2
14	Rice and flowery wine	Bottle (700 ml)	5 %	4.1	16.2
15	Pure rice wine[a]	Bottle (700 ml)	5 %	10.7	45.7
16	Brut fruit sparkling wine	Bottle (700 ml)	5 %	7.3	8.5
17	Chiang Chun[a] (Whisky 28°)	Bottle (625 ml)	28 %	1.2	19.1
18	White liquor (35°)	Bottle (625 ml)	35 %	not detected	13.6
19	Brandy[a]	Bottle (700 ml)	38 %	0.5	29.8
20	Whisky[a] 28–35°	Bottle (300 ml) Peg/Tong/Gong (50 ml)	40 %	0.9	18.7
21	Whisky mixed with soda[a] (Cola whisky)	Glass (190 ml)	40 %	10.6	33.7
22	Lemon juice and Bacardi rum mixture	Bottle (375 ml)		9.8	20.7
23	Sweet gin	Bottle (375 ml)	40 %	not detected	10.7
24	Vodka Mixed Drink	Bottle (375 ml)	40 %	6.8	17.9

[a] Illustrated name in Fig. 1.

Fig. 1. A standard alcoholic drinks conversion tool.

calorie, sugar, and alcohol content of the common alcoholic beverages for health education and counseling Thai patients with type 2 diabetes. Furthermore, this tool is culturally tailored to fit into a Thai setting. The limitation is that the results of the trial to verify the efficacy of the tools among Thai diabetes patients have not been described as the process evaluation of the trial is ongoing and publications of the whole cluster randomized trial are not yet finished. The selection of the colors for easy identification of the figure did not consider avoiding certain colors for color-blind individuals may limit the usage of our tool. Furthermore, the tool can only be used as a rough guide, as the values are not representative of all types of available alcoholic beverages. We also acknowledge that the amount of pure alcohol in a 'standard drink' may be varied by region. For example, the National Institute on Alcohol Abuse and Alcoholism in the United States defines one standard drink as containing roughly 14 g of pure alcohol rather than the 10 g used in Thailand [42]. People, especially the consumers of alcoholic beverages may misuse the tool to test and select the type of alcoholic beverages illustrated in the figure, as there is no "best alcohol drink" for patients with diabetes. The tool may inform decision-making (for instance a consumer weighing low-sugar content as more important than low-alcohol content and thus selecting drinks with a high alcohol content), and whether this could have any unintended consequences or not. An individualized care plan should be considered to achieve the overall goal of diabetes control, including weight management and maintenance of a balanced diet [43].

2. Discussion and conclusion

Public health interventions such as having standard drink labels have demonstrated that they can help the individual identify and pour standard drinks [44]. Our tool is another example of a visual health education tool, using photos for standard drink conversion to provide information on calorie and sugar contents in alcoholic beverages to be used as a part of a diabetes self management education program. The tool presented can be transferrable to other countries where alcohol consumption and diabetes patients are prevalent. With advancements in technology, the freely available online version where users can easily receive the results by selecting the drink type and adding the volume consumed can be considered. Countries can also develop similar tools depending on their preferences for common alcoholic beverages and the differences in the definition of standard drinks. Future research considers how the information included in this tool could be incorporated into front-of-package product labels so that people do not need to carry the tool around, but rather have easy access at the point-of-sale to the information to make an informed decision from the package labelling. Augmenting information using a standard alcoholic drinks conversion tool could be explored more in the behavioral interventions and management of other chronic non-communicable diseases such as hypertension.

Ethics and consent

This study was conducted according to the Declaration of Helsinki and International Ethical Guidelines for Biomedical Research Involving Human Subjects. Ethical approval was obtained from the ethical review committee of Chiang Mai University (No. 326/2018)

and the London School of Hygiene & Tropical Medicine (16113/RR/12850). The study participants were recruited by their written informed consent voluntarily.

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Data availability

Data included in article/supp. material/referenced in article.

CRediT authorship contribution statement

Thin Nyein Nyein Aung: Writing – original draft. **Kanittha Thaikla:** Writing – review & editing, Conceptualization. **Nutchar Wiwatkunupakarn:** Writing – original draft. **Chanchanok Aramrat:** Writing – original draft. **Kanokporn Pinyopornpanish:** Writing – review & editing, Methodology. **Wichuda Jiraporncharoen:** Writing – review & editing. **Orawan Quansri:** Writing – review & editing, Methodology. **Iliatha Papachristou Nadal:** Writing – review & editing. **Sanjay Kinra:** Methodology. **Chaisiri Angkurawaranon:** Writing – review & editing, Writing – original draft, Methodology, Conceptualization.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:Chaisiri Angkurawaranon reports financial support was provided by Chiang Mai University. CA is a section editor for Heliyon If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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