Formative Research to Develop a Prototype of Sugar-sweetened Beverages Monitoring Application for Obesity Management among Indonesian Adolescents

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Abstract: The increase in obesity prevalence in adolescents is caused by passive overconsumption, such as the intake of sugar-sweetened beverages (SSB). There are limited useful applications that can help people to monitor calories and sugar from drinks. We aimed to investigate the SSB application requirement, develop, and explore the acceptance of a prototype SSB application. This study was conducted in three stages: formative research, development, and acceptance of the prototype application. The formative research employed qualitative methods to provide information from 17-22 years in Medan to plan the application development. The stage of development included selecting a developer, selecting the programming language, and designing the application. An acceptance test was performed among 100 adolescents in Medan afterward. Participants required an informative, easy, and exciting application. EduDrink is a prototype application to monitor calorie and sugar intake of SSB that has simple features, educational videos, notifications, a food database, estimated portion sizes, and regular monitoring charts. The EduDrink prototype has excellent acceptance regarding content, graphic, and flow applications. This prototype can be further developed into a mobile application for validation in obesity management.

1 INTRODUCTION

The prevalence of obesity increases significantly over the years. Basic Health Research Data (Riskesdas) in 2013 showed that 10.8% of adolescents aged 13-15 years in Indonesia had an overweight problem, consisting of 8.3% overweight and 2.5% obesity. There was also an increasing trend in the incidence of being obese from 1.4% in 2007 to 7.3% in 2013 in adolescents over the age of 15 years (Kemenkes, 2013).

This increasing trend can be caused by ignorance in choosing beverages. Sugar-sweetened beverages (SSB) are added with simple sugars during the production process, adding energy content with little nutritional content (McGrath et al., 2012; Miller et al., 2019). Research at Harvard University (2009) found that in 300-500 ml serving of sweetened drinks, Indonesia's unit contains 37-54 grams of sugar. The amount of sugar content is four times more than the recommendation for a safe added sugar content, 6-12 grams (Harvard University, 2009). Sugar sweetened-beverages are the favorite drinks consumed by teenagers. In America, adolescents aged 12-19 years consume as much as 65.4% SSB at least one time per day (Bleich and Vercammen, 2018). Basic Health Research data shows the proportion of SSB intake in Indonesia ≥ 1 times a day at ≥ 10 years of age reaches 53.1% (Kemenkes, 2013). According to the British Soft Drinks Association, SSB is divided into several types, namely: carbonated drinks, dilutable, fruit juices, still/ juice drinks, sports/energy drinks (The British Soft Drinks Association, 2014). The high energy

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and sugar content in these drinks have an impact on health in the form of weight gain, obesity, type 2 diabetes mellitus, dental caries, and the risk of cardiovascular disease (Miller et al., 2019; Scharf and DeBoer, 2016; Bleich and Vercammen, 2018). Besides, SSB usually does not have the same satiety effect as solid food. There is a tendency to consume other foods to feel fuller, leading to higher calorie consumption (Pan and Hu, 2011; Bachman et al., 2006).

The use of technology-based mobile applications has also increased its use in obesity prevention because it is flexible, cost-effective, and easily accessible (Paul et al., 2016). Obesity management in the form of lifestyle interventions in the future requires specific control, self-monitoring with mobile applications, pharmacotherapy, education via the internet, meal changes, and telephone interventions to increase its success (Mahan and Raymond, 2017). This phenomenon is also supported that smartphone usage is getting bigger in the era of the 4.0 industrial revolution, with more than 100 million users in Indonesia in 2015. This number is predicted to reach 5 billion users in 2019 globally (Anderl, 2015; Kemenkominfo, 2015). At present, technology development is very rapid, including medical science. Still, only a few applications exist in nutritional science to monitor calories and food. There is no Android technology-based application to monitor SSB intake to control and prevent the increase in obesity rates, hypercholesterolemia, and the risk of other diseases. So, we want to create a prototype application for monitoring SSB intake as one of self-monitoring in preventing obesity.

2 MATERIALS AND METHODS

We developed a prototype of a mobile application called EduDrink. EduDrink (Education and Drink) can monitor calorie and sugar intake on SSB and provide education according to the results. This prototype can guide people to achieve weight loss or maintain healthy body weight by self-monitoring their calorie intake, sugar intake, and educational video advice. People can also track their targets such as their weight loss, Body Mass Index (BMI), calorie intake, and sugar intake.

The study had three stages: formative research, development of the mobile application prototype, and the acceptance of the application prototype. The formative research used qualitative methods to provide users with information to plan the mobile application prototype's development. The development stage included selecting a developer, selecting the programming languages, and designing the application. The acceptance test was performed among adolescents in Medan after the development stage.

The formative research process is a critical step in developing the application prototype. The feasibility and the acceptability of the application were tested in focus group discussions (FGD). The subject consisted of 10 participants, divided into two focus groups aged 17-22 years. The participants were students in the Faculty of Medicine University of Muhammadiyah Sumatera Utara, Medan, Indonesia. They were asked about their prior knowledge in SSB, history of using food records, history of using the dietary mobile application, and the kind of expected application. The subjects were recruited in February 2020. Inclusion criteria included being 17-22 years old, apparently healthy, and owning an Android smartphone.

In the development stage, we collaborated with application developers and graphic designers. The application developers and the graphic designers worked together to develop the application prototype according to the FGD and literature input.

The acceptance stage was performed among students in Medan after the development stage. The subject consisted of 100 adolescents living in Medan, Indonesia, who were recruited in May 2020. Inclusion criteria included being 17-22 years old, apparently healthy, and owning an Android smartphone. For testing the application's acceptance, each subject was provided the application to install it into their android smartphone. Each subject received instructions and was shown how to use the EduDrink app. The subjects were interviewed to discover the acceptance of EduDrink in terms of contents, design, and flow of the application. They were also asked to comment on its limitations, advantages, and suggestions for future improvements.

The investigators designed a sociodemographic survey to gather general sociodemographic information, namely age, and sex. In the acceptance stage, the sociodemographic information was based on age and sex. The prototype allowed users to input their weight, height, and date of birth to calculate BMI and get the nutritional status and total energy expenditure. The prototype also allowed users to enter a particular type of beverage and obtain its nutrition facts to be used as a dietary record.

Descriptive analysis was performed to describe the characteristics of subjects and the acceptance of EduDrink. The qualitative analysis was performed to describe the formative research by matrix analysis.

3 RESULTS

Table 1 describes the subject characteristics of FGD. FGD subjects were 70% women and predominantly aged 19-20 years.

Table 1: Characteristic of subjects in formative research.

Variable	n (%)
Sex	
Male	3(30)
Female	7(70)
Age (years)	
17-18	3(30)
19-20	6(60)
21-22	1(10)

Table 2 describes the subject characteristics for User Acceptance Test. The subject was predominantly female with an age range of 19-20 years. All subjects have android at least the last six months.

Table 2: Characteristics of subjects in development and acceptance test of EduDrink.

Variable	n (%)
Sex	
Male	23(23)
Female	77(77)
Age (years)	
17-18	13(13)
19-20	76(76)
21-22	11(11)
Time of having an android smartphone	
<6 months	0(0)
≥Six months	100(100)

It was found that the subjects were not very familiar with SSB, including the calories and sugars contained therein. The hope of an application that is easy to use, interesting and informative (Table 3). It can be understood that EduDrink is well accepted in terms of its content, graphic, and flow app. However, some parameters are below 70%, such as an appropriate font size (67%) and an attractive appearance (69%). Those were shown in table 4.

Detailed SSB items (name of SSB, portion size, and nutrient) and educational video were uploaded into the database server in the development stage. The exact food items (SSB) were uploaded from the database of NutriSurvey. Educational videos were made based on SSB energy and sugar sufficiency figures and uploaded manually into the database server. The formulation of the Body Mass Index and total energy expenditure based on the Harris-Benedict formula were also uploaded to calculate the nutritional state and the total energy expenditure individually. This application also has a push notification reminder if any gap from the recommendation of calories and sugar deviates from the required amount.

Table 3: Focus group discussion result based on matrix analysis (n=10).

Topic	Quotation
Understanding SSB	SSB is a sweetened drink containing added sugar, drinks with artificial sweeteners such as canned drinks and boxes. The effects of SSB on health are obesity, diabetes, stimulate thirst as it contains high calories.
How to control SSB consumption	Unable to know the amount of calorie or sugar in a drink, unless a Boba drink and a packaged drink, which included its composition /nutrition facts on the back label
Understanding about food record	Do not know
To do a food record with paper-based, web-based, mobile-apps	Preferably using mobile applications because it is easy, efficient, and mobile
Using dietary mobile apps before	Know but do not use it
Helpful features	There is information on the type of drink, the amount of calorie, the right menu with a simple application to enter a drink with a picture, or the menu is in the form of images and writing
Level of boredom filling dietary mobile app	It depends on features and input frequency
How mobile apps are expected to be	Easy to use, simple, attractive, informative, and user-friendly

Table 4: Acceptance of EduDrink (n=100).

Parameters	n (%)		
	Good	Moderate	Poor
Understanding of information	84(84)	16(16)	0(0)
Understanding of terminology	77(77)	22(22)	1(1)
Appropriate food picture	76(76)	24(24)	1(2)
Appropriate information	83(83)	17(17)	0(0)
Ability to monitor the goal	77(77)	22(22)	1(1)
Know calorie intake and the composition	77(77)	22(22)	1(1)
Know nutrition facts	75 (75)	22(22)	3(3)
Useful reminder	76(76)	23(23)	1(1)
Useful information	80(80)	20(20)	0(0)
Graphic			
Attractive color combination	75(75)	22(22)	3(3)
Appropriate font size	67(67)	31(31)	2(2)
Attractive appearance	69(69)	30(30)	1(1)
Flow app			
Understanding of command	82(82)	17(17)	1(1)
Easy step to input beverages	75(75)	25(25)	0(0)
Easy to track the calorie intake and its composition	86(86)	13(13)	1(1)

4 DISCUSSION

This study aims to investigate the requirement (content, feature, and design), to develop, and to explore the acceptance (content, feature, and design) of a mobile application prototype based on SSB. As we know, formative research is crucial to do in developing this intervention. We found that a dietary mobile app's expected requirements are easy to use, informative, and enticing through the study. According to Duff et al., the technical aspects of the application (such as push notifications and the user interface) and interactive contents are the techniques to modify a healthy behavior (Duff et al., 2016). So we have applied all of these in the prototype that we have developed.

In the development process, the EduDrink mobile application prototype is a tool to record dietary data and to give the individuals educational videos based on the number of calories and sugar that they should be restricted. EduDrink also gives some health videos, push notifications, food databases, and estimated portion sizes to improve compliance in the long term for dietary interventions. Ananda et al. said that mobile applications might be an innovative tool for an individual's health behavior change intervention (Ananda et al., 2016). This process's limitation was the availability of the Indonesian food composition table that is important data to estimate the nutrient intake. All food databases in EduDrink are from Nutrisurvey 2007 food database, but the database is not up-to-date (Ananda et al., 2016).

This application prototype is also equipped with nutrition education related to monitoring individual calorie and sugar intake. Nutrition education is adjusted to the amount of individual calorie and sugar intake per day. Education that utilizes unique factors on online platforms is an effective intervention to change behavior, which can reach a larger sample size (Murimi et al., 2019; Backinger et al., 2011). Visualized nutrition education has a better effect on increasing fiber intake than un-visualized education and without education. This effect occurs in culturally adapted short-duration treatments and is delivered in series (Li et al., 2018). Several factors influence the success of online nutrition education interventions, namely 1) the use of specific messages and individual feedback; 2) participant involvement, as measured by the level of interaction between investigators and participants; 3) duration of intervention for three months; 4) identification of specific vs. general health targeted behaviors; 5) alignment of intervention activities with stated objectives; 6) and the use of theory-based interventions. On the other hand, several factors represent the poor design in online nutrition education interventions, including comparisons of bias, lack of specific details on duration or dose, lack of objective measurements, and lack of tracking systems (Backinger et al., 2011).

EduDrink was found to have a good acceptance among the users regarding its content, features, and design. Respondents found EduDrink to be a useful application, easy to carry and use because of its typical feature as a paperless food record. However, some users gave feedback that EduDrink should be improved for the appropriate font size and more attractive appearance. This feedback means that EduDrink also has some good points but needs to be improved in the future. The Technology Acceptance Model (TAM) and constructs related to diet application usage adoption (i.e., Technical Barriers [TB], Social Norms [SN], Personal Innovativeness [PINN], and Perceived Enjoyment [PE]). Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) are crucial in deciding an individual's aim to use a particular technology. Okumus and Bilgihan (2014) stated that diet applications do not only offers tools to

have utilitarian aims such as losing weight, but they also have hedonic aims such as the excitement of using the app. When the goal is to discover ITU in managing a diet on a smartphone application, the model should be supported by other theories that incorporate both utilitarian and nonutilitarian motives for use. Users may be motivated to use technology due to PE while using it (Okumus et al., 2015).

5 CONCLUSION

In conclusion, EduDrink has good acceptance regarding its content, features, and design. The improvement of this mobile application prototype in the future might include design problems and food database update. This prototype can be further developed into a mobile application for validation to be used for obesity management.

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