Application of Cloud Platform in Health Promotion—An Example of Improvement on Sugar-sweetened for Adolescents

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Keywords: Health promotion, APP-Cloud, Sugary drinks.

Abstract. APP-Cloud-based mobile healthcare has rapidly risen in recent years, which brings the disabled people, bad walker and dementia patients the chance to receive medical treatment opportunities without having to go to the hospital. The healthy people can also enjoy the benefit it brings to make ubiquitous monitoring for self-healthcare. In this paper, a pre-test to investigate the factors including the sources and drinking contexts which affect the intake of sugary drinks are made for the target group of adolescents. Next, the APP tool is designed to provide reminding and guidelines in real time. The early warning core implemented in the cloud can be used to monitor users' past drinking records and predict possible impacts as the time passes. The experimental results show this kind of health management mechanism indeed have considerable effect and which can achieve the indirect goal of reducing medical costs.

Introduction

According to the National Nutritional Health Status Survey from 2005 to 2008, the prevalence of metabolic syndrome in the age group of 19-30 years was 8.3% for males, 4.7% for females and 6.4% for all. According to this nutrition survey compared with 1993-1996 version, waist circumference of people in Taiwan tends to increase with 4-5 cm for males and 3-4 cm for females, both of which increase more in young people [1]. In recent years, the health hazards of sugary drinks have gradually been taken seriously. Many studies indicate that intake of sugary drinks may be related to obesity, diabetes, cardiovascular diseases and metabolic syndrome [2][3][4]. Some studies have pointed out that the frequency and calorie by taking the sugary drinks among adolescents have increased year by year [5][6]. The intake the sugary drinks has the negative impact on health which makes it become the issue worth to study further. On the other hand, with advances in technology, health care has been into a new era by using cloud technology. For example, Taiwan's Ministry of Health and Welfare launched the Taiwan Health Cloud overall program [7]. It is composing of the medical cloud, the care cloud, the health cloud and epidemic cloud. Its aim is to establish an immediate and convenient personal health management system through the application of the concept of health information infrastructure and cloud computing, to develop the integration and application of health information to the public on the premise of information security and personal data protection, and further provide medical institutions and public health organizations and health service providers to cooperate with each other. With the health insurance medical information cloud inquiry system, when a doctor visits the public, the consultation physician or the pharmacist can instantly check the patient's health insurance information through the health insurance information service system hence avoid duplication of physicians’ prescriptions, repeated patient medication, repeat inspection to enhance medical safety and quality.
APP-based Healthcare

In the medical industry, a variety of mobile healthcare applications emerge, and mobile messaging services are attempting to subvert the healthcare industry. In order to standardize the health care-related APPs, Mobile phones and tablet applications, medical regulatory authorities in all countries actively promote the development of the health industry under the guarantee of information security in the same time. Once the cloud-driven health APP management system allows users to measure physiological information, the data can be uploaded to the cloud server, and the user can read and manage daily physiological information through the APP, so as to improve the health and self-management of the user. For example, Omron launched a Bluetooth and NFC-enabled sphygmomanometer in early 2015 [8], and used ‘Karada Graph’, an APP that uses short-range wireless communication to send measurement information to mobile phones for blood pressure management. OMRON also formed an alliance with Acer to provide Acer Open Platform (AOP). Data will be transmitted to the health management platform to provide tele-care services. In addition to its wireless networking capabilities, it can immediately upload test results to cloud-based blood pressure management and healthcare organizations. It also provides atrial fibrillation function, at the same time detect the two risk factors causing stroke and myocardial infarction, in order to achieve the purpose of prevention. In addition to the introduction of Bluetooth and NFC-enabled sphygmomanometers, H2 Care Company also aggressively deploys the products in wearable areas, and this strategy will help to integrate the advantages of its blood pressure measurement technology into wearable devices [9]. Yousheng Medical Company also introduced three network-based sphygmomanometers, and which linked to self-developed blood pressure management APP ‘Healthstyle’ [10]. The above-mentioned smart devices mostly use Bluetooth technology for completing the sensing information transmission, mainly due to the low power consumption of Bluetooth and the high availability of relevant devices, which making them widely used in tele-care terminals. In addition, the layout of various manufacturers emphasizes the connection of back-end health management platform. Regardless of using self-developed platform or cooperating with information and communication providers, all manufacturers are moving toward providing a complete solution for distance care.

Research Process

Pre-test

In this study, a total of 124 college freshmen in New Taipei City are participated at this research. The number of boys and girls is 52 and 72. The frequency of dietary life style questionnaire survey, analysis of their admission medical examination to explore the intake of sugary drinks, body position and biochemical values, and analysis the factors that affect the intake of sugary drinks are performed. The collected data include the following: (1) Basic information: contains body type and blood pressure measurement, gender, age, height, weight, waist circumference, and blood pressure. (2) Disease-related information: includes the history of disease and whether has tooth decay or not. (3) Biochemical values: includes the urine protein, urine sugar, white blood cells, hemoglobin, hematocrit (in Ht unit), platelets, GOT, GPT, uric acid, creatinine, urea nitrogen, total cholesterol, and triglycerides. The content of questionnaire consists of the items as follows: (1) Lifestyle survey: contains the exercise frequency and smoking history. (2) Surveys about the sources of sugary drinks: includes the sources of drinking, the source of purchasing, the drinking situation, weekly pocket money and weekly drinking frequency. (3) The items cover all type of sugary drinks drink, cognition of sugary drinks, considerations of purchasing sugary drinks, and self-efficacy to refuse sugary drinks. The statistical analysis is made by SPSS 12.0 and correlation analysis by Pearson coefficient is found. The t-test to examine the statistical differences among each group are also made. Total of 124 research cases including 52 males (41.9%) and 72 females (58.1%) are participated with an average age of 18.4±0.56 years old. The number of overweight and obesity cases was 30 (24.2%). The
overweight and obesity ratio of boys was higher than that of girls, with 32.7% and 18.1% for male and female respectively. The average BMI of all participants was 22.5±4.69 kg/m². A total of 15 participants (12.1%) had abnormal waist circumference. The abnormal waist circumference of boys was also higher than that of girls (15.4% and 9.7% respectively). In survey about the sources of sugary drinks, it shows that in addition to purchase by themselves, paying by friend or the families are also the main source of intake the sugary drinks. Therefore, nutrition educations are also important means for family members and friends. The factors of main sources of place are including on the school trips to and from school or shops in or near the school. It implies promotion of health drinks certification at shops in and around schools is a feasible way to improve the situation. Conditions for consuming sugary drinks are mainly thirsty, mealtimes and in the hot weather. For the sugary drinks cognition, it founds there are 5 questions less than 60% in correct ratio in the study. It implies efforts can be made to provide education on those questions which with higher error rate such as sports nutrition, sodas, the nutrition labeling and other nutritional knowledge in order to help young people to make the right choices for healthy drinks.

For sugary drinks intake frequency, the average number of weekly intake of sugar drinks in all subjects was 3.7~2.6 times. The average weekly intake by boys was 4.5±3.1 times and that of girls was 3.1±1.9 times. The frequency of weekly taking of sugary drinks by boys was significantly higher than that of girls (p = 0.005). According to the National Nutritional Health Survey from 2013 to 2014 in Taiwan, 89.9% of junior high school students and 85.3% of senior high school students drink at least one sugary drink weekly, in which junior high school students drink more than 6 times a week on average and senior high school students drink more than 8 times. The results also showed that the average daily intake of sugar drinks among adolescents has risen upwardly compared with 1993-1996. Although the frequency of weekly intake of sugary drinks in all subjects was lower than the value of the National Nutritional Health Survey from 2013 to 2014, 90.3% of the subjects drink at least one sugary drink weekly. On the other hand, the frequency of intake sugary drinks was positively correlated with the amount of weekly allowance (R = 0.203, p = 0.023). It suggested the parents have to keep track of the amount and need of young people's pocket money and pay attention to their use of it. The frequency of intake of sugary drinks was also positively correlated with the difficulty of self-efficacy of refusal sugary drinks in many test questions and the overall self-efficacy difficulty (R = 0.37, p = 0.000). It implies the higher the self-efficacy of refusing to drink the sugary drinks, the less behavior of consuming sugary drinks and more confidence with no intake of sugary drinks. Therefore, consider specific and effective dietary measures in food hygiene education according to different situations in order to really be away from sugary drinks is required. For biochemical value analysis, abnormalities on Serum triglyceride (>150 mg/dL) were higher for boys than for girls, with an abnormal proportion of male and female accounting for 17.3% and 2.8% respectively. Mean serum triglyceride for boys were significantly higher than for girls (106±72.6 mg/dL versus 68.7±36.7 mg/dL; p = 0.001). In this pre-test, boys were found to have significantly weekly intake of sugary drinks than girls (p<0.05), also Glycerides were significantly higher for boys than for girls (p<0.05). The body mass index and obesity were higher for boys than for girls, and boys' waist circumference was higher than girls. This result may be result from the higher weekly frequency of intake of sugary drinks in boys.

APP-Cloud Design

Bu summarizing the pre-test results, the factors have to be designed into the APP interface includes the gender, age, height, weight, waist circumference, blood pressure, history of disease, tooth decay status, the exercise frequency, smoking history, all type of sugary drinks type and weekly drinking frequency. Due to technology and device restrictions, only Android version APP is implemented. The APP system transfers these user data to and from the cloud by using the portal PHP scripting pages. In the flow design of APP, the first screen asks the user to enter the basic information. These values will determine the likelihood weighting of the various predictions. The life style survey is assigned on the second screen. The basic information and life style data are entered by checking the missing value.
After the submit button is pressed, the prediction risk screen will be shown in the third screen. The prediction is made by artificial neural network according to the training data consist of the combination of basic information and life style numerical data and the output which are based on the history investigation data is generated by backward propagation to determine the weight and threshold value in each neuron cell. Among the output values, the most important two factors are total cholesterol and triglycerides. They are list in probability form and another two multi-line textboxes are appeared. One is the diet and food suggestion, and another is the warning notification to remind the user to control the week amount of the sugary drink. On the cloud side, to establish the cloud environment, the Apache hadoop system is built and Hive data warehouse with Thrift interface are also set up. To make it be compatible to legacy MySQL database management system, HadoopR with R working environment are adopted to quickly create the inference engine in the cloud core. The framework of platform can be easily extended to contain other components of Hadoop ecosystem with computing core.

**Experiment Study**

**Experiment Setup**

All 113 participants are asked to install the APP to their smartphone, and the data should be updated at least for one week. The experiment continued for six months and the data are stored on the cloud side. The output risk evaluation is made by categorical level instead of numerical value to bring the user more comprehensive and visual effect. The evaluation table about body status is collected from the participants. The measurement parameters include: (1) The individual and total improvement of physical status after using the APP. (2) The individual and total improvement in amount of sugary drink after using the APP. (3) Effects for each factor after use the APP. (4) The user satisfaction for the APP. Only results of first three parameters are discussed in next section due to the space limitation.

**Experiment Result**

The improvement for individual and total improvement of physical status after using the APP is plotted in Figure 2(a). Almost all participants have significant improvement up to 75.3% in physical status and mental status. Some encouragement scheme like prize redemption may result in further enhancement of the effect. The improvement for individual and total improvement on amount of sugary drink is also obvious for these young participants up to 45% reduction, as depicted in Figure 2(b). The APP is regarded as a substitute like the billing book to record the consumption of these drinks. The alarm and warning messages delivered from the cloud played an important role to notify the unrestrained behavior and wasting action for these teenagers. It is worth mentioning the correlation between the improvement and the poor economic environment will be needed to be further
explored. Finally, the effects for several factors after use the APP are investigated. 70.4% participants afforded the benefit from the drink survey education page in APP which includes the calorie labels of major market available drinks. 32% participants become more capable of refusing the invitation for drinks after they check out the APP.

![Figure 2. Influence of APP intervention on two parameters.](image)

**Conclusion**

This paper described the introduction of the proposed APP-Cloud environment for health promotion, and evaluations are conducted to investigate the efficiency and feasibility of healthcare framework based on mobile devices. The experiments results show the amount and frequency of taking the sugary drink can be reduced significant by the APP-Cloud framework. The future work includes the extension of the functions in the APP, such as location-based services, incorporate with other self-health management functions, customized APP design and combination of application with Internet of Things.

**References**


