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Effects of an Online Community Intervention on Taiwanese Sugar Intake Behavior

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Abstract

Sugar intake has increasingly been a threat because of its association with chronic diseases such as diabetes. During the ongoing Covid-19 pandemic, people have stayed indoors with minimal activities, leading to unhealthy eating habits and weight gain. However, through health-promotion education, these threats could be managed. This study focused on an online health nutrition program for sugar reduction, with an aim of developing an online training program for reducing sugar intake. Data were collected from 100 participants belonging to a Facebook community in Taiwan. They performed activities guided by research's daily lesson plans for a maximum of 10 minutes per day for three weeks. Online questionnaires were used for the pretest and posttest. Findings revealed significant differences in health knowledge ($t(99) = -8.27, p < .001$), attitude ($t(99) = -8.98, p < .001$), self-efficacy ($t(99) = -10.14, p < .001$), and perceived healthy behavior ($t(99) = -12.40, p < .001$), with their posttest scores being higher than their pretest scores. These findings imply that online training on Facebook is an effective educational tool during the Covid-19 pandemic. Therefore, this study contributes to behavioral science knowledge by revealing Facebook as a facilitating and training platform for promoting healthy behavior, and access to information on reduction of sugar intake during pandemic. Furthermore, these findings could be used as empirical evidence of the possibility of implementing online nutrition programs for the teaching and training of online communities.

During the Covid-19 pandemic, people's lives have been adversely affected because they were afraid of getting the virus (Roy et al., 2020). People were forced to stay indoors with minimal activities which caused unhealthy habits and weight gain due to poor diet (AlMughamis, 2020). Therefore, people became increasingly exposed to potential types of diseases, for example, cardiovascular diseases and diabetes. It is estimated that over 451 million people in the world are living with diabetes, and these figures are expected to increase to 693 million by 2045 (Sinclair et al., 2019). The global increase in diabetes can be associated or triggered by many factors, including the aging population, an unhealthy diet, and a sedentary lifestyle (Sinclair et al., 2019). In recent years, the consumption of Sugar Sweetened Beverages (SSBs), for instance, fruit

drinks, soda, and energy drinks, has been increasing across the globe (Malik et al., 2010). These SSBs are now the primary source of added sugar as they contain sweeteners such as sucrose, high fructose corn syrup or fruit-juice concentrates, whereas beverages that are 100% fruit juice and blended without added sweeteners are not considered as SSBs (Malik et al., 2010). Taiwan has the highest density of chain shops selling bubble tea in the world; the beverages these shops sell contain SSBs (Yu et al., 2016). One cross-section study evaluated the association between obesity in adolescence and SSB consumption in Taiwan and found that 87.7% of adolescents drank SSBs daily with a high number being people with obesity (Yu et al., 2016). The findings from the previous studies pointed out that the consumption of SSBs is considered as a major

cause of obesity (Malik et al., 2010), high blood pressure, cardiovascular disease, and diabetes (Sinclair et al., 2019).

According to Emerging Risk Factors Collaboration (2011), patients with diabetes face higher death risk compared to patients without diabetes. Further, the Emerging Risk Factors Collaboration (2011) highlighted that National Health Services of England in March 2020 announced one in three patients who died in hospital in England following Covid-19 diagnosis was diabetic. Therefore, diabetes during the Covid-19 pandemic continues to be a major threat to global public health because uncontrolled diabetes can easily result in a higher death rate if people do not have an appropriate diet. Since the negative impact of diabetes cannot be underestimated during the Covid-19 pandemic, Borek et al. (2019) proposed diabetes prevention as an international priority. Particularly, nutritional management is considered as one of the bases of diabetes care and education. Studies have shown that diabetes can be prevented or delayed with efficient health management (Frech, 2012). Another way to prevent or delay diabetes is through health promotion education. To empower the sick and the healthy population, education plays a dominant role in knowledge, skills and lifestyle interventions that they can use to effectively manage their own conditions (Borek et al., 2019).

Nowadays, people have become increasingly reliant on the internet as a means of obtaining relevant information and social support to aid decision making in various aspects of their daily lives. For instance, Oroszlányová et al. (2018) highlighted that in the USA, millions of American adults use online resources on a daily basis to search for health information on the web related to their health concerns. Similarly, during the Covid-19 pandemic, a larger number of Taiwanese were using the Internet as a dominant source to update themselves on information about Covid-19, followed by local media, families, friends, and medical staff (Wang et al., 2020). Further, the use of social media emerged as an important platform for interactions and exchange of multidimensional information, including comments, reviews, invitations, images, photos and videos (Sarmah et al., 2018). Social media are considered as online social networks comprising virtual communities where users interact with others, including people they have not known before; they share information, experiences, videos,

pictures about organizations, and services with which they are in contact, thus improving social interactions (Sanz-Blas et al., 2017). Some of the social media, preferably known as Social Network Sites (SNSs), include YouTube, Twitter, Facebook, Instagram, MySpace, LinkedIn, Wikipedia and Google+ (Rahman et al., 2018; Aboelmaged, 2018). Several studies have used SNSs; for example, Facebook was used as a platform for co-creative service innovation to examine the relationship between key drivers of co-creation in a social media context (Sarmah et al., 2018); Twitter was used for predicting the success of health care by healthcare professionals (Aboelmaged, 2018). Among all of these SNSs, Facebook is the most widely used (Rahman et al., 2018), with over 1.8 billion users worldwide (Sanz-Blas et al., 2017). Raamkumar et al. (2020) confirmed that the spread of the use of social media, especially Facebook, can give deep insights into the public health authorities' communication strategies during the pandemic. It is therefore believed that using Facebook can have potential positive impacts on people's health behaviors. Although studies have demonstrated that SNSs were effective in terms of improving users' access to health information, engaging families in lifestyle changes, and weight management (Zhang et al., 2013), little is currently known about examining how Facebook can be used as a medium for health communication and promotion to reduce sugar intake (Zhang et al., 2013). Therefore, this study focused on using Facebook as a medium for educating an online community on encouragement of sugar intake reduction during the Covid-19 pandemic. Findings of this study could establish whether Facebook is effective for teaching an online community. Further, these findings could be empirical evidence of the possibility of implementing online nutrition programs for teaching and training online communities globally to promote their healthy behavior of reduction of sugar intake.

Research Question

Does a specially designed health intervention program on Facebook have effects on participant's health knowledge, self-efficacy, attitude, and healthy sugar intake behavior?

Literature Review

The following section explores previous literature related to this current study. Topics explored include the Health Belief Model (HBM),

health knowledge, self-efficacy, attitude, and perceived healthy behavior.

Health Belief Model

The HBM was developed in 1950 by Hochbaum and Rosenstock to explain widespread failure of people to participate in programs to prevent, and detect disease (Orji et al., 2012). HBM is one of the appropriate models for learning about individual health beliefs and infection prevention behavior (Asril et al., 2021). The success of HBM is based on its four concepts to develop designs for the effective measurement of interventions in health and education (Tavakoli et al., 2018). The model consists of four primary concepts to predict why people take action to prevent or control illness (Orji et al., 2012) including perceived susceptibility (belief about the likelihood of getting a disease), perceived severity (feeling about the seriousness of contracting an illness), perceived benefits (perception of good things that could happen from undertaking specific behaviors), and perceived barriers (the potential negative aspects of a particular health action).

Health belief model has evolved and been extended to help understand communicable and non-communicable disease prevention behaviors, and to explore individuals' responses to symptoms and their attitudes toward diagnosed diseases, and especially how they adhere to medical advice (Glanz et al., 2008; Asril et al., 2021). The extended HBM (EHBM) aims at strengthening explanatory power in which added variables require responses to specific health behavior domains because individual determinants are only directly related to healthy behavior and not mediating effects that exist between extension variables (Orji et al., 2012; Asril et al., 2021). Variables that have been added include self-efficacy, health motivation, and locus of control (Glanz et al., 2008; Asril et al., 2021). This model has successfully been used in breast cancer screening and health related behaviors, diabetic self-care (Tavakoli et al., 2018) and the dietary behaviors of pregnant women (Khoramabadi et al., 2016). However, HBM falls short because it does not provide a framework for how healthy behaviors may change over time (Frech, 2012; Orji et al., 2012). Furthermore, other factors such as demographic characteristics and individuals' attitudes could influence the knowledge, beliefs, and preventative health behavior of an individual (Asril et al., 2021). This motivated us to modify the HBM by including health knowledge, self-efficacy, attitude and

perceived healthy behavior, to explore comprehensively factors that influence the healthy behavior of an online community regarding reduction of sugar intake.

Health Knowledge

Health knowledge is a key variable in understanding individuals' lifestyles and decisions they make relating to health issues. If people have enough knowledge about bad lifestyle choices that affect their health, then they would most likely change their unhealthy behaviors. On the contrary, knowledge alone is insufficient to trigger changes in actions for most individuals. However, social influence can facilitate the change process because knowledge and interactions impact how an individual behaves (Razak et al., 2020).

Health knowledge refers to information, and skills acquired through experience or education in the understanding of a subject related to health and health-care (Gellert & Tille, 2015). Moreover, experience has an influence on health knowledge since it creates new knowledge and change behavior (Gellert & Tille, 2015). Studies conducted on health knowledge in AIDS prevention, health promotion, hypertension, cancer screening, and diabetes showed that health knowledge substantially influences health-promoting behaviors (Gautam et al., 2015). Therefore, this study incorporated health knowledge as a measure of effectiveness and learning outcome of the intervention.

Self-Efficacy

Self-efficacy is founded on social cognitive theory which refers to beliefs of an individual to successfully accomplish a task when faced with a challenge (Bandura, 2010). A strong sense of self-efficacy enhances human accomplishment in many ways. For instance, people with high self-efficacy view difficult tasks as challenges to be mastered rather than as threats to be avoided (Bandura, 2010). Besides, people with low self-efficacy shy away from difficult tasks they view as personal threats. They tend to have low aspirations and weak commitment to the goals they choose to pursue rather than concentrating on how to perform successfully (Bandura, 2010).

Several ways have been proposed to create a strong sense of self-efficacy like mastery of experience, vicarious experiences provided by social models, motivation to succeed, and reduction in people's stress reactions, their negative emotional

proclivities and misinterpretations of physical states (Bandura, 2010). Hence, the physiological indicators of self-efficacy can play an influential role in health functioning. Self-efficacy has been associated with self-management of diseases like diabetes, and health literacy, and it is believed that improving patients' self-efficacy is a critical pathway to improved self-management. Osborn et al. (2010) suggested that diabetes self-efficacy may be an important target of interventions to enhance diabetes control and promote the skills needed for diabetes management. Therefore, this study adopted self-efficacy as a measure of effectiveness and learning outcome of intervention for sugar intake.

Attitude

Attitude is considered as an effective measure of behavior and is defined as a characteristic acquired by an individual through beliefs and experiences, and attitude could be changed (Mata et al., 2012; Weng, 2019). An individual can have a positive or negative attitude towards an object or experience (Mata et al., 2012). Hence, awareness of an individual attitude towards these objects or experiences is a critical factor in course evaluation because attitudes are thought to inspire future behavior (Kroesen et al., 2017). A study by Kroesen et al. (2017) on conceptualization of the attitudes-behavior relationship reported that attitude and behavior influence each other over time, and the effects from behavior to attitudes are greater. Therefore, to measure participants' learning outcomes, attitude was included in this study.

Perceived Healthy Behavior

Healthy behaviors such as adequate exercise and sleep, eating breakfast, maintaining a healthy weight, and refraining from smoking and binge drinking are associated with higher levels of healthy behaviors of an individual (Frech, 2012). Healthy behavior refers to a person's actions in relation to their health and well-being (Razak et al., 2020). These behaviors are an important component of a person's health and are associated with common health diseases (Razak et al., 2020). Further, these behaviors prevent or delay the onset of many life threatening illnesses and chronic conditions including cardiovascular disease, onset of disability, Type-II diabetes, and obesity (Frech, 2012). In addition, healthy behavior practices do not act in

isolation, for instance, many social factors such as workers, spouse, and friends are likely to influence these healthy behavior practices (Mize, 2017). The perception of these beliefs and practices is considered as perceived healthy behavior. Mize (2017) reported that the perception of healthy behavior, is a person's action that influence health, disability, and mortality. Although, changing perceived healthy behavior is not easy because it requires continuous processes and practices embedded in social life, developing a sense of self control is usually a cognitively effortful process that initiates deliberate behaviors (Razak et al., 2020).

Therefore, this study proposes a framework that combines health knowledge, self-efficacy, and perceived healthy behavior to measure the effectiveness and learning outcomes of intervention for sugar intake to be used for a longer time in an online nutrition curriculum.

Method

The following section explores the methodology of this study. The following aspects are explored: participants, study design, procedure, teaching curriculum, measurement instruments, and statistical analysis.

Participants

The participants of this study were Taiwanese Facebook users. This sample was from an active Facebook group with more than a thousand active participants. A notification was sent in the Facebook group to clearly brief the intention and purpose of this study. A total of 100 group members agreed to take part voluntarily by replying to the notification. This study followed the ethical guidelines of Fraenkel et al. (2011). Participants were informed that there were no right or wrong answers, and no identifying information was recorded. Moreover, all practices performed in this study involving human participants were in accordance with ethical standards. Informed consent was obtained from all participants. This response rate was satisfactory given the busy nature and responsibilities of members of the group. Hair et al. (2010) mentioned that a 30% of response rate is sufficient for survey research. Further, the participants were encouraged to complete their tasks individually. The final sample descriptive statistics are shown in Table 1.

Table 1*Descriptive Statistics of Participants*

Demographic characteristics		%
Gender	Male	15
	Female	85
Age	19-30	35
	31-44	51
	45-65	14
Education background	Middle school	1
	High school	9
	Undergraduate	65
Total		100

Study Design

A quantitative research design with a single experimental group was used with a structured online questionnaire sent to participants for data collection. A pretest was administered in the first week followed by an intervention that took three weeks. After the third week, the intervention was withdrawn, and a posttest was done. The data from the questionnaire measured health knowledge, self-efficacy, attitude, and perceived healthy behavior related to nutrition education for reducing sugar intake. All the 100 pretest and 100 posttest questionnaires were filled out and returned by the respondents; all were valid and complete, thus were used for analysis. The data were collected in June 2020.

Procedure

During the first week participants were introduced to the online community group and its features. Some of the features included how to use the designed multimedia resources, lesson plans, audio, and visual materials in the new Facebook community. After they had learnt, how to use them, participants performed activities guided by the daily lesson plans for a maximum of 10 minutes every day for three weeks. To motivate participants to watch the videos, six categories of animations were used, each having different content and purpose for that day. They included, “sugar’s harm to health,” “why is sugar addictive,” “what to eat,” “that sugar film,” “how does sugar affect the body,” and “the ubiquitous sugar our life.” At the end of each video participants responded to it by answering questions

and giving their opinion about the video. This helped in tracking and ensuring that participants watched the videos. Participants were encouraged to work individually until the end of the study.

Teaching Curriculum

Teaching materials used included daily lesson plans and audio-visual materials which were designed based on health knowledge, self-efficacy, attitude, and perceived healthy behavior related to sugar reduction. The activities and tasks were designed with the advantages of Facebook to offer social support. Table 2 shows some of the multimedia resources employed as well as each lesson task.

Measurement Instrument

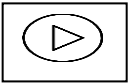
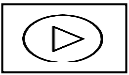
This research had four dependent variables comprising health knowledge, self-efficacy, attitude, and perceived healthy behavior.

There were 20 items related to health knowledge of sugar reduction. For instance, “What is sugar-free food?” The responses were scored on a 5-point Likert scale where (1) represents “strongly disagree” and (5) “strongly agree”. The score was expressed as a percentage whereby a high score demonstrated a high level of health knowledge. This scale was adopted from Cairncross et al. (2020) with a reliability of $\alpha = .79$.

Self-efficacy comprised 10 items adopted from Bandura (2010) with a reliability of $\alpha = .90$. It was further divided into rejecting sugary food and choosing low sugary food. The items were related to self-efficacy of participants regarding rejecting sugary food intake and choosing low sugary food. For instance, “I drink a lot of water instead of soft drinks.” The responses were scored on a 5-point Likert scale where (1) represents “strongly disagree” and (5) “strongly agree.”

Attitude had 10 items with a reliability of $\alpha = .78$. It was further categorized into sugary food rejection, eating sugar free food to avoid disease, and attitude toward sugar-free food. The items were related to participants’ attitude towards sugar-free foods. For instance, “I choose to eat sugar-free foods to avoid tooth decay.” The responses were scored on a 5-point Likert scale where (1) represents “strongly disagree” and (5) “strongly agree.” The scale was adopted from Messina et al. (2004).

Table 2*Content, Tasks, and Resources Designed for the Online Course*

Course Content	Tasks of participants
1. Addicted to sugar? 	The first lesson was about checking whether one is a sugar addict. It also tested their knowledge about sugary food and addiction. After the lesson, a pretest was administered.
2. What to eat? (self-made animation) 	Self-made animations were presented for six categories of food. Low sugar content foods enabled learners to understand which food intake was healthy for the body, and then promoted their choice of the right food. This tested their health knowledge and attitude towards sugary food.
3. Movie Sharing: That Sugar Film 	The film shows hidden sugar in foods and the consequences it can have on the human body. The learners in the community group requested that others to actively share their opinions and improve the interaction between members of the community. This tested four primary concepts of HBM.

Perceived healthy behavior included 15 items covering sweets intake behavior, beverage intake behavior, and food choice behavior. These items were related to behavior towards sugary food and drink selection. For instance, “I drink sugarless coffee.” The responses were scored on a 5- point Likert scale where (1) represents “never” and (5) represents “always.” This scale was adopted from Her (2004) with a reliability of $\alpha = .85$.

This study adopted the above scales because they have been tested and used in several studies, thereby ensuring high reliability (Dixon & Johnston, 2019). The internal reliability of these variables are illustrated in the following Table 3.

From Table 3, all the Cronbach’s alpha values for each variable were above .62. The values are acceptable since the coefficient exceeds the minimum threshold of .62 which is a satisfactory internal consistency (Ong et al., 2020).

Statistical analysis

The statistical method used to analyze data and answer the research question was the paired sample t -test.

Results

In the following section the statistical analyses are illustrated. They include health knowledge, self-efficacy, attitude, and perceived healthy behavior.

Health Knowledge

The pre and posttest data collected were analyzed using paired sample t-tests to show whether there was a significant difference between the pretest and posttest of health knowledge as shown in Table 4.

The analysis showed that there was a significant difference in health knowledge ($t(99) = -8.27, p < 0.001$) between the pretest ($M = 82.40, SD = 9.83$) and posttest ($M = 90.25, SD = 7.01$). In addition, health knowledge had a large effect size of $0.92 > 0.8$.

Self-Efficacy

The paired sample t-test analysis in Table 4 showed a significant difference in overall sugary food intake self-efficacy ($t(99) = -8.98, p < .001$) between the pretest ($M = 3.30, SD = .88$) and posttest ($M = 3.90, SD = .71$). Also, there was significant difference in rejection of sugary food self-efficacy ($t(99) = -7.24, p < .001$) between the pretest ($M = 2.95, SD = .99$) and posttest ($M = 3.52, SD = .90$). Further there was a significant difference in choosing low sugar food self-efficacy ($t(99) = -7.98, p < .001$) between the pretest ($M = 3.66, SD = .95$) and posttest ($M = 4.27, SD = .64$). It was also found that between the two subscales for self-efficacy, choosing low sugary food had the highest Cohen’s d (≥ 0.8) compared to rejecting sugary food on self-efficacy that had a medium effect size ($0.8 > 0.6$).

Table 3*Internal Reliability Coefficient of Variables*

Variables	Subscale	No of items	Cronbach's α	Cronbach's α
Health knowledge of sugar reduction	-	20		.79
Self-efficacy	Reject sugary food	5	.89	.90
	Choose low sugary food	5	.84	
Attitude	Sugary food rejection	6	.73	.78
	Eating sugar-free food to avoid disease	2	.80	
	Attitude toward sugar- free food	2	.76	
Perceived healthy behavior	Sweet intake behavior	8	.90	.85
	Beverage intake behavior	3	.72	
	Food choice behavior	4	.85	

Note. The information of the samples was taken from the following studies: health knowledge from Cairncross et al. (2020), self-efficacy from Bandura (2010), attitude from Messina et al. (2004), and perceived healthy behavior from Her (2004).

Table 4*Paired Sample T -Test on Health Knowledge, Self-Efficacy, Attitude, and Perceived Healthy Behavior on Sugar Reduction*

Variable	Item	n	Pretest		Post test		t	p	Cohen's d
			M	SD	M	SD			
Health knowledge		100	82.40	9.83	90.25	7.01	-8.27	<.001	0.92
Self-efficacy	Rejecting sugary food	100	2.95	0.99	3.52	0.90	-7.24	<.001	0.61
	Self-efficacy								
	Choosing low sugary food self-efficacy	100	3.66	0.95	4.27	0.64	-7.98	<.001	0.75
	Sugary food intake self-efficacy (overall)	100	3.30	0.88	3.90	0.71	-8.98	<.001	0.74
Attitude	Sugary food rejection	100	3.38	0.85	4.23	0.58	-11.37	<.001	1.17
	Eating sugar free food to avoid disease	100	4.26	0.81	4.48	0.86	-2.07		0.27
	Attitude towards sugar-free food	100	3.62	0.98	3.99	0.83	-3.66	<.001	0.41
	Sugar reduction diet attitude (overall)	100	3.60	0.67	4.23	0.51	-10.14	.003	1.05
Perceived healthy behavior	Sweet intake behavior	100	3.20	0.92	3.89	0.73	-8.92	<.001	0.83
	Beverage intake behavior	100	3.95	0.96	4.44	0.68	-5.50	<.001	0.59
	Food choice behavior	100	2.88	1.00	4.06	0.71	-14.15	<.001	1.37

Attitude

The paired sample *t*-test analysis in Table 4 showed a significant difference in overall sugar reduction diet attitude ($t(99) = -10.14, p < .01$) between the pretest ($M = 3.60, SD = 0.67$) and posttest ($M = 4.23, SD = 0.51$). Also, there was a significant difference in sugary food rejection ($t(99) = -11.37, p < .001$) between the pretest ($M = 3.38, SD = 0.85$) and posttest ($M = 4.23, SD = 0.58$). Likewise, a significant difference in eating sugar-free food to avoid disease was found ($t(99) = -2.07, p < .001$) between the pretest ($M = 4.26, SD = 0.81$) and posttest ($M = 4.48, SD = 0.86$). Moreover, there was a significant difference in attitude toward sugar-free food ($t(99) = -3.66, p < .001$), between the pretest ($M = 3.62, SD = 0.98$) and posttest ($M = 3.99, SD = 0.83$). Besides, among the three subscales of attitude, the largest Cohen's *d* value belonged to sugary food rejection ($1.17 > 0.8$), therefore gaining the highest effect size on attitude however, eating sugar-free food to avoid diseases had the lowest effect size ($0.5 > 0.27$).

Perceived Healthy Behavior

The paired sample *t*-test analysis in Table 4 showed a significant difference in overall sugar reduction behavior ($t(99) = -12.40, p < .001$) between the pretest ($M = 3.26, SD = .73$) and posttest ($M = 4.04, SD = 0.54$). Further, a significant difference in sweets intake behavior ($t(99) = -8.92, p < .001$) was noted between the pretest ($M = 3.20, SD = 0.92$) and posttest ($M = 3.89, SD = 0.73$). There was also a significant difference in beverage intake behavior ($t(99) = -5.50, p < .001$) between the pretest ($M = 3.95, SD = 0.96$) and posttest ($M = 4.44, SD = 0.68$). Moreover, the finding also revealed a significant difference in food choice behavior ($t(99) = -14.15, p < .001$) between the pretest ($M = 2.88, SD = 1.00$) and posttest ($M = 4.06, SD = 0.71$). Likewise, among the three subscales of perceived behavior, food choice had the highest Cohen's *d* value ($1.37 > 0.8$); therefore, exhibiting the largest effect size on perceived healthy behavior; however, beverage intake had a medium effect size ($0.59 > 0.5$).

Discussion

In the following part, the analysis of the dependent variables is explained. The variables are healthy knowledge, self-efficacy, attitude, and perceived healthy behavior.

The analysis of health knowledge showed a significance difference between the pretest and

posttest, with the posttest score being higher than that of the pretest. The analysis indicates that after the intervention period, participants gained a higher level of health knowledge on sugary food intake than before. This finding was consistent with a study by Billich et al. (2018), who reported that knowledge on graphic, text, labels and sugar information had the potential of reducing intended choice of sugary food intake of an online group. Further, the result in Table 4 illustrated that health knowledge had a large effect size of 0.92, meaning there was a strong relationship between the pre- and posttest means. Yang and Dalton (2012) suggested that effect size indices of 0.2, 0.5, and 0.8 can be used to represent small, medium, and large effect sizes, respectively. This implies that the knowledge participants gained online was as a result of the activities they performed and were involved in when learning about sugary food intake, which yielded a large effect size. Furthermore, during the intervention, participants interacted, shared, and gained a great deal from the online community. They also became aware of sugary food intake behavior and how to manage their sugar intake. Further, the lesson plans and multimedia used during the intervention assisted participants in recognizing not only the difference between sugar free foods and sugary food but also the benefits associated with eating sugar free foods. Besides, participants became aware of their health knowledge as a way of preventing diseases related with sugary food, for example, diabetes and tooth decay. Therefore, this online method on Facebook was an effective pedagogical method for an online community about health knowledge on reducing sugar intake during the Covid-19 pandemic.

Self-efficacy was also found to show a significant difference in overall self-efficacy and the other two subscales between the pretest and posttest scores. These analyses revealed that participants became aware of their sugary food intake which promoted their self-efficacy. This finding was consistent with a study by Strychar et al. (2012) which reported that self-efficacy increased with dietary self-care for patients with type 2 diabetes. Also, Khoramabadi (2016) highlighted that educational interventions based on HBM and health

promotion patterns was effective in terms of enhancing awareness and better understanding of risks, thus promoting self-efficacy of women's health and nutrition. Likewise, choosing low sugary food had a large effect size whereas rejecting sugary food had a medium effect size. This showed that participants became aware of their perceived barrier which assisted them in choosing low sugary food compared to rejecting the foods that they craved. Furthermore, the online intervention made participants become more aware of the effects of sugary food intake and how harmful it was to their health, thus boosting their self-efficacy. In this study, the multimedia during the intervention taught participants about the benefits of choosing low sugary food or rejecting sugary food. Based on the analysis, the majority of participants were enlightened about it especially after watching the self-made animation and the sugar film, so it assisted them in promoting their self-efficacy regarding sugary food intake.

Therefore, from these analyses, it can be inferred that the intervention of multimedia teaching on Facebook significantly promoted participants' self-efficacy regarding sugary food intake, rejecting sugary food, and choosing low sugary food.

In addition, all the items which measured participants' attitude showed a significant difference between the pretest and posttest, with their posttest scores being higher than their pretest scores. From this analysis, participants were aware of the effects of eating sugary food as a way of avoiding diseases such as diabetes or teeth decay after the intervention. This assisted them in having a positive attitude towards eating sugar-free food. Our findings were consistent with a study by Chawla et al. (2019) which reported that participants scored significantly higher on attitude, implying that imparting health education led to significant improvement in participants' attitude towards diabetes management. Furthermore, the analysis in Table 4 showed that sugary food rejection had the highest effect size, whereas eating sugar-free food to avoid diseases had the lowest effect size. This meant that participants would prefer to select food not because of avoidance of diseases but because they feared the consequences

associated with sugary food for their general health. Similarly, it was noted that participants were cheerful about learning from the online multimedia about rejecting sugary food as a way of keeping a healthy lifestyle and avoiding illnesses such as diabetes and tooth decay. This promoted their attitude towards rejecting sugary food and accepting sugar free foods. Therefore, the intervention of multimedia teaching on Facebook significantly enhanced the attitude of participants towards a sugar reduction diet.

The analysis of perceived healthy behavior also showed a significant difference in all its subscales, with their posttest scores being higher than their pretest scores. This finding indicated that participants perceived healthy behavior was promoted within the period of intervention. This result echoed a study by Tavakoli (2018) highlighting that educational messages improved behaviors of participants that were based on HBM constructs. Furthermore, food choice had the highest effect size whereas beverage intake had a medium effect size. This revealed that it was easier for participants to make a choice about the kinds of food to eat, for instance, with or without sugar, than about beverages. Likewise, the multimedia used during the intervention taught participants about sweets intake, beverage intake and food choice behaviors. Participants were now able to choose beverages and foods that were free from sugar not due to preference but because they had acquired a healthy behavior. This was evident after the intervention period when participants' posttest means were higher than their pretest means. Likewise, Weng et al. (2019) highlighted that health knowledge and healthy behavior achieved a significant difference after participants watched and performed online activities for awareness of a healthy lifestyle. Further regression analysis on healthy behavior showed that their model explained 70% of participants' healthy behavior. Their finding supported this current research which highlighted that after the three weeks of intervention, participants showed significant differences in their health knowledge, self-efficacy, attitude, and perceived healthy behavior. It implied that although people have undergone a worrying

Covid-19 period, they raised their awareness of health knowledge, self-efficacy, attitude, and perceived healthy behavior regarding sugar reduction as a way of staying healthy and safe.

Therefore, this study reveals that intervention of online nutrition teaching on Facebook community during the pandemic was proven to bring potential benefits such as significantly enhancing participants' perceived healthy behavior related to sugar reduction, sweets intake, beverage intake and food choice behaviors. In addition, the content of the videos helped participants become aware of the bad and good habits associated with sugar intake. Thus, these finding could be used as empirical evidence of the possibility of implementing online nutrition programs for teaching and training online communities about nutrition and behavior change.

Conclusion, Limitations, and Future Research

This study was about an online nutrition curriculum on sugar reduction with health knowledge, self-efficacy, attitude, and perceived healthy behavior as variables during the Covid-19 pandemic. The study highlights the role of Facebook in facilitating a healthy promoting behavior for reduction of sugar intake, thereby greatly easing access to information, especially during the pandemic when people relied on the internet to be informed. Likewise, users can freely learn from others in online health communities and exchange their conceptions of illness, healthy behavior and lifestyles at convenient time and space for free, since most governments have restricted human movement. This study found that within three weeks Facebook was an effective tool for teaching an online community about reduction of sugar intake as a way to stay healthy during the pandemic. Therefore, for future studies we recommend using Facebook with a larger sample size, different designs, and other dietary foci for longer term effects and deductive comparisons with our findings.

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