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The Use of Information Technology and Lifestyle: An Evaluation of Digital Technology Intervention for Improving Physical Activity and Eating Behavior

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ABSTRACT

The intervention of physical activity and the way of diet is needed to improve a healthy lifestyle and prevent non-communicable diseases. High rates of sedentary behavior and low rates of participation in sports/physical activity result in a high risk of various hypokinetic diseases (53% heart and stroke). This study aims to conduct a cross-sectional study to evaluate student health-related fitness and eating behavior. This research involves digital interventions and information technology in the form of using training videos and web-based fitness applications. Data collection was carried out on 56 students using a fitness test, the Eating Behavior Pattern Questionnaire (EBPQ), and a self-administered questionnaire. The result shows that all the studies reported on physical activity, the result also reveals that physical activity through ICT has a positive impact on other aspects such as psychosocial aspects. The conclusion of this study is the use of ICT for lifestyle behaviors is reported to be effective in ensuring health behaviors that promote physical health and eating behavior.

1. Introduction

Physical activity (PA) provides many health benefits, improves fitness, and will ultimately affect people's welfare. If the level of public health is high, it will reduce health costs so that people can save for their other living needs [1]. Research shows that physical inactivity causes high costs for health, this condition occurs in almost all countries in the world and 80% occurs in high-income countries [2]. Physical activity is highly recommended for people of all ages, from children to the elderly. Participation in physical activity is a strategy to avoid and reduce non-infectious diseases caused by lack of movement. The World Health Organization (WHO) states that increased participation in physical activity can prevent premature deaths [3]. The level of participation in physical activity that is carried out more than the minimum recommended by WHO can reduce the risk of colon and breast cancer, heart disease, stroke, and diabetes between 20-30% [4,5]. Lack of physical activity (PA) increases the risk of type 2 diabetes, including in overweight and obese people.

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Many researchers have found that sitting time has a role in cardiometabolic diseases, besides that it is also stated that sedentary behavior (SB) is an independent risk factor [6-9]. Sedentary behavior is time spent sitting at a desk, watching television, reading, and other activities without physical activity [10]. Research shows that low sedentary behavior (physically active) has been shown to reduce the risk of disease [9,11].

Non-Communicable Diseases (NCDs) are non-infectious diseases that are the main cause of death and morbidity almost all over the world, accounting for as many as 65% causing death [12,13]. Lifestyle factors are the main cause of NCDs including poor diet, low physical activity, tobacco, adiposity, and excess alcohol [13]. Therefore, it is very important to conduct interventions that can change lifestyle behavior and improve health. Evidence regarding the effectiveness of education and policies-based interventions to improve lifestyles and health has been systematically evaluated [13,14]. The use of novel information and digital technologies such as the Internet and mobile applications is considered very effective in improving lifestyles. These technological interventions are considered promising because they can reach a large scale, low cost, as well as opportunities for real-time modifications and improvements. However, studies regarding this matter are still not well established and have not been reviewed systematically. The growth and development of technology are currently very rapid, and the benefits of its sophistication are felt in people's daily lives. The use of information and digital technologies such as websites, mobile devices, mobile applications, telehealth, and tele media have been presented as a cost-effective platform to promote physical activity and improve health [15-17].

Access to this technology has greatly increased in all countries in the world, penetration of the Internet is recorded at 95% in developed countries and 60% worldwide [18]. The same thing also happens with the use of smartphones, as many as 90-95% of adults between 16-55 years own smartphones [19]. This means that most of the population in every country in the world has access to and can use information systems and technology to support their lives, especially those related to their health and lifestyle. Digital technology enables researchers, educators, and health practitioners to develop behavioral theory-based interventions to improve public health and welfare effectively and efficiently [20]. The benefits of information technology are used as a behavior change technique to meet the special needs of certain individuals or populations [21,22]. Thus, it can be concluded that information and digital technology are the vehicles for improving health and lifestyles in an informative way by empowering certain technology-based programs.

Although the benefits of digital technology and information have been widely expressed, different opinions state that the use of digital technology for the promotion and change of healthy behavior also creates a "digital divide". This is due to the use of smartphones or web applications, most of which can only be accessed by people with high education and economic levels [23,24]. A person's digital health literacy is a term used to describe an individual's ability to seek, understand, criticize, and act on health-related knowledge and guidance. This is conveyed through digital technology which is an important factor to determine which individuals can access digital technologies that promote health and healthy lifestyle behaviors [25-27]. Several studies have shown that individuals with lower levels of education and socioeconomic status tend to have lower eHealth literacy and consequently do not generate the same benefits as those with higher levels of education and socioeconomic status [28-30].

The intervention of physical activity and the way of diet is needed to improve a healthy lifestyle and prevent non-communicable diseases. High rates of sedentary behavior and low rates of participation in sports/physical activity result in a high risk of various hypokinetic diseases (53% heart and stroke). This study aims to conduct a cross-sectional study to evaluate student health-related fitness and eating behavior. This research involves digital interventions and information technology

in the form of using training videos and web-based fitness applications. Data collection was carried out on 356 students using a fitness test and the Eating Behavior Pattern Questionnaire (EBPQ), and a self-administered questionnaire.

2. Methodology

2.1 Method

This study used a quasi-experimental design, with participants assigned to either intervention or control groups. All subjects were informed about the procedure and provided written informed consent to participate. The intervention in this study was the use of the Strength Training Video [31] and the "Mahasiswa Bugar" application as a web-based fitness application. The data taken is the level of physical activity (SB, light, moderate, and vigorous) through the accelerometer Actigraph during the pre-posttest. Eating behavior was measured using the EBPQ, and that data was also obtained through a self-administered questionnaire.

2.2 Participants

Participants in this study were divided into intervention and control groups using a coin-toss random assignment. Participants were students in the age range of 17-22 years, with a low level of physical activity category based on a self-administered questionnaire PA. Based on this category, the participants included in this criterion consisted of men (N=36) and women (N=40). All participants signed the statement of informed consent.

2.3 Instruments

2.3.1 Accelerometer Actigraph for objective instrument of PA dan SB

Participants wore an Actigraph GT3X-BT accelerometer model mounted above their right hip (mid-axillary line) for 7 consecutive days without removing it, except when they were showering. This accelerometer Actigraph functions to measure movement behaviors and provides actual physical activity data at light, moderate, and vigorous PA levels. To extract data, Actigraph GT3XP-BTLE is also supported by ActiLife 6 single as software to read and analyze the data. The type of accelerometer Actigraph and ActiLife used is as shown in Figure 1 and 2 below.

Fig. 1. Actigraph GT3X-BT

Fig. 2. ActiLife software for data analysis platform

2.3.2 Eating Behavior Pattern Questionnaire (EBPQ)

Variable habits and eating behavior were measured using the EBPQ by Chenxi *et al.,* [32]. The EBPQ consists of 51 item statements developed from six indicators including low-fat eating, emotional eating, snacking on sweets, cultural/lifestyle behaviors, haphazard planning, and meal skipping. This instrument uses a Likert scale with a reliability coefficient of 0.84. Data collection was carried out during pre and post-tests on the same sample, then the results were processed using statistical analysis.

2.3.3 Self-administered questionnaire: the Godin Leisure-time PA questionnaire

The self-administered questionnaire used was in the form of self-reported physical activity during the pre, mid, and posttests. A self-administered questionnaire using The Godin Leisure-Time PA Questionnaire (GSLTPAQ) [33]. The Godin Leisure-Time PA Questionnaire is a Free Time Physical Activity Questionnaire that is widely used in research related to physical activity and sedentary behavior. This instrument aims to administer all the participants' physical activity before and during the study. Participants' physical activity recorded in this instrument will be converted into MET values to indicate their activity level (light, moderate, or vigorous). GSLTPAQ is a self-administered questionnaire consisting of 4 items with three questions. first, look for information about how many times a person engages in light, moderate, or vigorous physical activity for at least 15 min duration in a typical week. The score obtained from the GSLTPAQ includes the total weekly LTPA, which is called the Leisure Score Index (LSI). The number of bouts at each intensity is multiplied by 3, 5, and 9 Metabolic Equivalents (METs) and summed. The LSI score can be used to determine an individual's physical activity level from the lowest PA level to the highest.

2.3.4 Intervention

The intervention was conducted for 16 sessions with a frequency of 3 times per week and a duration of 60 minutes per meeting. This intervention was carried out based on belief in cognitive social theory which targets participants' self-efficacy towards their daily physical activities.

In particular, the development of the goals to be achieved is strengthened by feedback from individuals and peer models with low sedentary behavior. Interventions are carried out in a

combination of online and offline. Online interventions were conducted using Zoom media, where participants practiced using training videos and web applications provided by researchers, and supervision by researchers through Zoom media. Offline interventions are conducted face-to-face in the gym where participants did exercises using video training and web applications and are under direct supervision by researchers. The training program in each session can be seen in Table 1 below.

Table 1
Program Intervention

Session	Time	Intervention program
X1	120’	Pretest & dietary course
1	60’	Video training 1: strength training
2	60’	Video training 2: endurance training
3	60’	Video training 3: flexibility training
4	60’	Video training 4: agility training
5	60’	Video training 5: balance training
6	60’	Web app 1: strength training
7	60’	Web app 2: endurance training
8	60’	Web app 3: flexibility training
9	60’	Web app 4: agility training
10	60’	Web app 5: balance training
11	60’	Video training & web app 1: strength training
12	60’	Video training & web app 2: endurance training
13	60’	Video training & web app 3: flexibility training
14	60’	Video training & web app 4: agility training
15	60’	Video training & web app 5: balance training
16	60’	Combination training & dietary course
X2	120’	Post test

Before intervening in the first session, participants were asked to fill out a pre-test instrument in the form of The Godin Leisure-time PA Questionnaire and EBPQ. In addition, participants were asked to use the accelerometer for 7 days. After 7 days the accelerometer was removed for analysis, then the first session of intervention was carried out and continued until the end. After 16 intervention sessions, the participants returned to fill in the instrument for the post-test, and measurements were taken using the accelerometer again for 7 days. After that, all research data will be analyzed using statistics to see the effects of the interventions carried out. The intervention steps carried out can be seen in Figure 3 below.

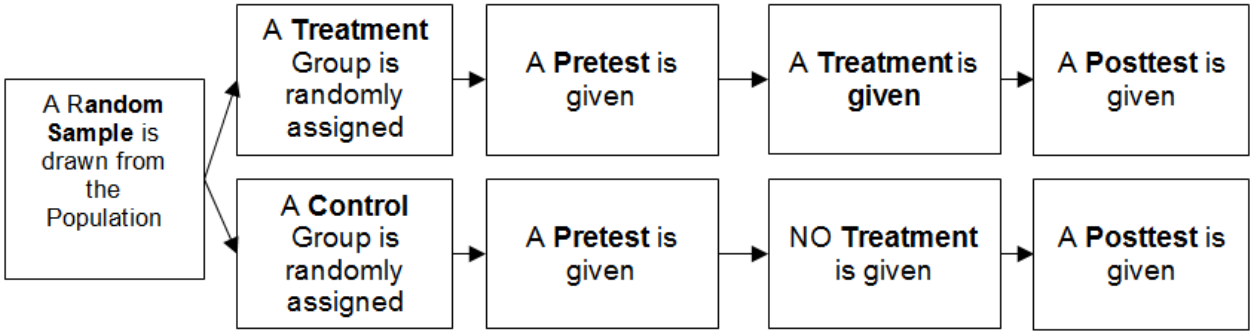

Fig. 3. The intervention steps

2.3.5 Analysis data

Data analysis used a paired sample t-test to test the effect of the intervention on increasing physical activity and eating behavior of participants. This was aimed at seeing the effect of interventions carried out through video training and web applications on participants' physical activity and eating behavior. Data analysis using SPSS version 26 with a significance value of 0.05.

3. Results

The results of data analysis regarding sample descriptions are available in Table 2. The table describes the descriptive characteristics of the participants consisting of height, weight, BMI, Total Physical Activity (TPA), moderate to vigorous physical activity (MVPA), screen time, total sleep, and eating behavior. The data in Table 2 describes the description of the average value of each component of physical activity and sedentary behavior and eating behavior based on the accelerometer Actigraph. Next, the difference in values between the pre and post-tests can be seen in Figure 4-10.

Table 2
Description of the sample based on pre and post test

Component	Sex	N	Mean	Std. deviation
Height	Pre	76	163.81	6.66
	Post	76	163.83	6.65
Weight	Pre	76	63.06	10.93
	post	76	59.94	9.55
BMI	Pre	76	25.22	6.69
	post	76	20.43	3.74
TPA	Pre	76	183.53	27.41
	post	76	272.33	26.08
MVPA	Pre	76	88.13	59.29
	post	76	146.18	55.83
Screen time	Pre	76	173.13	64.76
	post	76	119.24	36.54
Total sleep	Pre	76	659.15	67.99
	post	76	667.52	66.36
Eating behavior	Pre	76	161.80	61.06
	post	76	255.68	43.10

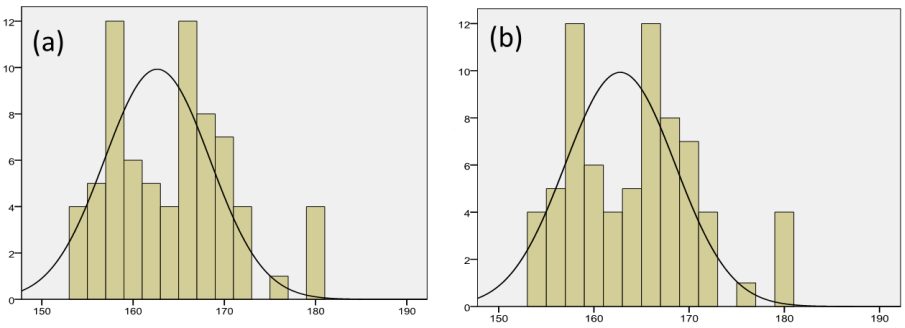

Fig. 4. (a) Pre and (b) post-test of height

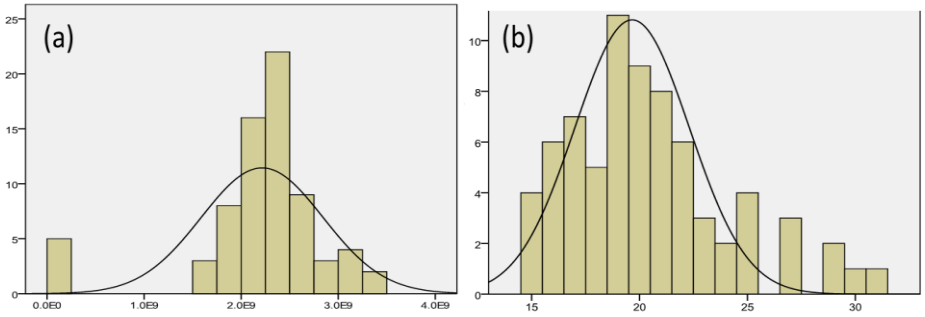

Fig. 5. (a) Pre and (b) post-test of weight

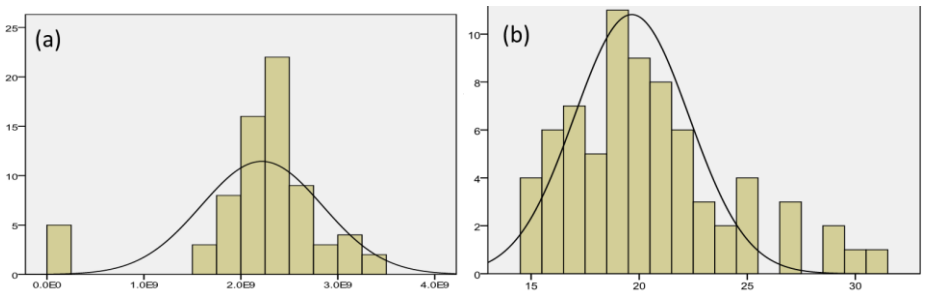

Fig. 6. (a) Pre and (b) post-test of BMI

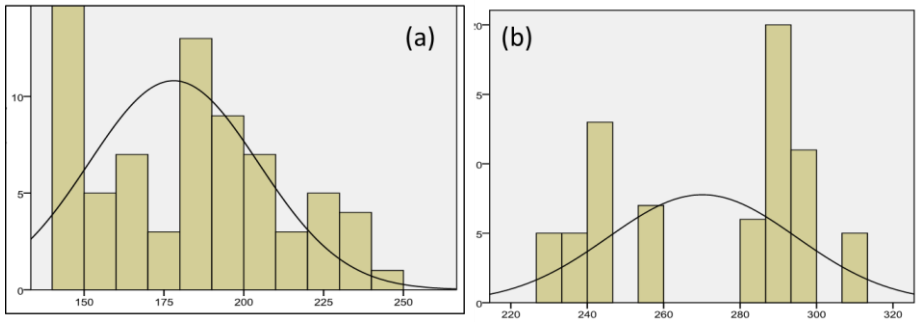

Fig. 7. (a) Pre and (b) post-test of total physical activity

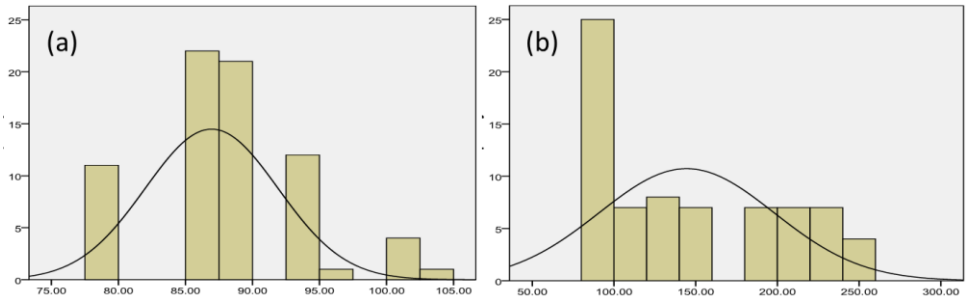

Fig. 8. (a) Pre and (b) post-test of moderate to vigorous physical activity

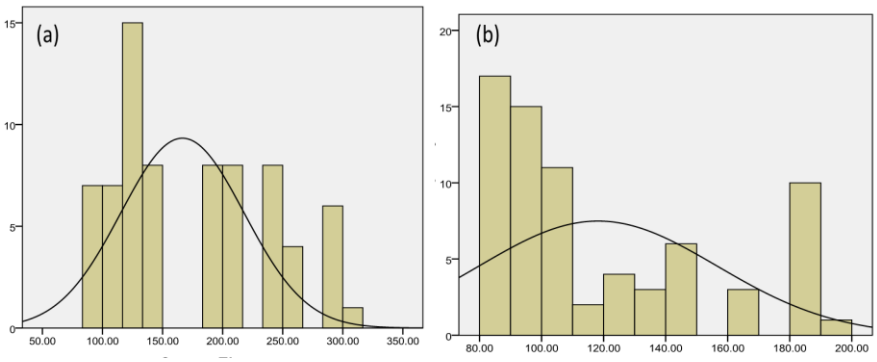

Fig. 9. (a) Pre and (b) post-test of moderate to vigorous physical activity

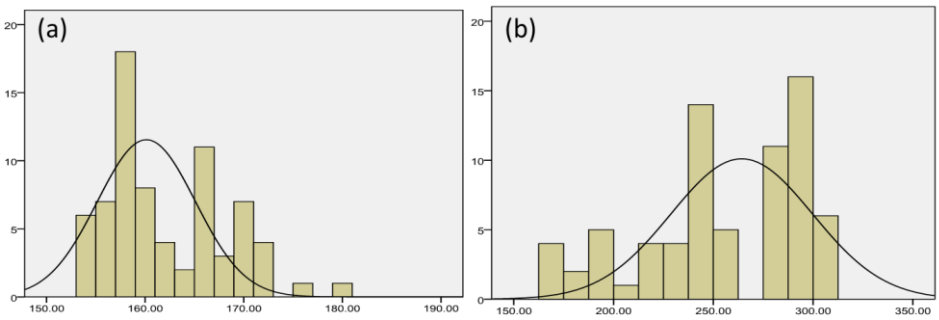

Fig. 10. (a) Pre and (b) post-test of eating behavior

Inference data analysis using paired sample t-test showed that there was an effect of intervention using video training and web application on several components of physical activity such as weight (t=6.579, p=0.00), BMI (t=28.162, p=0.00), TPA (t= -21.541, p = 0.00), MVPA (t= -8.839, p = 0.00), screen time, (t=7.529, p = 0.00), and eating behavior (t=-18.953, p = 0.00). Meanwhile for the height component (t= - 1.424, p = 0.159), and total sleep (t = - 0.749, p = 0.456), there is no significant effect. For more details, the analysis of inference data can be seen in Table 3 below.

Table 3
Analysis inference and eating behavior

		t	df	Sig.(2-tailed)
Pair 1	heihgt_pre - Heihgt_post	-1.424	76	.159
Pair 2	weight_pre - weight_post	6.579	76	.000
Pair 3	BMI_pre - BMI_post	28.162	76	.000
Pair 4	TPA_Pre - TPA_Post	-21.541	76	.000
Pair 5	MPVA_pre - MPVA_Post	-8.839	76	.000
Pair 6	Screen_Time_pre - Screen_time_post	7.529	76	.000
Pair 7	Total_Sleep_pre - Total_sleep_post	-.749	76	.456
Pair 8	Eating_Behavior_pre- Eating_behavior_post	-18.953	76	.000

The results of this study are in line with several conceptual studies which believe that physical activity interventions are fitness education conducted in certain communities that have an effective role in promoting physical activity and have a positive impact on other aspects such as psychosocial aspects. The intervention which constitutes fitness education in this study is believed to be a comprehensive multidisciplinary approach to help individuals acquire knowledge, attitudes, beliefs, and long-term active and healthy lifestyle behaviors [34-38]. Fitness education will be very effective when combined with the use of information and digital technology [39]. The use of information and digital technology in this study aims to increase individual skills and interest in physical activity

through movement experiences designed to help them stay active and have a healthy lifestyle [40,41]. Modifications in lifestyle programs increased physical activity, and eating behavior using information and digital technology in the school, family, and community environment are efficacious interventions in the short term, with the potential to dramatically reduce the risks associated with chronic disease in the long term [42]. This is in line with current research regarding physical activity [43-57].

4. Conclusions

Based on the analysis of the data presented above, this study concludes that the use of ICT for health-promoting lifestyle behaviors was reported to be effective in ensuring health behaviors that can improve physical health and eating behavior. The conclusion of this study is the use of ICT for lifestyle behaviors is reported to be effective in ensuring health behaviors that promote physical health and eating behavior.

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