Online Education on Social Media Increases the Knowledge about Diabetes Mellitus and Healthy Diet but Decreases Physical Activity

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**Abstract**. Education, as a preventive measure, lowers the incidence rate of Diabetes Mellitus (DM). The study compared two educational methods, lectures and social media on Instagram. The research design uses a quasi-experimental trial and prospective. The respondents were 92 active students of Ma Chung University Malang. They were willing to participate in research with purposive sampling techniques and then divided into two groups as much as random allocation. The data collection technique uses DM knowledge questionnaires, global physical activity questionnaire (GPAQ), and food frequency questionnaire (FFQ). The data is analyzed with multivariate regression using R open-source software. Results found improved knowledge of diabetes mellitus ( = 17.55, 95% CI: 9,399-24,059), increased vegetable intake ( = 8.80, 95% CI: 0.410-3735) and greater fruit consumption ( = 8.98, 95% CI: 5,959–12,823) and decreased snack consumption intake ( = -2.5, 95%CI: -3,778–(-0.916) with education using social media. But social media instead lowered the metabolic equivalent of task (MET) ( = -4,800.87, 95% CI: -13,166.18 - (-1,384.95) compared to the lecture group. The conclusion is that education by Instagram increases DM knowledge, increases the intake of vegetables and fruits more, decreases the consumption of snacks with sugar and fat content but decreases physical activity.

1. Introduction

Non-communicable disease is the primary cause of global mortality cases and becomes the main challenge in the health sector in the 21st century [1]. Diabetes Mellitus (DM) is one of the non-communicable diseases with a significantly increasing number of occurrences every year that is dominated by females of productive age [2]. In Indonesia, there is an addition of DM prevalence at ≥15 years of age by 8.5%, which is mostly caused by type 2 DM (DM2T). The increasing prevalence of DM happens due to the lack of public awareness of the importance of implementing a healthy lifestyle. Riset Kesehatan Dasar (Riskerdas) 2013 also reported the lack of consumption of fruits and vegetables, the lack of physical activities, and a high consumption rate of cigarettes [3]. A wider area of prevention and control efforts of DM2T is required [4].

Education is an essential factor in the effort to implement a healthy lifestyle [5]. In this digital era, social media such as YouTube, Facebook, and Twitter act as an alternative to spreading education widely. Additionally, human nature to socialize and building networks popularize the use of social media, even in the education sector. Social media provides all essential facilities needed in education, namely the capability of information search, the ease and speed of downloading or uploading learning media such as videos, and the ability to send feedback quickly [5,6].

Instagram is currently one of the most popular social media. Instagram is ranked third in the “Most Active Social Media Platforms” category with a percentage of 38%. According to the “Profile of Instagram Users” category, users with 18 – 24 years of age dominate the total of Instagram users with a total of 246 million users [7]. This condition shows an opportunity for social media to promote health education in this millennial era. Instagram has the potential to be one of the education media for implementing a healthy lifestyle to prevent the development of DM2T, especially for the millennial generation. Thus, we conducted this research to provide an educational program of DM disease systematically for the youth group in universities with Instagram users. The result of this study is compared with the result of conventional education methods using lecture and pocket notes as a comparison. This comparison method is a standard method with the purpose to give an explanation or verbal message to a target group to get information about health [8].

The education program provided in this study is expected to increase the public knowledge and give a behavior change effect, namely physical activities and nutrition types as the primary factors of diabetes prevention and glycemic control. This study also measures any changes of public knowledge, implementation of a healthy lifestyle, and physical activity after the education program is given with both the conventional methods namely lecture and pocket notes, and using the social media method using Instagram as the primary education platform. This study has the purpose of obtaining valid proof to develop an effective and efficient education model to reduce the number of DM2T occurrences, especially in the millennial generation.

1. Material and Methods

*2.1 Design Study*

The quasi-experimental design layout is used by comparing different education methods in form of a combination of lecture and pocket notes, and social media Instagram. This study hypothesizes that social media, especially Instagram can increase public knowledge, physical activities, and help in understanding the frequency of food types to prevent DM2T. This study was conducted from January until June 2019 at Universitas Ma Chung

*2.2 Diabetes Education*

Diabetes education by combining lectures from health experts and pocket notes was given to the respondents. Learning materials such as etiology, pathophysiology and manifestation, diagnosis, prevention acts through dietary arrangements, and the importance of physical activities. The next step includes handing out pocket notes to the respondents to take note of dietary arrangements and physical activities for everyday routine. This pocket note also acts as a self-reminder for the respondents to have a healthy diet and lifestyle every day.

The other diabetes education method was implemented on a different target group via Instagram social media. Respondents were asked to follow an Instagram account created by the researcher. This account contains summaries of information about diabetes redesigned with animated pictures to make them more understandable and interesting to look at. This Instagram account regularly posts animated educational content with similar content as the ones explained through direct lecture. The attendance of the group members was observed by the number of likes in each Instagram post. Besides, all respondents from this group were asked to send pictures of their daily meals to this account via direct message.

* 1. *Participants*

The population of this study is the active students of Universitas Ma Chung with a total of 1215. The sampling process through a purposive sampling technique with the minimum sample and calculation using the Slovin formula (margin of error 0.1) is 93 respondents. The initial sample acquisition includes 100 respondents and until the end of the study 8 respondents were excluded for not following the whole activities in the layout. Respondents were divided evenly into two groups; one group that receives the combination of lecture and pocket notes and the other is the Instagram group.

The inclusion criteria for this study are: [1] the active students of Universitas Ma Chung Malang; [2] respondents must have an attendance percentage of at least 60%; [3] respondents must not be under the treatment of steroid-class medications or weight loss program for the last three months. The exclusion criteria for this study are [1] hospitalized; [2] pregnancy; [3] resignation from the study. All respondents included in this study must sign informed consent as an agreement with the terms for this study.

* 1. *Variables and Instrument*

The instrument for this study is the DM knowledge questionnaire that consists of 14 questions with the Alpha Cronbach value of 0.66. Physical activities are measured using the global physical activity questionnaire (GPAQ) by observing the value of the metabolic equivalent of task (MET). All physical activities are reclassified into light activity (MET<600), medium activity (MET 600 – 3000), and heavy activity (MET >3000). Food types are measured using the food frequency questionnaire (FFQ). Food frequency is divided into more than once a day, once a day, 4 until 6 times per week, 2 until 3 times per week, once a week, 1 until 3 times per month, and never. Furthermore, FFQ is classified into carbohydrates, vegetables, eggs and meats, seeds and nuts, milk and cheese, oil and fat, snacks, and fruits.

* 1. *Data Collection*

Acquired data in this study includes the characteristics of respondents, physical activity data using the GPAQ questionnaire, and food frequency using the FFQ questionnaire. Respondents characteristics data includes gender, age, body mass index (BMI), housemate(s), participation in students’ activity unit (UKM), a family member with a history of DM, smoking habit, and the sleep duration within a day. Physical activity data is obtained with the GPAQ questionnaire and the calculation of the MET value from the questionnaire. Food frequency is divided into more than once a day, once a day, 4 until 6 times per week, 2 until 3 times per week, once a week, 1 until 3 times per month, and never. Furthermore, FFQ is classified into carbohydrates, vegetables, eggs and meats, seeds and nuts, milk and cheese, oil and fat, snacks, and fruits.

* 1. *Statistical Analyses*

Propensity score matching is the analysis technique used to ensure the balance between both groups. To observe the impact of the difference on the outcome, a difference-in-difference (DiD) calculation was applied on both outcome results with this formula:

|  |  |
| --- | --- |
|  | (1) |

is the DiD that measures the difference of average results on intervening groups before and after the treatment, subtracted by the difference in control groups . The correlation between and the treatment variables, namely the educating methods, which covariates are stated within the multiple linear regression as below:

|  |  |
| --- | --- |
|  | (2) |

DiD coefficient in this study is the knowledge obtained from both Instagram and the lecture methods, is a specific covariate on each individual (Fredriksson & Oliveira, 2019; Schneider, Hommel, & Blettner, 2010), DiD coefficient until is the consumed food type, and physical activities are measured using MET. Statistical measurements are calculated using the open-source software, R (R Core Team, 2012).

1. Results

Score distributions on groups educated with Instagram and lecture methods are relatively as good, both before the matching process (unmatched) and after the matching process (matched). This result shows that all data from both groups are balanced and thus matching process (Figure 1) is no longer required. Respondents’ characteristics are briefly served in Table 1.

**Tabel 1.** Baseline Characteristics of Participants

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Baseline Characteristics** | **Lecture and Pocket Notes (n=46)** | | **Instagram (n=46)** | | **Total** |
| **Gender** |  |  | |  | |
| Male | 5 (10.87) | 8 (17,39) | | 13 (14,13) | |
| Female | 41 (89,13) | 38 (82,61) | | 79 (85,87) | |
| **Age (year)** |  |  | |  | |
| 17-19 | 18 (39,11) | 17 (35,42) | | 37 (40,22) | |
| 20-21 | 24 (52,17) | 19 (39,58) | | 45 (48,91) | |
| 22-23 | 4 (8,70) | 12 (25) | | 16 (17,39) | |
| **Body Mass Index** |  |  | |  | |
| Underweight | 7 (15,22) | 11 (22,92) | | 18 (19,57) | |
| Normal | 32 (69,57) | 31 (64,58) | | 63 (68,48) | |
| Overweight | 6 (13,04) | 4 (8,33) | | 10 (10,87) | |
| Obesitas | 1 (2,17) | 4 (8,33) | | 5 (5,43) | |
| **Housemate** |  |  | |  | |
| Family | 28 (60,87) | 28 (58,33) | | 56 (60,87) | |
| Dormitory | 18 (39,13) | 13 (27,08) | | 31 (33,70) | |
| Live in a rent house | 0 (0) | 5 (10,42) | | 5 (5,43) | |
| **Member of Student Activity Unit** |  |  | |  | |
| Sports | 20 (43,48) | 7 (14,58) | | 27 (29,35) | |
| Non-sport | 10 (21,74) | 15 (31,25) | | 25 (27,17) | |
| Doesn’t Join | 16 (34,78) | 24 (50) | | 40 (43,48) | |
| **Families with a History of DM** |  |  | |  | |
| Yes | 21 (45,65) | 18 (37,50) | | 39 (42,39) | |
| No | 18 (54,35) | 28 (58,33) | | 46 (50,00) | |
| **Smoking Status** |  |  | |  | |
| Yes | 1 (2,17) | 0 (0) | | 1 (1,09) | |
| No | 45 (97,83) | 46 (100) | | 91 (98,91) | |
| **Sleeping duration** |  |  | |  | |
| 0-3 hours | 0 (0) | 1 (2,01) | | 1 (1,09) | |
| 4-6 hours | 29 (63,04) | 28 (58,33) | | 57 (61,96) | |
| 7-9 hours | 17 (39,13) | 19 (39,58) | | 36 (39,13) | |

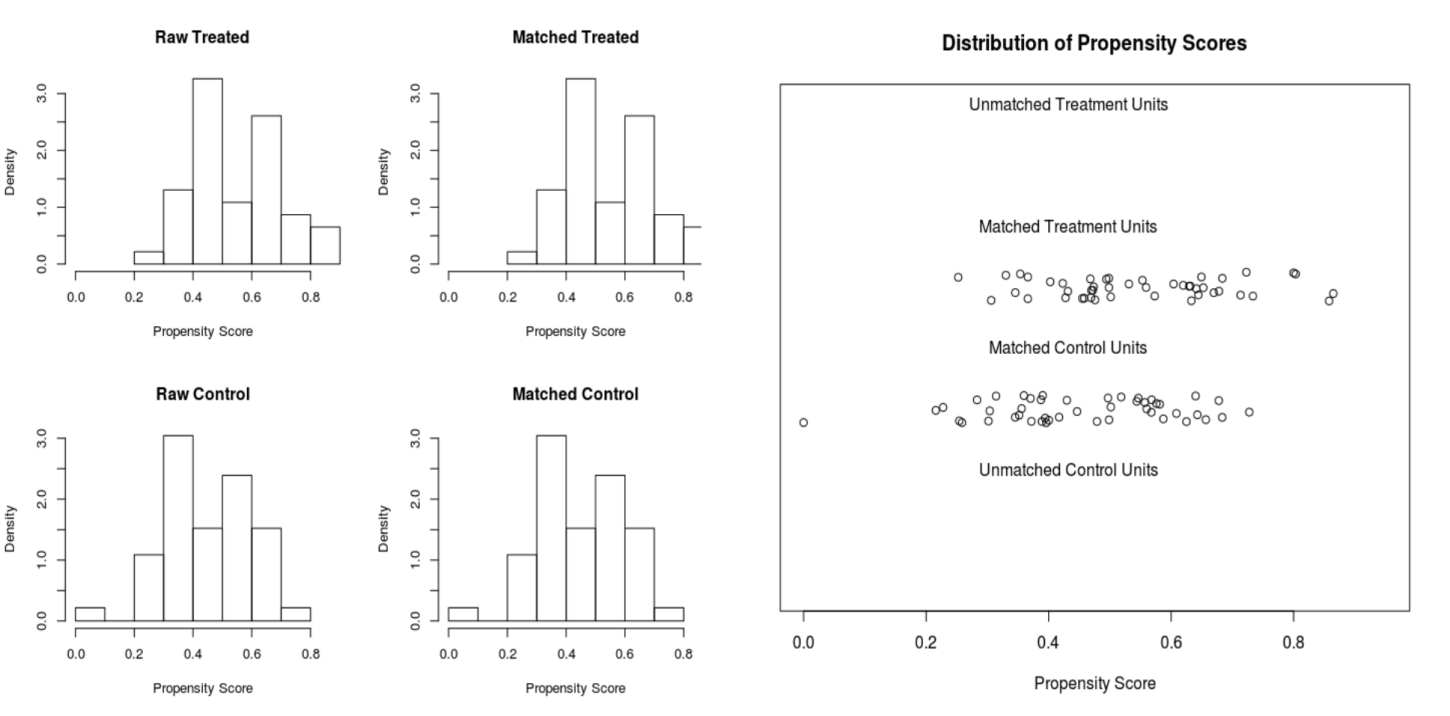


Figure 1. Distribution of prospensity scores

Respondents are dominated by females with 20 - 21 years of age with normal IMT category and sleep time duration within a day of 4- 6 hours, followed by 7- 9 hours. No respondents with a smoking habit in the intervention group, while there is a percentage of 2.17% in the lecture education group. Respondents’ families with a history of DM are 42.39% of the total respondents, with a similar composition between the lecture group (45.65%) and the Instagram group (37.5%). 56.52% of the respondents were participating in students’ activities unit, 29.35% were participating in sports activities such as futsal, Wushu, swimming, etc., while 27.17% were participating in non-sports activities, such as cooking, Chinese corner, Ma Chung Music Club, dance, and vocal group.

**Tabel 2. Relationship between outcome variable within covariates**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Outcome variable | Factor | Coefficient | Lower 95% CI | Upper 95% CI | p |
| **I. Food Intake** |  |  |  |  |  |
| Carbohydrates | Sleep duration for 4 - 6 hours | -9.195 | -17.781 | -0.609 | 0.036 |
| Nuts and beans | Underweight | 1.905 | 0.077 | 3.733 | 0.041 |
| Milk,yogurt, and cheese | Overweight | -2.924 | -5.600 | -0.249 | 0.033 |
| Butter and vegetable oils | Live in a rent house | -1.753 | -3.260 | -0.245 | 0.023 |
| Vegetables | Sleep duration for 4 - 6 hours | -8.346 | -16.467 | -0.225 | 0.044 |
| Education *via* Instagram | 2.073 | 0.410 | 3.735 | 0.015 |
| Snack high in fat and sugar | Female | -2.170 | -4.220 | -0.120 | 0.038 |
| Member of student activity unit (sports) | -1.872 | -3.732 | -0.012 | 0.048 |
| Smoking status “Yes” | -8.832 | -15.598 | -2.065 | 0.011 |
| Sleeping duration for 4 - 6 hours | 14.703 | 7.710 | 21.696 | 0.000 |
| Sleeping duration for 7 - 9 hours | 14.997 | 7.896 | 22.098 | <0.001 |
| Education *via* Instagram | -2.347 | -3.778 | -0.916 | 0.002 |
| Fruits | Live in a rent house | 5.549 | 2.026 | 9.073 | 0.002 |
| No history DM in family | 4.388 | 0.900 | 7.876 | 0.014 |
| Education *via* Instagram | 9.391 | 5.959 | 12.823 | <0.001 |
| Eggs and meat | No significant factor was observed | | | | |
| **II. Knowledge and Physical Activity** | | |  |  |  |
| Knowledge | Overweight | -16.278 | -30.030 | -2.523 | 0.034 |
| Education *via* Instagram | 16.729 | 9.399 | 24.059 | <0.001 |
| MET | Overweight | -11527.0 | -22717.037 | -337.025 | 0.044 |
| Education *via* Instagram | -7275.0 | -13166.180 | -1384.945 | 0.016 |

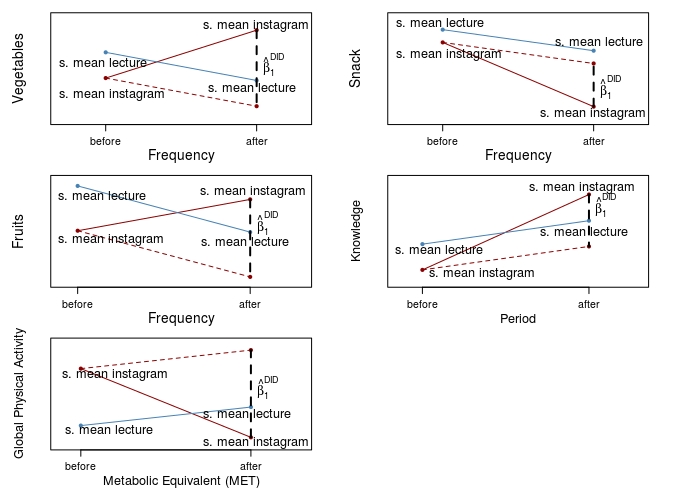


Figure 2 Differences-in-Differences Estimator Analysis

The outcome was represented by DiD before and after the intervention which also continued with multiple linear regression analysis. The increasing knowledge about DM in the Instagram group is better compared to the lecture method group (= 16.729, 95% CI: 9.399-24.059). A similar condition occurred in the food frequency category, which shows better improvements in vegetable intake in the Instagram group compared to the lecture method group (= 2.073, 95% CI: 0.410-3.735). The same result was also found in the fruits consumption category, with an additional fruit consumption frequency of (= 9.391 95% CI: 5.959–12.823) in the Instagram group. In tune with the increasing frequency of fruits and vegetable consumption, this treatment also lowers the consumption of snacks with a high content of fat and sugar (= -2.347, 95%CI: -3.778-(-0.916). The education process via social media also lowers the consumption of snacks (Figure 2). However, this intervention also lowers physical activities measured with the MET value (= -7.275, 95% CI: -13.166,18 - (-1.384,95).

1. Discussion

The impact of Instagram as the chosen intervention media on health behavior is measured by the knowledge, food types and consumption frequency, and physical activities. The intervention with Instagram increases knowledge about diabetes mellitus better than lecture and pocket note methods, as shown in Table 2 and Figure 2. The superiority of the Instagram method is the proof of public interest in a new communication media as the result of advancement and development on the implemented public communication means, known as the “age of communication” [9]. The increasing trend of social media usage is due to its advantages in providing reliable communication services that enable all users to stay connected more intensively [10–13], even before the decision to participate in the scope of health [14]. Some other advantages of using Social Networking Sites (SNSs) are more cost-effective in finding information and facilitating changes in health behavior, although there is no further study for a longer-term [12]. SNSs changes the way people interact and socialize in the learning process [5]. Because the education targets in this study are the youths, social media is a better alternative by emphasizing the dietary arrangements as an effort to prevent insulin resistance in the future [6]. Social media also has the potential in bridging the gap between quantity of health services as a primary resource in educating and observing the public, following the increasing demands of nutrition education as an effort to prevent DM [4]. Body mass index becomes a significant covariate, especially for overweight people. Table 2 shows that overweight people have less knowledge about DM, compared to non-overweight people, which also affects attitudes and behavior [15]. The lack of knowledge about food types that may increase blood sugar makes it hard for most people to control body weight [15,16].

Using Instagram as an educational media helps to increase fruit and vegetable intake more significantly when compared with the lecture and pocket note methods as shown in Table 2 and Figure 2. The surplus in the frequency of vegetable consumption using Instagram intervention is due to a change in health behavior control and the mean of conveying and facilitating supports for lifestyle changes. Dynamic presentation by social media can inspire, motivate, and facilitate social supports [17,18]. Stronger social support from the social media method is due to the sustainability and an over-time engagement in implementing the behavioral changes when compared with the participants who attended the lecture [17]. The engagement using Instagram measured with the “likes” on each post also helps to observe all contents passively. Food consumption pattern using Instagram is observed through the daily messages with menu frequency containing fruits and vegetables [19]. Individuals have a better understanding of eating habits, informing the choice of food, and learning to be able to choose healthy food over unhealthy ones [20]. There is also an influential covariate on the consumption of vegetables, namely sleep duration within a day. The table shows that individuals with 4 until 6 hours of daily sleep duration consume fewer vegetables. There is an underlying mechanism that a short sleep duration or disturbed sleep can increase emotions, stress, sensitivity to high-calorie foods, and low consumption of fruits and vegetables. A change of appetite hormones, ghrelin and leptin due to a short sleep duration also triggers an appetite for high-calorie foods to replace the energy needs and causes low consumption of fruits and vegetables [21,22]. This condition also occurred on the respondents included in this study with 4 until 6 hours of sleep duration, when an increase of high fat and sugar foods intake occurred. Individuals who live in rental houses eat more fruits. According to Menezes et al., the frequency of fruits and vegetables consumption is significantly influenced by geographical access to healthy meals or fruit markets and low exposure to unhealthy foods [23]. Individuals with no history of DM also eat more fruits. Low consumption of snacks with a high amount of sugar and fat on females, students participating in sports activities, and smokers.

However, education via Instagram lowers MET value more than those in the lecture group. This is the adverse impact of social media, where individuals spend more time surfing on social media. To overcome that adverse impact of social media, individuals need to maintain awareness and monitoring actions for social media usage [5]. The majority of individuals with low physical activity are also included in the overweight category in this study.

The limitation of this study is the unbalanced composition between male and female students, therefore, this study cannot project a significant impact of using social media as an educational media for males. Short-term intervention and no follow-ups to learn the long-term impacts of physical activities and eating frequency categories. The Instagram intervention is also unable to measure engagement in health intervention in depth.

1. Conclusion

Using Instagram to educate individuals about the threat of diabetes mellitus, increasing fruits and vegetables consumption, and lowering the consumption of snacks with a high content of fat and sugar is proven better than using the conventional method. However, this method also has a drawback, namely lowering the MET value more than using the conventional technique.

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**Competing interests**

None declared

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