Effect of nutrition counseling and self-monitoring mobile application (*MyFitnessPal*) on iron and calcium intake among overweight and obese college students

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ABSTRAK

Latar Belakang: *Prevalensi obesitas terus mengalami peningkatan hingga saat ini. Penelitian terkini memperlihatkan bahwa orang dengan status gizi obesitas cenderung memiliki asupan kalsium dan kadar serum besi lebih rendah dibandingkan dengan orang yang memiliki status gizi normal. Pengaturan pola makan yang kurang tepat menjadi salah satu penyebab tingginya prevalensi obesitas. Oleh karena itu, perlu adanya pengendalian asupan makan pada individu obesitas dengan memanfaatkan kombinasi konseling gizi dan pengendalian asupan makanan harian dengan bantuan aplikasi self-monitoring (MyFitnessPal).*
Tujuan: *Penelitian ini bertujuan untuk mengetahui asupan zat besi dan kalsium pada subyek overweight dan obesitas dan pengaruh penggunaan konseling gizi dan aplikasi self-monitoring asupan (MyFitnessPal).*
Metode: *Rancangan penelitian experimental dibuat dengan pretest-posttest with control group design pada 68 mahasiswa (32 mahasiswa setiap kelompok) di Universitas Alma Ata Yogyakarta. Analisis statistik yang digunakan adalah uji Wilcoxon Signed Rank Test dan Mann Whitney.*
Hasil: *Hasil penelitian ini ditemukan bahwa ada perbedaan yang signifikan antara asupan zat besi sebelum dan sesudah intervensi pada kelompok eksperimen (p=0,001) sedangkan pada kelompok kontrol tidak terdapat perbedaan yang signifikan (p=0,417). Ada perbedaan yang signifikan antara asupan kalsium sebelum dan sesudah intervensi pada kelompok eksperimen (p=0,002) sedangkan pada kelompok kontrol tidak terdapat perbedaan yang signifikan (p=0,126). Terdapat perbedaan yang signifikan pada asupan zat besi (p=0,005) dan kalsium (p=0,001) antara kelompok eksperimen dan kontrol.*
Kesimpulan: *Ada pengaruh konseling gizi dan self-monitoring asupan (MyFitnessPal) memengaruhi asupan zat besi dan kalsium pada mahasiswa overweight dan obesitas.*

KATA KUNCI: *asupan kalsium; asupan zat besi; konseling gizi; MyFitnessPal; self-monitoring*

ABSTRACT

Background: *Prevalence of obesity gradually increasing in the worldwide. People who had obesity status tend to have lower calcium and iron intake levels compared to non-obese people. Unhealthy diet practice is one of the causes of high prevalence of obesity. Therefore, it is necessary to control food intake of obese individuals by utilizing a combination of nutritional counseling and monitoring food intake using mobile apps MyFitnessPal.*
Objectives: *This study aimed to determine intake of iron and calcium among overweight and obese student and whether effect of nutritional counseling and self-monitoring mobile application (MyFitnessPal) associated with their food intake.*
Methods: *This experimental study was made by pretest-posttest with control group design. Of 68 students (34 subjects in each groups) at Alma Ata University Yogyakarta were recruited. Wilcoxon Signed Rank Test and the Mann Whitney test created to assess the statistical analysis.*
Results: *The results of this study found that there was a significant difference between iron intake before*

and after the intervention in the experimental group (p = 0.001), however, there was not significant difference in the control group (p = 0.417). There was a significant difference between calcium intake before and after intervention in the experimental group (p = 0.002), but not in the control group (p = 0.126). This study found a significant difference between intake of iron (p = 0.005) and calcium (p = 0.001) in each group.
Conclusions: *Using mobile apps for self-monitoring intake in combination with nutritional counseling could be considered as it was proven to be associated with iron and calcium intake among overweight and obese students in this study. Further studies are required to confirm our findings.*

INTRODUCTION

Obesity is one of the common health problems around the world and the prevalence its increasing from adolescents to adults in both developed and developing countries. The prevalence of overweight and obesity has very sharply increased and about 50% of this malnutrition happened in the Asia Pacific Region (1). Indonesia Basic Health Research Survey (Riskesdas) in 2018 showed that the prevalence of overweight and obesity in adults (>18 years) was 13.6% and 21.8%. Those overweight women were 15.1% and obesity 29.3% higher than men with overweight and obese status. Special Region of Yogyakarta placed in the seventeenth highest position for incidence of overweight and obesity cases in adults (2). Overweight and obesity can occur in all age groups, and are prone to occur at a young age, especially in students (3). Students tend to have constant energy needs, but current student consumption patterns tend to contain high calories.

Recent study from Wilujeng, et al (2013) showed that there were significant differences in calcium intake between overweight and not overweight individuals. The overweight group found that had lower calcium intake than individuals who had lower body weight (4)disease pattern and management are not entirely the same with hypertension in young adults. Hypertension in overweight elderly requires particular attention because it is closely associated with overall management (medical and nutritional. Another

research which was conducted by Dieny et al., also showed that there were differences in iron serum concentration in obese and non-obese women. The obese group found that they had lower iron serum concentration (83.99 ± 20.66 mg) than the non-obese group (99.2 ± 26.03 mg) (5).

The prevalence of overweight and obesity status remains high, it was necessary to handle the diet-related to overweight and obese patients (6). A method that can be used to help control of food intake is a nutrition counseling and its related to improve dietary adherence. Dietary assessment using nutrition and diet application-based in smartphone can help to solve nutrition-related problems especially among college students (7). An effective application practice can affect the tremendous cost savings.

One of the most popular diet-related application is MyFitnessPal (MFP) (8) but little is known about their effectiveness. Objective: To evaluate the effect of introducing primary care patients to a free smartphone app for weight loss.\nDesign: Randomized, controlled trial. (ClinicalTrials. gov: NCT01650337. The MyFitnessPal smartphone application was developed in 2005 by MyFitnessPal Inc and was acquired in 2015 by Under Armor, this application license is freeware or free to use by users both using smartphones with Android and iOS operating systems. This application can be downloaded on Google Play Store for android use and Apple Store for iOS use (7). MFP can help users easily to track the nutritional value of an user's diet by

scanning a barcode or searching a food or beverage database. MyFitnessPal provides an overview of the total daily intake in the form of calorie or nutritional values with graphs. The features in MFP bring many beneficials and one of them is users facilitate a handy and convenient to interpret the data and give the signs when the intake less or exceeds the predetermined its calorie limit (9). A study conducted by Carter et al (2013), found that the adherence to self-monitoring diet was higher in individuals using smartphone applications than with the individuals using daily paper (10). Hence, the aim of this study was to determine the association between intake of calcium and iron after being given nutritional counseling and applying self-monitoring smartphone application for daily intake (MyFitnessPal).

MATERIALS AND METHODS

Study design

This study design was pretest-posttest quasi-experimental design with a control group. The location of this study was located at Alma Ata Yogyakarta University and collected from February to July 2020.

Data Collection

Nutritional Preliminary screening was carried out in 1,118 student subjects using secondary data and primary data. The primary data came from online questionnaire where we shared with the students in the form of an online Google Form. The secondary data were obtained from academics of Alma Ata University in the form to find a list of the student's subject personal data to help us reach them names and primary data in the form of an online form regarding the characteristics of the respondents.

A total of 144 subjects with nutritional status were obtained with overweight and obese status. Research subjects were recruited if they met the inclusion and exclusion criteria of the study. Inclusion criteria in this study were active students of Alma Ata University, over 18 years of age, BMI> 23.0 kg / m^2, have a smartphone with an Android or iOS operating system, not undergoing a weight loss diet program, and willing to participate in the study. Meanwhile,

the exclusion criteria were following a weight loss diet program. Informed consent was given to prospective subjects and subjects who agreed to join the program will become the subjects of this study and it was found that we had 68 subjects who were willing to take part in the study and met the inclusion and exclusion criteria and, while 76 subjects were excluded because they did not want to participate in the study.

Data Characteristics

Characteristic data taken from research subjects included age, gender, nutritional status, history of obesity, consumption of iron and calcium sources of food. The method used in collecting data on the characteristics of the subject is using Google Forms. This study was using the classification of nutritional status according to WHO Asia Pacific Region **(Table 1)** (11).

Table 1. BMI Classification

Classification	Body Mass Index (BMI)
Overweight	23 – 24.9
Obese I	25 – 29.9
Obese II	≥ 30

Experimental design

The subjects in this study were divided into the control group and the experimental group (34 subjects in control and experimental group, respectively). We randomly selected by using Microsoft Excel to the subjects for determining the distribution to both of control and experimental groups. In the experimental group, we were given nutritional counseling in twice (± 30 minutes) per meeting. Well-trained nutrition students carried out this treatment and guiding in how to use the MyFitnessPal application. Subjects were encouraged to use the MyfitnessPal application during the study as a self-monitoring for their daily intake during the experiment program. The control group was only given balanced nutrition leaflets without providing nutritional counseling and the MyFitnessPal application. The study flow diagram of this research can be seen in **Figure 1.**
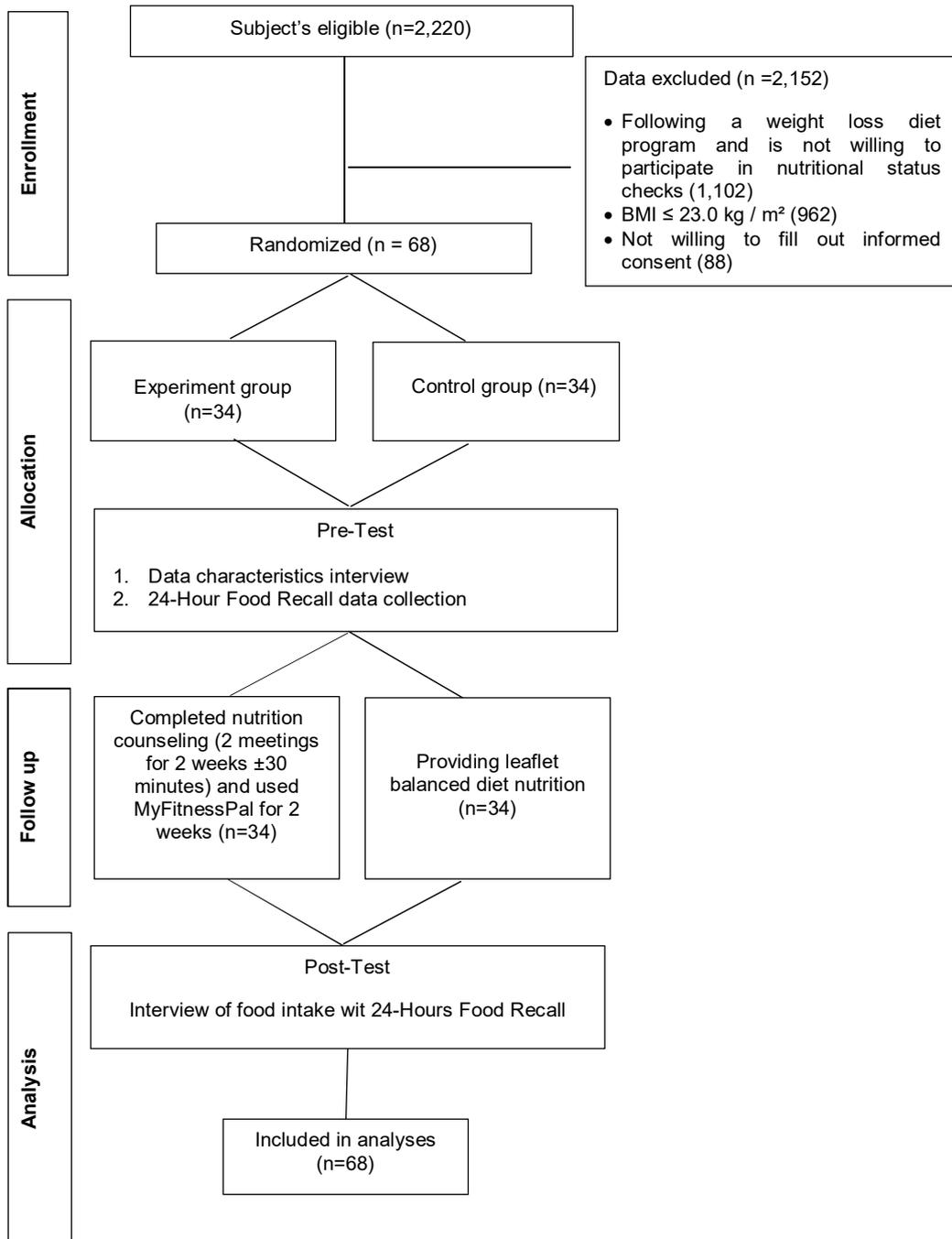
Figure 1. The study flow diagram

Dietary assessment

Data collection of iron and calcium intake used by 24-hour Food Recall questionnaire. Iron and calcium intake data were collected for 3x24 hours Food Recall with two times on weekdays and one time at weekend then averaged to assess the daily intake of iron and calcium. The 24-hour Food Recall data collection was carried out before and after the study to identify any changes in iron and calcium intake. Then, data collection in iron and calcium consumption obtained by using google form.

The recall data were collected using 3x24 hour Food Recall will be converted to the number of URT (household size) into units of weight (grams), then processed all the food ingredients consumed by the subject using the Nutrisurvey application. Furthermore, the results of the nutritional survey were reprocessed to obtain the average nutritional consumption of each subject. Based on the Recommended Dietary Allowance (RDA) for ages 19-29 years, the iron and calcium cut-off intake were 18 mg/day and 1000 mg/day, respectively. The mean iron and calcium intake which was consumed by the subjects compared to RDA and categorized based on the percentage (%) of intake category. These categories include <80% RDA which means that the intake was inadequate and ≥80% RDA means that the intake was adequate (12).

Statistical analysis

Data analysis in this study used SPSS version 20.0 and Nutrisurvey to assess the average of iron and calcium intake. Continuous data were presented as mean values and standard deviation (SD) while categorical data were represented by numbers and percentages (%). To analyze the difference between iron and calcium intake in each control and experimental group, the Wilcoxon test was used. The mean difference between the control and experimental groups was used in the Mann Whitney test. Chi-square was used to test the difference between the data variable on the characteristics of the subjects between the control and experimental groups. SPSS statistical software version 20 was used for data analysis. P values were 2-sided and statistical significance was set at <0.05 with 95% Confidence Interval (CI).

Ethical clearance

This current research was conducted according to the guidelines laid down in the Declaration Helsinki, and all procedures involving the study subjects were obtained research approval from the Ethics Committee of Alma Ata University (KE/AA/II/10120/EC/2020). Verbal informed consent was obtained and collected from all subjects. The subject's consent was witnessed and formally recorded.

RESULTS AND DISCUSSION

Table 2 showed that subject's data characteristics such as gender, age, nutritional status and history of obesity in the experimental and control group were not significantly different (p> 0,05). In this study, most of the subjects were female between 19-22 years, had nutritional status in obesity 1 (25 – 29,9 kg/m²), had no inheritance obesity history, and the dietary assessment status of iron and calcium intake <80% RDA for more than 90%, respectively.

Table 2. The differentiation between control and case group in subject characteristic variables

Variables	Experimental Group (%)	Control Group (%)	P*
Gender			
Male	14.7	23.5	0.355
Female	85.3	76.5	
Age Groups			
19-22 years	94.1	88.2	0.393
23-26 years	5.9	11.8	
Nutritional Status			
Overweight	32.4	32.4	0.952
Obese I	47.1	44.1	
Obese II	20.6	23.5	
Inheritance Obesity History			
Yes	38.2	26.5	0.300
No	61.8	73.5	
Iron Intake			
Inadequate	94.1	97.1	0.555
Adequate	5.9	2.9	
Calcium Intake			
Inadequate	97.1	97.1	1.000
Adequate	2.9	2.9	

Chi Square Test; BMI was categorized by Overweight (≥23-24,9 kg/m²); Obesity grade I (25,0-29,9 kg/m²); Obesity grade II (≥30 kg/m²); RDA was categorized by Adequate (≥80%); Inadequate (<80%).
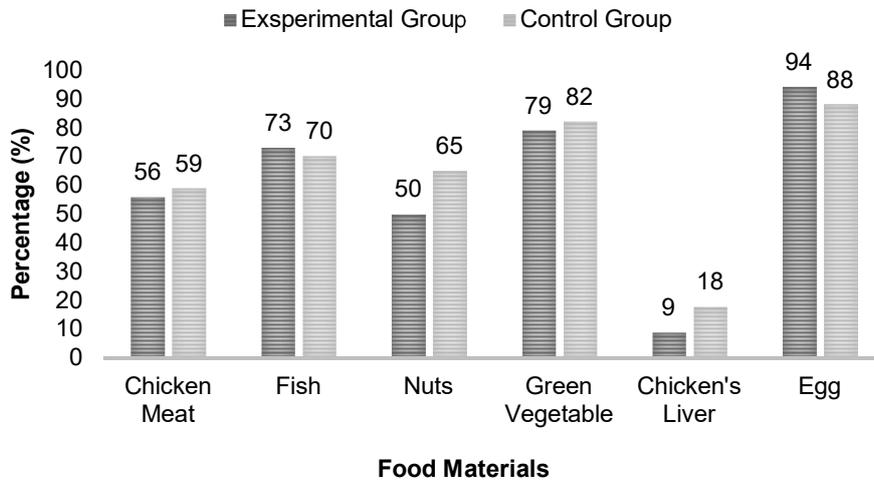
Figure 1. Iron-rich food consumption

Figure 1. showed that the respondent's consumption of food sources of iron before being given intervention, so it can be concluded that the most consumed food source of iron by both groups were eggs. In addition, the least consumed source of iron by both groups were chicken liver. Consumption of eggs and fish was higher in the experimental group than in the control group, while consumption of chicken meat, beans, green vegetables, and chicken liver was higher in the control group than in the experimental group.
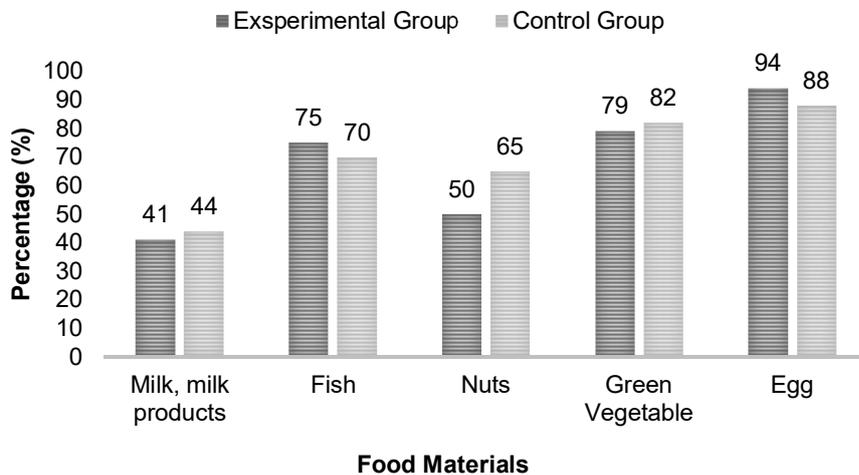

Figure 2. Calcium-rich food consumption

The diagram showed that the respondents' consumption of calcium-rich foods before being given intervention. This study found that the most consumed calcium-rich foods by both groups were eggs even though eggs may contain small amount of calcium. On the contrary, the least consumed by both groups were milk and dairy products yet this sources known to be a good source of calcium. Consumption of eggs and fish was higher in the experimental group than the control group while consumption of nuts, green vegetables, milk, and dairy products was higher in the control group than in the experimental group (**Figure 2.**).

Tabel 3. The difference between iron and calcium intake before and after intervention

Variables	Experimental Group			Control Group		
	Before Intervention	After Intervention	P-*Value*	Before Intervention	After Intervention	P-*Value**
Iron Intake (mg)	3.1±1.1	4.9±3.2	0.001	5.1±3.13	6.1±5.06	0.209
Calcium Intake (mg)	122.5±96.1	195.3±141.0	0.002	183.7±242.5	150.4±169.7	0.126

*Wilcoxon Test

Table 3 showed that the average value of iron intake in the experimental group before treatment was 3.1 ± 1.1 mg, an increase to 4.9 ± 3.2 mg after treatment. There was a significant difference in the iron intake before and after the nutritional counseling treatment and self-monitoring food intake in the experimental group, respectively ($p \leq 0.05$). The mean of iron intake in the control group was 5.1 ± 3.1 mg/day and increased to 6.1 ± 5.1 mg/day after treatment, but there was no significant difference in the iron intake before and after using balanced nutrition leaflets in the control group ($p = 0.209$). The mean of calcium intake was increased from 122.5 ± 96.1 mg/day to 195.3 ± 141.0 mg/day after subjects received the intervention. There was a significant difference in calcium intake before and after the nutritional counseling treatment and mobile apps self-monitoring intake in the experimental group ($p=0.02$). However, we had no significant difference in calcium intake before and after the treatment of giving balanced nutrition leaflets in the control group ($p=0.126$). This control group had decreased mean of calcium intake from 183.7 ± 242.5 mg/day to 150.4 ± 169.7 mg after the treatment.

Tabel 4. The difference between iron and calcium intake in experimental and control group

Variables	Average Intake		Changes Between Groups
	Eksperiment Group	Control Group	P-*Value**
Iron Intake (mg)	1.80±2.14	1.03±1.93	0.005
Calcium Intake (mg)	72.8±44.9	33.2±72.8	<0.001

* Mann Whitney Test

Table 4 showed that the mean of iron and calcium intake in the experimental group which was treated with nutritional counseling and mobile apps self-monitoring intake compared to the control group which was given the balanced nutrition leaflet treatment showed a significant difference ($p <0.05$).

The main finding of this study was nutritional counseling can increase the students motivation to go on a diet. Besides, the MyFitnessPal application as self-monitoring was also very helpful for subjects in managing their diet. Nutritional counseling and self-monitoring (MyFitnessPal) could provide an increase in subjects' iron and calcium intake compared to those given only balanced nutrition leaflets. Even though, the increase of iron and calcium intake in the students were still far from the Indonesia's RDA guideline, this could be due to the short duration of the intervention so that iron and calcium intake was still very slightly increased.

In this study, the students' mostly have iron intake <80% RDA for adults aged 19-29 years. At this age, it was advisable to get an iron intake of 18 mg/day (13). This can happen, however, most of the respondents in this study consumed high animal sources of iron such as fish and eggs, there were still many respondents who consumed nuts and green vegetables. It is known that there are substances that inhibit the absorption of iron that are consumed, such as phytic acid in nuts, tannins in tea, and oxalates in green vegetables (14). Besides, heme iron has high levels of absorption and bioavailability (15).

This study found that the status of calcium intake was <80% RDA for adults aged 19-29 years. At this age, it is advisable to have a calcium intake of 1,000 mg/day (13). Low calcium consumption among students happened while the most students in this study had consumed good sources of calcium

from animals such as fish and eggs. However, they highly consumed green vegetables too where it contains many substances that can inhibit the calcium absorption such as phytate and oxalate (16). Students rarely consumed milk because they were not used to it, do not like it, and so on, while it is known that 100 grams of milk contain 125 mg of calcium which is very helpful to meet calcium needs. According to the research by Shita and Sulistiyani (2010), food ingredients such as shrimp, milk, and processed products such as yogurt, cheese and ice cream, egg yolks, fish are good sources of calcium from animals (17).

In this study, nutritional counseling was carried out once a week and showed significant results on iron and calcium intake in the experimental group, this is supported by research by Hestuningtyas (2014) that nutritional counseling conducted once a week proved to be quite effective in changing behavior eat (18)meliputi pengetahuan, sikap, dan praktik ibu sehingga asupan zat gizi dapat diperbaiki.Tujuan: Menganalisis pengaruh konseling gizi terhadap pengetahuan, sikap, praktik ibu dalam pemberian makan anak, dan asupan zat gizi anak stunting usia 1-2 tahun.Metode: Penelitian eksperimen dengan quasi experiment nonequivalent control group design pada anak stunting usia 1-2 tahun di Kecamatan Semarang Timur. Jumlah sampel adalah 20 ibu pada kelompok kontrol dan 20 ibu pada kelompok perlakuan. Kelompok kontrol adalah ibu dari anak stunting yang tidak diberi konseling gizi. Kelompok perlakuan adalah ibu dari anak stunting yang diberi konseling gizi. Konseling dilakukan 1 kali tiap minggu selama 6 minggu. Subjek penelitian adalah ibu yang mempunyai anak stunting. Analisis data menggunakan uji beda, yaitu dependent t test atau independent t test untuk data yang berdistribusi normal, dan wilcoxon atau mann-whitney untuk data yang tidak berdistribusi normal.Hasil: Sebanyak 65% subjek adalah perempuan, dan 85% subjek tidak mendapatkan ASI eksklusif. Pendidikan responden 60% adalah SMA, 57.5% responden merupakan ibu rumah tangga, dan pendapatan rumah tangga responden 60% <Upah Minimum Kota Semarang. Pada kelompok kontrol, tidak terdapat peningkatan skor sikap, praktik ibu, dan asupan zat gizi anak secara signifikan, tetapi skor pengetahuan

meningkat signifikan (p=0.022. The implementation of counseling was also equipped with the help of leaflet media. The provision of leaflets as a guide can affect the success of the delivery of counseling (19).

There were many options to find out the nutritional content of food, including by using a mobile application on smartphone, such as *MyFitnessPal*. Some of the aspects that users love about *MyFitnessPal* include ease of use (100%), feedback on progress (88%), and 48% showing that MyFitnessPal was interested to use. It was found that MyFitnessPal users have increased awareness of food choices, and more caution about food choices (8)but little is known about their effectiveness. Objective: To evaluate the effect of introducing primary care patients to a free smartphone app for weight loss.\nDesign: Randomized, controlled trial. (ClinicalTrials.gov: NCT01650337.

The limitations of this study were the intervention group which was done by online and potentially gave bias data in results. This study found that the list of various foods on the *MyFitnessPal* application still incomplete so that may some foods did not provide and also considering that the variety of foods in Indonesia was very diverse so this can also lead to bias.

CONCLUSION AND RECOMMENDATION

Nutrition counseling and using mobile app as self-monitoring food intake (*MyFitnessPal)* associated with the increasing of iron and calcium intake among overweight and obese students. This method could be considered as the strategy to achieve an adequate intake of iron and calcium for students with higher BMI levels. Further studies are needed to confirm our findings.

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REFERENCES

1. Iriyani Harun VH dan Nurpudji A Taslim. Obesity and HsCRP Content among new Students Adolescent at Hasanuddin University [Skripsi]. In Makassar: Universitas Hasanuddin; 2012.

2. Kementerian Kesehatan RI. Laporan Hasil Riset Kesehatan Dasar (Riskesdas) Indonesia tahun 2018. Riset Kesehatan Dasar 2018. 2018. p. 182–3.

3. Halim R, Suzan R, Karolina ME. Pengaruh Terapi Gizi Klinik Intensif Terhadap Penurunan Berat Badan , Komposisi Tubuh , dan Profil Lipid pada Remaja Overweight dan Obesitas. 2019;88–95.

4. Wilujeng CS, Rochmah W, Susetyowati S. Perbedaan asupan mikronutrien pada lansia penderita hipertensi esensial yang overweight dan tidak overweight. J Gizi Klin Indones. 2013;10(1):25.

5. Dieny FF, Widyastuti N, Fitranti DY, Nissa C, Tsani FA, Jauharany FF. Defisiensi Besi Pada Wanita Usia Subur Pranikah Obesitas. Media Gizi Mikro Indones. 2019;10(2):101–10.

6. Wing RR, Lang W, Wadden TA, Safford M, Knowler WC, Bertoni AG et al. Benefits of modest weight loss in improving cardiovascular risk factors in overweight and obese individuals with type 2 diabetes. Diabetes Care. 2011;34(7):1481–6.

7. Esti N, Chyi-Huey B. Validation Study of MyFitnessPal App for the Dietary Assessment Among College Students non-English Speaker in Indonesia adn Taiwan. Asia-Pasific Partnership On Health and Nutritional Improvement. 2019.

8. Laing BY, Mangione CM, Tseng CH, Leng M, Vaisberg E, Mahida M, et al. Effectiveness of a smartphone application for weight loss compared with usual care in overweight primary care patients. Ann Intern Med. 2014;161(100):S5–12.

9. Evans D. MyFitnessPal. Br J Sport Med. 2017;51(14):1101–1102,.

10. Carter MC, Burley VJ, Nykjaer C CJ. Adherence to a smartphone application for weight loss compared to website and paper diary: pilot randomized controlled trial. J Med Internet Res. 2013;15:e32([PMID: 23587561]).

11. WHO WPR. Prevalence of obesity in Malaysia. In: The Asia-Pacific perspective: redefining obesity and its treatment. Geneva, Switzerland: World Health Organization. 2000. p. 56.

12. WNPG. Pemantapan Ketahanan Pangan dan Perbaikan Gizi Masyarakat Berbasis Kemandirian dan Kearifan Lokal. LIPI:Jakarta; 2012.

13. Kemenkes R. Angka Kecukupan Gizi Yang Dianjurkan Untuk Masyarakat Indonesia. Permenkes RI, Nomor 28. 2019;

14. Heather A Eicher dan Miller AC. Food Insecurity is Associated Withiron Deficiency Anemia in USAldolescents. Am J Clin Nutr. 2009;90 : 1358-.

15. Posen J. Iron and Vegetarian Diets. Med J Aust. 2013;199(4):S11-6.

16. Almatsier S. Prinsip Dasar Ilmu Gizi. Jakarta; PT. Gramedia Pustaka Utama ; 2011.

17. Shita, A.D.P. S. Pengaruh Kalsium Terhadap Tumbuh Kembang Gigi Geligi Anak. Stomatognatic (JKG Unej). 2010;Vol 7. No:41.

18. Hestuningtyas TR, Noer ER. Pengaruh Konseling Gizi Terhadap Pengetahuan, Sikap, Praktik Ibu Dalam Pemberian Makan Anak, Dan Asupan Zat Gizi Anak Stunting Usia 1-2 Tahun Di Kecamatan Semarang Timur. Vol. 3, Journal of Nutrition College. 2014. 17-25 p.

19. Rahmad AH AI, Almunadia A. Pemanfaatan Media Flipchart Dalam Meningkatkan Pengetahuan Ibu Tentang Konsumsi Sayur Dan Buah. J Kedokt Syiah Kuala. 2017;17(3):140–6.