The Effect of Consumption of Whole Fruits before Meals and Walking 10 minutes after Meals on Daily Food Intake in Overweight Adults

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Abstract. Increased consumption of whole fruits and physical activity are inversely correlated with energy intake and weight gain. This study aimed to analyze the daily consumption of whole fruits before meals and walking 10 minutes after meals on dietary intake in overweight adults. Twenty-two overweight adults in Surakarta city were randomly divided into two groups: the T1 group ate a combination of five different fruits/day before meals and walking 10 min after meals. The other group only ate a combination of five different fruits/day before meals for 30 days. The average of energy and fat intake in T1 and T2 groups after intervention decreased significantly than that of before intervention ($p=0.016$ and $p=0.019$; $p=0.002$ and $p=0.021$). In addition, both groups had a higher average of fiber intake after the intervention compared before intervention ($p<0.001$). In conclusion, consuming whole fruits before meals decreases energy and fat intake and increases fiber intake in overweight adults but walking 10 min after meals does not affect their daily food intake.

Keywords: Whole fruits consumption, Walking 10 min, Daily food intake, obesity

1 Introduction

During the last three decades, the global prevalence of overweight and obesity has increased rapidly across countries worldwide in all ages groups and gender [1]. Similarly, data from the Indonesian Basic Health Research show that overweight and obesity in adults aged >18 years old has increased from year to year. The prevalence of adult overweight remains stable at about 13.5% in 2013 and 2018, while most obesity rose from 15.4% in 2013 to 21.8% in 2018. In addition, the prevalence of obese women increases more rapidly than the prevalence of men obese [2, 3].

Unhealthy diets such as excessive consumption of fast food, low consumptions of fruits and vegetables, and low physical activity are essential determinans to the incidence of obesity [4]. A study shows that a high frequency of fast food has a 1.46 times risk of increasing the incidence of abdominal obesity [5]. Meanwhile, consumption ≥ one time/day of whole fruits reduces obesity and metabolic syndrome compared to an adult who rarely consumed whole fruit

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[6]. In addition, individuals with low physical activity tend to be obese [7]. In the future, obesity may cause medical comorbidities, including type II diabetes mellitus, dyslipidemia, coronary heart disease, and cancer [8, 9].

WHO recommends increasing fruits and vegetables consumption and physical activity for reduction of body weight in adults obese. It has to consume 150g fruits and 250g vegetables [10], but most Indonesian people consume fruits and vegetables more minor than the recommended consumption of fruits and vegetables [3]. According to recent studies, increased consumption of whole fruits is inversely correlated with weight gain and macronutrients intake [11, 12]. WHO also recommends performing the physical activity at least 150 minutes/ week with aerobic moderate-intensity. Walking, for instance, is a popular physical activity for weight management and reduced stress and depression [13]. Moreover, walking is easily performed by obese people to manage their body weight [14]. Routine 1,000 steps walking will burn about 400 kcal/day and affect adipokines release, resulting in reduced adipose tissue mass and increased energy metabolism [15]. Therefore, this study aimed to investigate the effect of whole fruits consumption before meals and walking 10 minutes after meals on energy, fat, carbohydrate, and fiber intake in overweight and obese adults.

2 Research Methods

This randomized controlled trial (RCT) study with the pre-posttest group design was conducted in 22 adults in Surakarta city, which matched criteria: aged 20-29 years old, low levels of physical activity (METs $\leq$ 600), and Body Mass Index > 23 (overweight and obese nutrition status). The independent variables were fruit consumption and walking, while the dependent variable was energy, fat, carbohydrates, and fiber intake. Before the study began, all participants who take part in this study signed informed consent. The research protocol of this study was approved by the Health Research Ethics Commission (KEPK), Faculty of Medicine, Universitas Sebelas Maret, Surakarta (No. 042 / UN27.06.6.1 / KEPK / EC / 2020).

Before the intervention began, all participants were educated about their nutrition management in obesity and physical activity. Then the selected participants have randomly divided into two groups: 11 participants in the Treatment 1 (T1) group and 11 participants in the Treatment 2 (T2) group. T1 group consumed five types of fruits/ day before meals and walking 10 minutes after meals, while the T2 group only consumed five types of fruit/ day before meals for 30 days. Daily consumption of other foods was based on their habits. We used 13 different fruits, which were arranged in a seven-day cycle, and every day, the participants received ± 500g/ day five slices of fruits before meals which were consumed five times in the breakfast, snack time, lunch, snack time, and dinner.

Fruit intake data were collected using fruit consumption compliance, adopted from the Comstock method, and walking data were obtained from a form of walking compliance. Meanwhile, data of energy, fat, carbohydrate, and fiber intake were obtained from personal interviews using a 24-hour food recall form and processed using Nutrisurvey software.

The Statistical Package for Social Sciences (SPSS) program version 25 software was used to analyzing all the data. All data were presented as mean ± standard deviation. Data normality was verified using the Shapiro Wilk test. The Independent and Paired Student T-tests were used to evaluating the mean difference of fat, carbohydrate, and fiber in both groups. For energy intake, the Wilcoxon and Mann Whitney tests were used to analyzing those abnormal data. The p-value < 0.05 was recognized as a significant difference.

3 Results and Discussion

The characteristics of research participants and the daily intake of energy, fat, carbohydrates, fiber were presented in Table 1. In general, basic characteristics and daily food intake in the T1 group were similar to that of the T2 group except for age (p = 0,053). The T1 group had a higher mean of age, energy, fat, carbohydrate, and fiber intake than the T2 group, but there were no significant differences. Meanwhile, the average body weight, BMI, and physical activity in the T1 group were lower than in the T2 group, but there were no significant differences. It is not surprising that research participants in both groups have overweight nutrition status since their physical activity and fiber daily intake are lower than the recommended physical activity and fiber daily intake in adults.

Table 1. Characteristics of Research Participants

Variable	T1 (n=11)	T2 (n=11)	p value
	Mean ± SD		
Age (years)	24.63 ± 2.41	22.72 ± 1.90	0.053
Weight (kg)	75.01 ± 15.36	76.35 ± 19.23	0.859
BMI (kg/m^2)	28.79 ± 4.16	29.02 ± 5.76	0.693
Physical Activity (METs)	248.31 ± 169.5	305.13 ± 164.4	0.434
Energy (cal/day)	1752.69 ± 353.3	1682.22 ± 219.02	0.922
Fat (g/day)	72.42 ± 19.58	65.25 ± 13.11	0.325
Carbohydrate (g/day)	216.24 ± 41.57	213.57 ± 34.47	0.974
Fiber (g/day)	10.66 ± 2.02	9.32 ± 1.77	0.114

The average energy, fat, carbohydrate, and fiber intake in T1 and T2 groups were evaluated to determine the effects of whole fruits consumption before meals and walking 10 minutes after meal (Table 2). The average daily carbohydrate and fiber intake in T1 and T2 groups increased, whereas the average daily energy and fat intake averages decreased. In the T1 group, the averages of energy and fat intake after treatment decreased significantly compared to the averages of energy and fat intake before treatment (p = 0.016 and p = 0.002, respectively). A higher average of fiber intake was observed after treatment (18.24 ± 5.08 g/ day) than before treatment (10.66 ± 2.02 g/ day), and it reached significantly (<0.001). The same pattern of daily intake changes also occurred in the T2 group. The averages of energy and fat intakes after treatment were significantly lower than the averages of energy and fat intakes before treatment (p = 0.019 and p=0.021, respectively). After treatment, the average fiber intake significantly increased compared to the average fiber intake before treatment (p <0.001). In contrast, the average carbohydrate intake before treatment in both groups did not differ from carbohydrates after treatment.

Table 2. The Average of Energy, Fat, Carbohydrate, and Fiber in Research Participants Before and After Treatment

Nutrients	T1			T2		
	Before	**After**	**p-value**	**Before**	**After**	**p-value**
Energy (cal/day)	1752.69 ± 353.3	1524.75 ± 215.64	0.016*	1682.22 ± 219.02	1495.95 ± 316.08	0.019
Fat (g/day)	72.42 ± 19.58	50.54 ± 10.62	0.002	65.25 ± 13.11	49.93 ± 16.40	0.021
Carbohydrate (g/day)	220.15 ± 30.92	0.594*	213.57 ± 34.47	216.43 ± 41.57	0.657*	
Fiber (g/day)	18.24 ± 5.08	<0.001	9.32 ± 1.77	10.66 ± 2.02	42.61	<0.001
					16.91 ± 4.34	

*Wilcoxon Test was used to compare the average of energy and carbohydrate intake within T1 and T2 groups while other averages of food intake used the Paired T-Test

Table 3 indicated the comparison of changes in daily energy, fat, carbohydrate, and fiber intake between the T1 and T2 groups. Overall, the changes in daily food intake in the T1 group were similar to the changes in daily food intake in the T2 group with $p > 0.05$. Decreased energy intake in the T1 group (-227.94 ± 302.58 cal/ day) was more significant than the T2 group (-186.27 ± 220.12 cal/ day). Similarly, decreased fat intake in the T1 group (-21.88 ± 17.82 g/ day) was more significant than the T2 group (-15.32 ± 18.49 g/ day). In addition, the T1 group had a higher increase of carbohydrate intake changes (3.91 ± 39.98 g/ day) compared to the T2 group (2.86 ± 28.50 g/ day). In contrast, the changes in fiber intake in the T1 group were slightly different from the T2 group.

In this study, whole fruits consumption before meals reduces energy and fat intake by 13% and 30%, respectively, and increases fiber intake by 81%. This result is in line with Fitri's study that consumption of 300g whole fruits before a meal can reduce energy intake and increase fiber intake in patients with type II diabetes mellitus [16]. Our result findings also support the previous results that eating a salad before carbohydrates reduces energy intake by 165.6 ± 87.0 kcal/ day in prediabetes adults than the nutritional balance group by 206,4 ± 113,8 kcal/ day [17]. Another study has also shown a decrease in energy intake by 11% after consuming 300g vegetable salad before lunch eating [18]. However, the research method, whole fruits consumption, and research participants in our study are different from the previous studies discussed above.

Whole fruits have a high fiber content which contributes to human health during regular consumption. Other benefits of whole fruits consumption improve gastrointestinal tract activity and weight management and prevent cardiovascular disease risks such as type II diabetes mellitus and metabolic syndrome [19]. The fiber in the human gut provides a good source for bacterial fermentation by which generates high levels of Short-chain Fatty Acids (SCFAs). Therefore, it increases satiety hormone release such as GLP-1 and PYY, resulting in a more prolonged feeling of fullness and reduction of energy intake [20, 21]. Subsequently, it will increase body weight loss as reported by other studies that higher fruit intake contributes to weight loss and waist circumference in overweight adults [22, 23].

Meanwhile, physical activity is a modifiable factor for obesity prevention [24]. In this study, a combination of whole fruits consumption and physical activity reduces energy and fat intake more significantly than whole fruits consumption only. But, the mean differences in the food intake are not significant. The results of our study are in contrast to the previous research that the combination of whole fruits consumption and jumping jacks increases energy and fat

intake in patients with type II diabetes mellitus [25]. The discrepancies of research findings are due to the different research methods, participants, whole fruits consumption, and physical activity. However, the limitations of our study do not use control groups with the daily habit of food intake and only walking 10 minutes after meals, which probably has a more pronounced effect compared to the combination of whole fruits consumption and walking 10 minutes.

Table 3. The Comparison of Changes in Daily Energy, Fat, Carbohydrate, and Fiber Intake between T1 and T2 Groups

Nutrients	T1	T2	p-value
Energy (cal/day)	-227.94 ± 302.58	-186.27 ± 220.12	0.974*
Fat (g/day)	-21.88 ± 17.82	-15.32 ± 18.49	0.407
Carbohydrate (g/day)	3.91 ± 39.98	2.86 ± 28.50	0.944
Fiber (g/day)	7.58 ± 4.03	7.59 ± 3.29	0.993

*The difference of energy intake between T1 and T2 groups was analyzed using Mann Whitney Test while other food intake used the Independent T-Test

4 Conclusion

Whole fruits consumption before meals decreases daily energy and fat intake and increases daily carbohydrate and fiber intake in adults with obesity. Meanwhile, physical activity – added whole fruits consumption does not influence the daily food intake. The change of fruits consumption order will be an important strategy for reducing daily food intake in patients with obesity. Biochemical analysis of blood serum is required to detect critical biomarker changes during whole fruits consumption before meals.

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References

[1] Ng M, *et al*. Global, Regional, and National Prevalence of Overweight and Obesity in Children and Adults during 1980-2013: A Systematic Analysis for the Global Burden of Disease Study 2013. The Lancet. 2014; 384: 766-781.

[2] Ministry of Health of the Republic Indonesia. Basic Health Research 2013. Ministry of Health of the Republic Indonesia, Jakarta. 2013.

[3] Ministry of Health of the Republic Indonesia. Basic Health Research 2018 Ministry of Health of the Republic Indonesia, Jakarta. 2018.

[4] Lyngdoh M, Akoijam BS, Agui RK, & Singh SKh. Diet, Physical Activity, and Screen Time among School Students in Manipur. Indian Journal of Community Medicine. 2019; 44 (2): 134-137.

[5] Mohammadbeigi A, Asgarian A, Moshir E, Heidari H, Afrashteh S, Khazaei S, & Ansari H. Fast Food Consumption and Overweight/ Obesity Prevalence in Students and Its Association with

General and Abdominal Obesity. Journal of Preventive Medicine and Hygiene. 2018; 59 (3): E236 – E 240.
[6] Choi A, Ha K, Joung H, & Song Y. Frequency of Consuming of Whole Fruit, Not Fruit Juice, is Associated with Reduced Prevalence of Obesity in Korean Adults. Journal of the Academy of Nutrition and Dietetics. 2019; 2212 – 2672.
[7] Singh S, Issac R, Benjamin AI, & Kaushal S. Prevalence and Association of Physical Activity and Obesity: An Urban, Community-Based, Cross-Sectional Study. Indian Journal of Community Medicine. 2016 ; 41 (1): 77.
[8] Reinehr T. Long-term Effects of Adolescent Obesity: Time to Act. Nature Reviews Endocrinology. 2018; 14: 183-188.
[9] Manna P & Jain SK. Obesity, Oxidative Stress, Adipose Tissue Dysfunction, and the Associated Health Risks: Causes and Therapeutic Strategies. Metabolic Syndrome and Relate Disorders. 2015; 13, 10
[10] World Health Organization (WHO). Fruit and Vegetable Promotion Initiative. World Health Organization Geneva. 2003.
[11] Christensen AS, Viggers L, Hasselstrom K, & Gregersen S. Effect of Fruit Restriction on Glycemic Control in Patient with Type 2 Diabetes – A Randomized Trial. Nutrition Journal. 2013; 12: 29.
[12] Schroder KEE. Effect of Fruit Consumption on Body Mass Index and Weight Loss in a Sample of Overweight and Obese Dieters Enrolled in a Weight-loss Intervention Trial. Nutrition. 2010; 26(7-8): 727-734.
[13] Glasper A. Walk This Way: Improving Activity Levels. British Journal of Nursing. 2017; 26 (6).
[14] Ekman MJ, Klingenberg M, Bjorck U, Norstrom F, & Ridderstrale. Six-Minute Walk Test Before and After a Weight Reduction Program in Obese Subjects. Obesity Biology and Integrated Physiology. 2013; 21 (3).
[15] Mika A, Macaluso F, Barone R, Felice VD, & Sledzinski T. Effect of Exercise on Fatty Acid Metabolism and Adipokine Secretion in Adipose Tissue. Frontiers in Physiology. 2019; 10: 26.
[16] Fitri N. Pengaruh Urutan Konsumsi Buah dengan Indeks Glikemik Rendah, Sedang, Tinggi terhadap Kadar Glukosa Darah Puasa, Homa-β dan Short-Chain Fatty Acids pada Pasien Diabetes Melitus Tipe 2 Tesis M.Gz. Universitas Sebelas Maret Surakarta; 2019.
[17] Yabe D, Kuwata H, Fujiwara Y, Sakaguchi M, Moriyama S, Makabe N, *et al*. Dietary Instructions Focusing on Meal-sequence and Nutritional Balance for Prediabetes Subjects: an Exploratory, Cluster-randomized, Prospective, Open-label, Clinical Trial. Journal of Diabetes and Its Complications. 2019; 33 (12).
[18] Roe LS, Meengs JS, & Rolls BJ. Salad and Satiety The Effect of Timing of Salad Consumption on Meal Energy Intake. Appetite. 2012; 58 (1): 242-248.
[19] Dreher M. Whole Fruits and Fruit Fiber Emerging Health Effect. Nutrients. 2018; 10 (12): 1833.
[20] Byrne CS, Chambers ES, Morrison DJ, & Frost G. The Role of Short-Chain Fatty Acids in Appetite Regulation and Energy Homeostasis. International Journal of Obesity. 2015; 39 (9): 1331-1338.
[21] Tiles S & Ozgoz S. Health Effects of Dietary Fiber. Acta Scientiarum Polonorum. 2014; 13 (20): 191-202.
[22] Ledoux TA, Hingle MD, & Baranowski, T. Relationship of Fruit and Vegetable Intake with Adiposity: a Systematic Review. Obesity Reviews. 2010; 12: e143-e150.
[23] Sharma PS, Chung HJ, Kim HJ, & Hong ST. Paradoxical Effect of Fruit on Obesity. Nutrients. 2016; 8 (10): E633.
[24] Ang YN, Wee BS, Poh BK, & Ismail MN. Multifactorial Influences of Childhood Obesity. Current Obesity Report. 2013; 2: 10-22.
[25] Dwipajati. Pengaruh Konsumsi Buah sebelum Makan dan Latihan Fisik setelah Makan terhadap Kadar Glukosa Darah dan Aktivitas Enzim Dipeptil Peptidase-4 Pasien Diabetes Melitus Tipe-2 Tesis M.Gz. Universitas Sebelas Maret Surakarta; 2018.