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Effects of 4-Week Supplementation of Oat on Body Mass Index, Waist-Hip Ratio and Physical Fitness Performance among Overweight University Students

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ABSTRACT

Introduction: Overweight has become a serious health problem around the world and it is necessary to find the best strategic to prevent it. Therefore, the objective of this study was to investigate the effects of oat consumption for four weeks on body mass index, waist-hip ratio and physical fitness performance among overweight university students.

Methodology: A total of 30 subjects (age: 22.7 ± 1.9 years; body weight: 77.5 ± 16.6 kg; body mass index: 29.8 ± 4.8 kg.m-2) participated in this study. Subjects consumed oat twice a day for four weeks. Anthropometry measurements such as body mass index and waist-hip ratio were measured at pre and post of four week intervention study. Physical fitness performance tests such as push-up, sit-up and plank were also measured at pre and post of four weeks intervention study.

Results: This study found there was a signification reduction in body weight and body mass index between pre and post of four weeks intervention study ($p<0.05$). Body weight and body mass index decreased by 1.16 ± 1.36 kg (1.50%) and 0.46 ± 0.48 kg/m2 (1.54%), respectively. However, there was no significant difference in waist-hip ratio between pre and post of four weeks intervention study ($p>0.05$). For physical fitness performance tests, there were significant improvements in the push-up, sit-up and plank test between the pre and post of four weeks intervention study ($p<0.05$).

Conclusion: This study found that consumption of oat for four weeks was effective in reducing body weight, body mass index and improving physical fitness performance among overweight university students. However, more researches are still warranted to reconfirm these findings at different population and intervention protocols.

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Introduction

Overweight is one of the most serious health problems of the 21st century. Overweight has threatened the lives of nearly 300 million people worldwide and increase the risk to have a non-communicable diseases and premature death [1]. It was well documented that overweight would affect health condition and increased the risk of heart disease, diabetes, dyslipidemia and cancer [2-10]. The sharp rise of the issue of overweight in most countries has resulted in deaths of more than three-tenths of four million. The increased health risk was due to the increasing value of body mass index and waist-hip ratio. Therefore, overweight issue should be curbed in order to produce a healthy and disease-free society [11]. An ideal weight was the best strategic to ensure a good level of health [12]. Oat is a nutritious food and it contains high in fibre and β-glucans. To date, several previous studies found long term supplementation of oat was effective to reduce body mass index and waist-hip ratio but there was still scanty information on short term supplementation of oat on body mass index and waist-hip ratio among overweight university students. There was also limited data on effects of oat supplementation on physical fitness performance among overweight university students. Therefore, the objective of this study was to investigate effects of 4-week supplementation of oat on body mass index, waist-hip ratio and physical fitness among overweight university students.

Methodology

A total of 30 subjects were randomly selected and participated in this study. Subjects consumed oat (two full spoons) mixed in warm water twice a day for four weeks. The oats used in this research was high in protein, dietary fibre, β-glucans and free of cholesterol. Subject's selection was based on the inclusion and exclusion criteria as subjects. Inclusion criteria selection was aged 19 to 29 years old, body mass index more than 24.9 kg/m2, did not exercise more than once a week and also did not take any supplements that could reduce body weight during this four week of intervention study. Subjects who have asthma, tuberculosis,

diabetes, hypertension, heart disease, liver disease, lung disease and cancer were excluded as subjects in this research.

Anthropometry measurements such as body mass index and waist-hip ratio were measured at pre and post of 4-week intervention study. For measurement of height subjects, subjects should wear minimal clothing and remove shoes and socks. Before the measurement begins, the scale should be attributed and the subjects were required to stand in the centre of the scale without support with equal weight distribution between two legs [13]. Subjects should place both hands at the sides of the body and face straight forward [14]. Measurements should be taken on the nearest 0.1 kg [13].

For measurement for weight, subjects were required empty the urine in the bladder and did not consume any food before the measurement. Body mass index (BMI) was calculated with body weight (kg) divided by height (m2). The cut-off point of BMI used for the overweight classification was based on the clinical practice guidelines on management of obesity. A person was classified as overweight when his/her body mass index exceeded 24.9 kg/m2. Waist circumference and hip circumference were measured with a measuring tape and recorded to the nearest 0.1 cm. Measurement of waist circumference was taken around the midpoint between the lower margin of the last rib and the upper part of the iliac crest. Hip circumference was measured at the maximum circumference of the buttocks [15]. Waist measurements were measured after subjects fasted overnight because the amount of water, food or gas in the gastrointestinal tract can affect the accuracy of the measurements. Waist-hip ratio was calculated with the formula of waist circumference (cm) divided by hip circumference (cm).

Physical fitness performance tests such as push-up, sit-up and plank were measured at pre and post of 4-week intervention study. To perform sit-up, subjects lay supine on the floor with 90° flexion at the knee joint, hands at the sides of the head with elbows facing straight forward at the starting position. Then, sit-up was performed with the elbows touching the knees and the shoulders touching the floor while the body is facing backwards [16]. The number of sit-up done was recorded in one minute [17]. Push-up was performed with only the hands and toes touching the floor in the starting position. Hands are placed on either side of the chest with the back of the body straight. Then, the chest is lowered towards the floor at the same level each time until the elbows was at 90° angle [18]. The number of push-ups was recorded in one minute [19]. Plank was performed with the elbow vertical below the shoulder with the forearm and fingers extended straight forward. The neck was maintained in a neutral position so that the body can be kept straight from head to heel [20]. The number of minutes of doing plank was recorded with a stopwatch [21]. Statistical Package for the Social Sciences (SPSS) version 28.0 was used to analyze the collected data. Normality tests were performed by Shapiro-Wilk test. Paired t-test was used to determine significant differences between pre and post-test of 4-week intervention study within the group. The difference was considered significant if the p value was less than 0.05 with 95% confident level ($p<0.05$). All data were displayed in the form of mean ± standard deviation (Mean ± SD).

Results and Discussion

Thirty overweight university subjects were selected and participated in this intervention study for four weeks. All subjects were healthy and free from asthma, tuberculosis, diabetes, hypertension, heart disease, liver disease and cancer. This study found body weight and body mass index of subjects were significantly reduced after consumed oat for four week ($p<0.05$) (Table 1). These findings were agreements with several previous studies also found there was a significant decrease in body weight and body mass index after consumed oat [22-24]. Schuster et al. (2015) reported that there was a significant reduced in body weight and body mass index in the experimental group after consumed of 40 gram (two table spoons) of oat for eight weeks [22]. This findings reflected that consuming oat for 4-week has similar effects on body weight and body mass index in comparison with consuming oat for 8-week. Another study by Chang et al. (2013) also reported that there was a significant reduction of body weight and body mass index after consuming oats for six or twelve weeks compared with baseline data ($p<0.05$) [23]. Research data from Souza et al., (2016) also showed that subjects who received nutritional counselling with oat bran intake for 30 days experienced significant weight loss and body mass index when compared to baseline data [24]. The reduction of body weight and body mass index may due to consumption of oat can increase satiety and in turn decrease food intake. This can be attributed to the viscous fibre in oats that can affect appetite and can increase the viscosity of intestinal contents, promoted gastric contraction, reduced kinetics and nutrient absorption, slowed down gastric emptying as well as modulating incretion and appetite suppressant hormones. Thus, the energy deficit created can lead to reduction of weight and body mass index with unchanged height [25].

The oatmeal used in this study consisted of β-glucan that dissolves easily after mixing with warm water. Consumption of β-glucan oat produced a viscous solution that slowed gastric emptying, inhibited digestive enzymes and slowed the transferred of glucose molecules from the intestinal lumen to the brush border. Oat fibre that escaped from digestion in the small intestine can be used as an ingredient for colon fermentation that results in the production of short-chain fatty acids (SCFA) such as acetate, butyrate, and propionate. Increase in short-chain fatty acids (SCFA) production as well as dietary fibre intake were associated with increased concentrations of the appetite suppressant hormones GLP-1 and PYY after meals [26-27]. Oat β-glucan also increased the hormone cholecystokinin (CCK) after a meal in overweight subjects [28]. Hormone cholecystokinin (CCK) can slow down gastric emptying and suppressed appetite and eat less [29]. Therefore, subjects fell full and eat less that contributed to the less energy input which reduced body weight and body mass index.

This present study discovered waist-hip ratio had no significant difference although reduction was shown in the subjects after the 4-week of intervention between pre and post tests ($p>0.05$). This finding was similar with several previous studies also found there was not significant reduction in waist-hip ratio between pre and post test intervention of oat consumption [30-33]. Xue et al. reported that waist-hip ratio did not decrease significantly with consumption of oat bran although blood pressure reduced significantly [30]. Similar finding also found by Geliebter et al. and Tabesh et al. that there was no significant difference in waist-hip ratio in the experimental group consumed oat compares to the control group who only drank plain water [31-32].

Table 1: Comparison of anthropometric measurements between pre and post of 4-week intervention study

Anthropometric	Pre	Post	Differences	p-value
Body weight (kg)*	77.5 ± 16.6	76.4 ± 16.1	-1.16 ± 1.36	(p=0.00)
BMI (kg/m^2) *	29.8 ± 4.8	29.4 ± 4.7	-0.46 ± 0.48	(p=0.00)
Waist-hip ratio	0.87 ± 0.06	0.86 ± 0.07	-0.008 ± 0.02	(p=0.06)

Values are mean ± SD.
* denotes significant difference from pre trial at p<0.05.

For physical fitness performance tests, this study found there were significant improvement in push up, sit up and plank between pre and post test of 4-week intervention study (p<0.05). Subjects performed push-up for 18.2 ± 10.6 times per minute at pre test and increased significantly to 20.1 ± 12.5 times per minute at post test with a difference of 1.90 ± 1.90 times per minute or 10.4% (p <0.05). Subjects performed sit-up for 18.8 ± 9.6 times per minute at pre test and also increased to 22.1 ± 12.0 times per minute at post test with a difference of 3.30 ± 2.40 times per minute or 17.6 % (p<0.05). The length of time for the subjects to perform plank at pre test was 44.3 ± 20.5 seconds and increased to 55.3 ± 26.5 seconds at post test with differences 11.00 ± 6.00 seconds or 24.8% (p <0.05) (Table 2).

This study found there were significant improvements in push up, sit up and plank between pre and post tests after 4-week of intervention study. To our knowledge, these were novelty findings since up to date, there was scanty data on effects of oat consumption on physical fitness performance such as push-up, sit-up and plank. The improvement of these physical fitness parameters may due to nutrition content and antioxidant properties of oat. Zeng et al. (20221) discovered that oat contain Avenanthramide (AVA) which was an antioxidants agent that able to reduce reactive oxygen species resulting from exercise [33]. Avenanthramide (AVA) in oats was able to reduce blood inflammatory markers and reactive oxygen species, activation of NF-κB mononuclear cells and increased antioxidant capacity [34-35]. These may contribute to subjects more energetic and able increase their physical fitness performance. However, more studies were still warranted to explain the mechanism improvement of physical fitness performance due to antioxidant properties and calorie of the oat supplementation among overweight person.

Table 2: Comparison of physical fitness performance between pre and post of 4-week intervention study

Physical fitness	Pre	Post	Differences	P value
Push-up (times) *	18.2 ± 10.6	20.1 ± 12.5	1.90 ± 1.90	(p=0.01)
Sit-up (times) *	18.8 ± 9.6	22.1 ± 12.0	3.30 ± 2.40	(p=0.00)
Plank (seconds) *	44.3 ± 20.5	55.3 ± 26.5	11.00 ± 6.00	(p=0.00)

Values are mean ± SD.
* denotes significant difference from pre trial at p<0.05.

Conclusion

This study found that consumption of oat at two full spoons twice a day for four weeks was effective in reducing body weight, body mass index and improving physical fitness performance such sit up, push up and plank. However, more researches are still warranted to reconfirm these findings at different population and intervention protocols.

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