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The effect of high fiber beverages consumption on anthropometric, defecation and quality of life changes in overweight / obese female volunteers

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Abstract

Overweight status and obesity are major risk factors that cause noncommunicable diseases and lower quality of life. Currently, rice germs can be a source of dietary fiber which is the main ingredient for the production of the dietary fiber drinks. This study aimed to determine the effect of high fiber beverages consumption on anthropometric, defecation and quality of life changes among overweight/obese female volunteers. A randomized controlled trial with two parallel groups (control group = 18, experimental group = 18), were conducted for 12 weeks. Anthropometrics included body weight, BMI and body fat percentage (the total mass of fat divided by total body mass, multiplied by 100). Defecation was assessed using the Bristol Stool Form Scale−7. Quality of life was assessed using the WHOQOL−BREF−THAI−26 questionnaire. Fecal appearance and quality of life were analyzed using Chi−square tests (SPSS Software, Version 18; SPSS Inc., Chicago, IL, USA). At week 12, the experimental group had a significantly lower body fat percentage than the control group (P−value = 0.040). Within experimental groups, the average fat body percentage was decreased (P−value < 0.05) at weeks 4, 8 and 12 but did not differ in the control group. The experimental group had a higher average frequency of defecation than the control group and significantly increased frequency in the experimental group (P−value < 0.05). Experimental and control groups correlated regarding quality of life overall at week 12 (P−value = 0.004) with 65 and 20% good quality of life, respectively.

The group of high fiber beverages intake (a) reduced the body fat percentage (b) increased the average frequency of defecation and (c) correlated with quality of life concerning better physical health.

Keywords: High fiber, beverages, defecation, quality of life, overweight/obese

1. Introduction

Overweight status and obesity are major public health problems globally and in Thailand. A study done by The Thai National Health Examination Surveys V (NHES V) 2014 reported the prevalence of obesity (BMI ≥ 25 kg/m^2) aged over 15 years was one third of adults. (Aekplakorn *et al.,* 2014). These factors cause no communicable diseases (Nonboonyawat *et al.,* 2019). Inappropriate eating behaviors such as consuming few fruits and vegetables or consuming foods with high energy and fat (Duthie *et al.,* 2018) are risk factors of these diseases. Fruits and vegetables are sources of high fiber. The World Health Organization (WHO) recommends 27 to 40 grams of dietary fiber daily (World Health Organization, 2003). Dietary fiber prevents intestinal diseases such as constipation, hemorrhoids, hiatus hernia, diverticular disease and colon cancer (Ötles and Ozgoz, 2014). At present, Thais consume less fiber than their daily requirement that can cause constipation (Khonchanwit, 2004; Ho *et al.,* 2012).

In adulthood, overweight status and obesity are associated with psychosocial disorders. These results lower quality of life as well (Pimenta *et al.,* 2015). Therefore, consuming a healthy diet is one way to prevent overweight status and obesity (Esmaillzadeh *et al.,* 2006) and improve the excretory system and quality of life. Currently, most people are interested in healthy diets. Drinks with dietary fiber are an alternative choice for people because they are healthy and useful in many ways (Popkin and Hawkes, 2016).

The benefits of dietary fiber for human (Anderson *et al.,* 2009) health include: positively affecting glucose and lipid levels in the blood, generating short chain fatty acids (butyrate fatty acid) to prevent colon cancer, increasing bowel movement, helping in the growth of epithelial cells in ileum and colon, and reducing constipation. Dietary Reference Intakes (DRIs) recommends about 20 to 35 grams of fiber daily, easing defecation and to strengthening the intestinal mucosa. In addition, rice and germ are grains consisting of carbohydrates, proteins, fats, calcium, phosphorus, vitamins and especially dietary fiber. Brown rice has many benefits for human health. It prevents angular stomatitis, anemia, gallstones, some neurological diseases and peripheral neuropathy and constipation (Chaudhari *et al.,* 2018; Jung *et al.,* 2020). Currently, few Thai studies have been conducted on the clinical effects of dietary fiber drinks (Sharafi *et al.,* 2018).

Thus, the study aimed to investigate the effect of consuming high fiber beverages consumption on anthropometrics, defecation and quality of life changes in overweight/obese female volunteers.

2. Materials and Methods

2.1 Study population

A total of 52 overweight/obese female volunteers in Bangkok were enrolled in this study. Inclusion criteria included adult female, aged 18 to 59 years old, BMI 23.0 to 29.9 km/m^2, literacy skills, no underlying diseases and volunteer. Participants taking medication or consuming supplements effecting body composition or the excretory system, having digestive problems, pregnancy or lactation, or fiber allergy were excluded from the study. This study was approved by the office of Ethics Review Committee for Human Research, Faculty of Public Health, Mahidol University (COA. No. MUPH 2016−151) and informed consent was obtained from all participants.

2.2 Experimental study

The study, used a randomized control trial with two parallel groups carried out for 12 weeks. Participants were divided in two groups using simple random sampling. They received either a placebo beverage with on fiber (control group), or a high fiber beverage with Thai Jasmine brown rice germ, wheat germ, and oats (12,000 mg/360 mL beverages/day; experimental group). All placebo beverages and treatment beverages have the same appearance. During the study periods, all participants measured their body weight, BMI and body fat percentage at the Faculty of Public Health, Mahidol University and recorded their defecation and quality of life every 4 weeks.

2.3 Data collection

Basic characteristics including age, ethnicity, occupational status, physical data, monthly income, food record and exercise were collected using standardized questionnaire. For defecation assessment, the Bristol Stool Form Scale−7 Questionnaire and the Bowel Assessment Form, developed from the CNPG Poststroke Rehabilitation: Fecal Incontinence were employed. Participants' weight, percentage of body fat and BMI were measured using the Tanita DC−360 body composition analyzer. Height was measured using a standard height gauge, while the quality of life was assessed using the WHOQOL−BREF−THAI−26 Questionnaire. Energy and nutrients were calculated using the INMUCAL-Nutrients Program, Version 3.

2.4 Data analysis

The basic characteristics of the participants in both groups were analyzed using the t−test (SPSS Software, Version 18; SPSS Inc., Chicago, IL, USA). The changes in weight, BMI, body fat percentage and frequency of defecation within 12 weeks were analyzed using the t−test and One-way repeated measures ANOVA. Fecal appearance and quality of life were analyzed using Chi−square tests.

3. Results and Discussion

The characteristics of the 52 participants were compared between the experimental (n = 26) and control groups (n = 26). Sixteen participants did not follow the research process and discontinued the study. Table 1 shows participant characteristics. No significant differences were found regarding age, ethnicity, marital status, occupation, height, body weight, BMI and average salary between the control and experimental groups.

Table 1 Characteristics of study participants

General characteristic	T group n = 18	C group n= 18	P-value
Population characteristic	39 ± 13.4	35.3 ±	
Age (year), mean ± SD		12.9	0.743[a]
Race, n [%]		18 [100.0]	
Asia	18 [100.0]		1[b]
Marital status, n [%]		12 [66.7]	
Single	11 [61.1]	6 [33.3]	0.685[b]
Others (married/separated/divorced)	7 [44.4]		
Occupation, n [%]		10 [55.6]	
Housewife	11 [61.1]	8 [44.4]	0.540[b]
Others (student/employee)	7 [38.9]		
Anthropometry data, mean ± SD		154.3 ±	
Height (cm)	154.5 ±	5.1	0.658[a]
Weight (kg)	4.5	64.4 ± 6.0	0.098[a]
BMI (kg/m^2)	62.8 ± 4.1	27. ± 2.2	0.840[a]
	26.4 ± 2.2		
Average salary, n [%]		13 [72.2]	
Less than 10,000 baht	14 [77.8]	5 [27.8]	0.7[b]
10,000 baht or over	4 [22.2]		

[a] The correlation between groups was tested by Independent−sample T−test [b] The correlation between groups was tested by Chi−square [T] group means group consuming high fiber beverages [C] group means group consuming no dietary fiber drinks or not receiving a placebo drink

The results showed that consuming high fiber beverages did not change body weight, BMI and percentage of body fat compared with the control group during the study (Table 2). However, body weight, BMI and percentage of body fat after weeks 4, 8 and 12 of consuming high fiber beverages significantly decreased compared with baseline ($P<0.05$). At week 12, the experimental group had a significantly lower percentage of body fat than that of the control group ($P = 0.040$).

Table 2 Mean and SD of weight, BMI, percentage of body fat by group and study period

Group	Duration				P−value[b]
	Week 0	Week 4	Week 8	Week 12	
Weight					
T group	64.7 ± 4.0	64.2 ± 4.4	63.9 ± 4.2	63.8 ± 4.5	0.007*
C group	64.4 ± 6.5	64.1 ± 6.1	63.9 ± 6.1	63.8 ± 6.6	0.421
P−value[a]	0.871	0.943	0.997	0.979	
BMI					
T group	26.29 ± 1.9	26.09 ± 2.1	25.98 ± 1.9	25.93 ± 2.2	0.016*
C group	26.75 ± 2.4	26.59 ± 2.2	26.53 ± 2.1	26.48 ± 2.4	0.284
P−value[a]	0.628	0.491	0.427	0.465	
Percentage of body fat					
T group	38.43 ± 3.2	37.49 ± 3.9	37.00 ± 3.7	36.94 ± 3.9	0.000*
C group	38.51 ± 3.5	38.17 ± 3.6	37.69 ± 3.8	37.77 ± 3.8	0.083
P−value[a]	0.949	0.586	0.583	0.526	

[a]The correlation between groups was tested by Independent-sample T-test, [b]The correlation within groups was tested by One-way repeated measures ANOVA *p*-value<0.05 The differences are statistically significant T group means group consuming high fiber beverages C group means group consuming no dietary fiber drinks or not receiving a placebo

A significant difference was detected between the placebo and the high fiber beverage groups after two weeks. In addition, the average frequency of defecation after consuming high fiber beverages at 2 to 4 and 4 to 6 weeks had significantly increased compared with the control group (P<0.05, Table 3). Compared with baseline, consuming high fiber beverages caused a significant increase in the frequency of defecation (P<0.05), but no differences were found in the control group.

Table 3 Mean and SD of frequency of defecation (times/week) by group and study period

Group	Duration						*P*-value[b]
	Week 0 – 2	Week 2 – 4	Week 4 – 6	Week 6 – 8	Week 8 – 10	Week 10 – 12	
Tgroup	7.5 ± 3.1	9.6 ± 3.5	9.5 ± 3.2	9.5 ± 3.0	9.0 ± 3.4	8.9 ± 3.6	0.018*
Cgroup	7.5 ± 2.5	7.3 ± 3.0	7.1 ± 3.0	7.5 ± 3.2	7.2 ± 2.9	7.2 ± 3.1	0.978
P-value[a]	0.976	0.040*	0.027*	0.053	0.094	0.128	

[a] The correlation between groups was tested by Independent−sample T Test [b] The correlation within groups was tested by One−way repeated measures ANOVA *P*−value <0.05 The differences are statistically significant.[T] group means group consuming high fiber beverages[C] group means group consuming no dietary fiber **d**rinks or not receiving a placebo

Experimental and control groups correlated with the quality of life in physical health during weeks 4 and 12 (P<0.05; Table 4). After 12 weeks of the experiment, the results showed that experimental and control groups correlated with mental health, social relations, environment and overall aspects (P<0.05) with a good quality of life.

Table 4 Quality of life score (assessed using WHOQOL−BREF−THAI) by component, group and study period

Component	Week 0		Week 4		Week 8		Week 12	
	T group n [%]	C group n [%]	T group n [%]	C group n [%]	T group n [%]	C group n [%]	T group n [%]	C group n [%]
Physical health								
- Good quality of life	5[27.8]	7 [38.9]	13 [72.2]	5 [27.8]	12 [66.7]	7 [38.9]	15[83.3]	6 [33.3]
- Poor quality of life[1]	13 [72.2]	11 [61.1]	5 [27.8]	13 [72.2]	6 [33.3]	11 [61.1]	3 [16.7]	12[66.7]
p-value	0.480		0.008*		0.095		0.002*	
Mental health								
- Good quality of life	7 [38.9]	7 [38.9]	10 [55.6]	8 [44.8]	9 [50]	8 [44.4]	12[66.7]	6 [33.3]
- Poor quality of life[1]	11 [61.1]	11 [61.1]	8 [44.8]	10 [55.6]	9 [50]	10 [55.6]	6 [33.3]	12[66.7]
p-value	1		0.505		0.738		0.046*	
Social relations								
- Good quality of life	6 [33.3]	3 [16.7]	7 [38.7]	2 [11.1]	10 [55.6]	3 [16.7]	9 [50]	2 [11.1]
- Poor quality of life[1]	12 [66.7]	15 [83.3]	11 [61.1]	16 [88.9]	8 [44.4]	15 [83.3]	9 [50]	16[88.9]
p-value	0.248		0.054		0.015*		0.011*	
Environment								
- Good quality of life	3 [16.7]	1 [5.6]	3 [16.7]	4 [22.2]	2 [11.1]	4 [22.2]	7 [38.9]	1 [5.6]
- Poor quality of life[1]	15 [83.3]	17 [94.4]	15 [83.3]	14 [77.8]	16 [88.9]	14 [77.8]	11[61.1]	17[94.4]
p-value	0.289		0.674		0.371		0.016*	
Overall quality of life								
- Good quality of life	4 [22.2]	2 [11.1]	10 [55.6]	6 [33.3]	10 [55.6]	7 [38.7]	13[72.2]	2 [11.1]
- Poor quality of life[1]	14 [77.8]	16 [88.9]	8 [44.4]	12 [66.7]	8 [44.4]	11 [61.1]	5 [27.8]	16[88.9]
p-value	0.371		0.180		0.317		0.000*	

[a] The correlation between groups was tested by Chi−square * P−value < 0.05 The differences are statistically significant.[1] Poor quality of life means moderate and poor quality of life T group means group consuming high fiber beverages [C] group means group consuming no dietary fiber drinks or receiving a placebo drink

4. Discussion

This study determined the effect of consuming high fiber beverages on anthropometrics, defecation and quality of life changes in overweight/obese female volunteers. The results of both groups exhibited no difference in average body weight, BMI and body fat percentage. Within the group consuming high fiber beverages, average body weight, BMI and body fat percentage significantly decreased. This result was supported by the consumption of soluble fiber. Soluble fiber can dissolve in water forming viscous gels and then pass through the small intestines as well as the large intestines (Lattimer and Haub, 2010). The increasing dietary fiber intake could reduce energy absorption by way of diluting a diet's energy availability. Based on a study of Tucker and Thomas, 8 gm increase in dietary fiber per 1000 kcal reduced body weight and body fat after consuming for 20 months among middle aged women (Tucker and Thomas, 2009). Moreover, soluble fiber has the ability to bind with fat and sugar complexes in the digestive tract (Anderson *et al.*, 2009; Lattimer and Haub, 2010). They cannot be digested or absorbed in the body and are excreted from the body with food waste in form of feces. Anthropometrics in both groups tended to decreased because this research is a study on weight loss. Subjects in this study may have intended to lose or control weight.

The results of both groups in 12 weeks differed at weeks 2 to 4 and weeks 4 to 6. In fact, insoluble fiber enhances the volume of food waste and cleanses the digestive tract (Lattimer and Haub, 2010; Tucker and Thomas, 2009). Moreover,

soluble fiber has the ability to absorb water (Dhingra *et al.*, 2019), which is gel−like (Tucker and Thomas, 2009). This increases the perception of excretion, thus increasing the frequency of defecation (Marlett *et al.*, 2000; El-Salhy *et al.*, 2017).

The mean defecation frequency of the two groups did not significantly differ because in the first part of the study, the subjects receiving dietary fiber beverages were more adaptive and obviously altered the excretory system. However, after the period of research, the average frequency of defecation slightly decreased. This may have been because the body adapted and became familiar with the high levels of fiber intake. Moreover, consuming dietary fiber was associated with overall fecal appearance. The group consuming high fiber beverages had a greater proportion of normal stool samples than those without dietary fiber. Normal stool samples tended to increase over the time of the study after consuming high fiber beverages and likely to decrease among nondietary fiber consumers. In addition, abnormalities of the feces were less likely in the high fiber consumption group with an increasing tendency among those who did not consume. Regarding inconsistency in recording fecal appearance, the subjects could not recall and classify the feces themselves or maintained incomplete records. This affected the statistical data analysis.

After the study period, a larger proportion in the high fiber beverage group experienced greater quality of life. Dietary fiber, whether given in the form of a food or supplement, can have many benefits for the digestive system (Makki *et al.*, 2018; Hasan *et al.*, 2019; Bliss *et al.*, 2014). It can increase the volume of food waste, cleanse the digestive tract to make the epithelium of the colon strong and promote the growth and function of gut microbiota in the large intestines. Moreover, consuming dietary fiber resulted in better control of glucose and lipids in the blood circulation. Based on Anderson et al.'s report, dietary fiber also prevented and treated constipation and diarrhea and improved immunity to prevent colon cancer (Anderson et al., 2009; Makki *et al.*, 2018). Therefore, these diverse benefits contributed to improved quality of life concerning physical health.

The limitations of the present study need to be considered. The number of participants should be increased. The eating patterns, exercise and physical activity were not controlled during the study. Moreover, a further study should compare the effects of high fiber beverages.

4. Conclusion

The Thai Dietary Reference Intakes (Recommended Dietary Allowances and Adequate Intakes of energy and selected nutrients) for adults aged 19 to 50 years recommends a daily intake for total fiber for adults of 25 to 38 gm for healthy men and women (Dietary Reference Intake for Thais 2020). In conclusion, consuming high fiber beverages may reduce body weight, BMI and body fat among overweight /obese female volunteers with improved defecation. Interestingly, high fiber beverage intake was also related to greater quality of life regarding better physical health.

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