Other

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EFFECT OF WHEY PROTEIN INTAKE ON FEMALE BODY COMPOSITION AND RESTING METABOLIC RATE

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Sumia Shukri AlSaif* Bachelor Of Science In Clinical Nutrition Department of Clinical Nutrition Imam Abdulrahman Bin Faisal University- Dammam- Saudi Arabia *Corresponding Author sumiaalsaif@gmail.com

Dema Obaid AlHajri Bachelor Of Science In Clinical Nutrition Department of Clinical Nutrition Imam Abdulrahman Bin Faisal University- Dammam- Saudi Arabia

Fay Jalawi AlMutairi Bachelor Of Science In Clinical Nutrition Department of Clinical Nutrition Imam Abdulrahman Bin Faisal University- Dammam- Saudi Arabia

Hanan Nabeel AlSaif Bachelor Of Science In Clinical Nutrition Department of Clinical Nutrition Imam Abdulrahman Bin Faisal University- Dammam- Saudi Arabia

Manar Mohamed Badawy PhD of cardiovascular and pulmonary Department of Clinical Nutrition Imam Abdulrahman Bin Faisal University- Dammam- Saudi Arabia

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ABSTRACT:

Objective: The aim of the current study was to examine the effect of whey protein supplement on anthropometric measures as well as on resting metabolic rate. Methods: Forty-one female students between 18-24 years old were recruited for this case controlled study. Twenty-eight students were given 24 grams of whey protein supplement daily for 21 days. These subjects were divided into three groups based on their body mass index (BMI). Normal weight group (NWG), overweight group (OWG) and obese group (OG). The remaining subjects who had normal weights served as controls(C). Anthropometric measurements, blood analysis, resting metabolic rate were measured in all subjects at baseline and at the end of the study. Results: Fat body mass decreased significantly (P= < 0.024) in the (NWG). Resting metabolic rate increased significantly in the NWG and OG (P= < 0.001). Conclusion: Dietary whey protein supplementation even during a 3-week intervention showed significant increase in resting metabolic rate amongst normal and obese female subjects.

Background

The World Health Organization (WHO) estimate that 2.8 million people die annually as a result of being overweight or obese. In all WHO regions women were more likely to be obese than men ("World health organization", 2017). Body fat accumulation is associated with several health risks such as atherosclerosis, heart diseases, cancer, type 2 diabetes and osteoarthritis (Must, & McKeown, 2012).The recommended dietary allowances (RDA) for a normal person for protein intake should constitute between 10-35% of the total daily energy requirement (Pesta, & Samuel, 2014; Antonio, Peacock, Ellerbroek, Fromhoff, & Silver, 2014).A diet with more than 0.8 grams per kilogram body weight is considered a high protein diet ("United States Department of Agriculture", 2016). High protein intake is a potential successful tool for weight loss (Halton, & Hu, 2004; Tang, Armstrong, Leidy, & Campbell, 2013; Lorenzen, Frederiksen, Hoppe, Hvid, & Astrup, 2012). In addition, subjects who consumed a high protein diet lost less lean body mass than subjects who consumed normal amount of protein (Tang, Armstrong, Leidy, & Campbell, 2013). The addition of high protein in breakfast prevented an increase in body fat and weight (Leidy, Hoertel, Douglas, Higgins, & Shafer, 2015). When the effect of different protein types (whey, casein and soy) on energy metabolism was studied, it was found that whey, casein, and soy protein meals were better than carbohydrates in their thermogenic effect (Halton, & Hu, 2004; Acheson et al, 2011). Amongst the proteins whey was found to have the highest thermogenic effect and cumulative fat oxidation (Mikkelsen, Toubro, & Astrup, 2000; Acheson et al, 2011; Tsani, Kim & Kim, 2012).The aim of the current study was to examine the effect of a whey protein supplement on anthropometric measures as well as on resting metabolic rate (RMR).

Subjects and Methods

Subjects

Healthy Saudi female students recruited from Imam Abdulrahman Bin Faisal University for this case controlled study. The inclusion criteria were: age (18-24 years), non-smokers, non-pregnant, and non-lactating. The exclusion criteria were: whey protein allergy, metabolic disease, diabetes, hypothyroidism or being rigorously athletic.

Food habit questionnaire

A questionnaire was designed to collect data related to food habits, nutritional intake, and food consumption pattern. This utilized 24-hour recall 4-5 times during the study to determine macronutrients intake.

Experimental design

Forty-one subjects were divided to 4 groups; A control group (C) with normal body mass Index (BMI) (BMI range 18.5-24.9) (n=13). The experimental groups were as follows: an obese group (OG) (BMI range 30-34.9) (n=7), an overweight group (OWG) (BMI range 25-29.9) (n=6) and a normal weight group (NWG) (BMI range 18.5-24.9) (n=15).

The study was conducted over a period of 21 days. Experimental groups received whey protein powder (24 grams daily). They were instructed to take the supplement mixed with water only, at 8:00 am. Reminder messages were sent via social media platforms daily.

The following measurements were made at baseline and at the end of the study period. Body weight and height were measured with calibrated electronic scale and a stand meter. The BMI was derived from these measurements. Total body fat (TBF) and lean body mass (LBM) were measured using the Tanita device. Blood analysis for

albumin, total protein, and creatinine were performed at the same hospital laboratory using UNICELL DXC 600 made by Beckman Coulter International SA,Switzerland.

Cardio Pulmonary Exercise Testing (CPET) measured RMR, oxygen consumption (VO2) and carbon dioxide production (VCO2) after a period of 12 hours fast in the Exercise Physiology Laboratory at the Physical Therapy Department of Imam Abdulrahman Bin Faisal University in Dammam.

Ethical consideration

1-Ethics approval

The study was approved by the institutional review board (IRB) committee at University of Imam Abdulrahman bin Faisal (University of Dammam previously). They IRB number: IRB-UGS-2015-03-217 dated 7th December 2015. (Appendix 1)

2-Consent for publication

All participants in the study were provided with an information sheet that clearly stated that the result from the study shall be published in a scientific journal. All participants signed a written consent agreeing to take part in the above study (appendix 2)

Material

The whey protein used was commercially available and supplied by Optimum Nutrition Inc, Downers Grove, IL.

Statistical analysis

Significant differences (P-value) by (ANOVA) and least significant difference (LSD) for verifying differences between groups, and paired sample t-test for verifying differences between values before and after dietary intervention was done using Statistical Package for the Social Science program (SPSS version 23). A P value =/< 0.05 is considered significant.

Results

All subjects had complete baseline data. Five subjects did not complete the study for the following reasons: One subject developed vomiting and diarrhea following supplement ingestion, two could not come for the final visit due to lack of suitable transport at the required time, one did not tolerate the taste of the supplement while the fifth decided not to come for the final visit.

Table 1 describes the anthropometric measurements before and after dietary intervention. There was no significant difference in body weight, BMI or LBM at the end of the study compared to baseline. However, FBM decreased significantly (P=0.024) only in the NWG.

Table (1): Mean±SD of anthropometric measurements among female students before and after dietary intervention

		C	Experimental groups			ANOVA	
			NWG	OWG	OG	P value	Sig.
Height (cm)		159.678.93	160.767.21	160.667.60	156.352.80	0.615	0.610
Weight (kg)	Baseline	55.759.17	56.017.75	68.70	77.76	16.213	0.000*
	End of study	56.069.27	55.477.90	68.455.71	77.231.76		
	t-test	0.220	0.062	0.303	0.239		
BMI (kg/m2)	Baseline	21.932.07	21.411.53	26.611.08	31.841.22	46.607	0.000*
	End of study	21.832.00	21.201.86	26.511.17	31.621.49		
LBM (kg)	Baseline	39.503.67	39.045.39	42.87	44.407.09	7.664	0.000*
	End of study	39.503.89	40.38	432.48			
	t-test	0.984	0.406	0.324	0.666		
FBM (%)	Baseline	24.266.75	24.166.36	34.282.14	40.154.71	11.968	0.000*
	End of study	24.156.73	236.45	2.16	39.243.76		
	t-test	0.797	0.024*	0.115	0.323		

Table (2): Mean±SD of RMR among female students before and after dietary intervention

		C	Experimental groups			ANOVA	Sig.
			NWG	OWG	OG	P value	
RMR kcal/day	Baseline	1684.8458.96	1638.5443.19	1675.6642.73	1655.8350.53	1.170	0.338
	End of study	1692.6958.45	1706.7249.23	1760.33111.43	1690.0049.85		
	t-test	0.213	0.000*	0.166	0.001*		
VCO2 ml/min	Baseline	195.8419.77	187.9011.22	183.008.54	138.5035.38	11.911	0.000*
	End of study	192.0718.92	204.7210.48	187.3310.40	142.8337.31		
	t-test	0.080	0.000*	0.096	0.038*		
VO2 ml/min	Baseline	237.3811.58	239.369.38	234.667.09	239.167.65	1.503	0.235
	End of study	236.1517.78	247.3612.41	240.335.03	246.166.67		
	t-test	0.602	0.002*	0.042*	0.001*		

C: Control Group; NWG: Normal Weight Group; OWG: Over Weight Group; OG: Obese Group; RMR: Resting Metabolic Rate; VO2: Oxygen Consumption; VCO2: Carbon Dioxide Production * indicates a significant difference; Sig.: Level of significance for ANOVA test P value; the t-test compared Baseline to End of study significance of difference

Table 3 illustrates the least significant difference between the control group and the experimental groups and shows that the OG had significantly more VCO2 production in comparison to the C group (P=< 0.001).

Table (3): LSD of RMR among female students before and after dietary intervention

		RMR kcal/day	VCO2 ml/min	VO2 ml/min
C	NWG	-14.034	-12.650	-11.209
	OWG	-67.641	4.743	-4.179
	OG	2.692	49.243*	-10.012

LSD: least significant difference; C: Control Group; NWG: Normal Weight Group; OWG: Over Weight Group; OG: Obese Group; RMR: Resting Metabolic Rate; VO2: Oxygen Consumption; VCO2: Carbon Dioxide Production; * indicates a significant difference.

Laboratory testing showed no significant change in serum total protein, albumin or creatinine for any of the subjects during the course of the study.

The questionnaire revealed that 53.3% of NWG and 28.6% of the OG ate three meals per day. Sixty-one % of the C group also had three meals per day. But, 33.3% of the OWG skipped dinner. From the OG group 42.9% skipped dinner while 28.6% skipped lunch. In addition, it showed that OWG and OG were not regularly eating breakfast by 42.9% and 50%, respectively. The highest percentage of breakfast consumption was amongst the C and NWG at 69.2% and 66.7% respectively.

The result from 24-hour recall analysis indicated that there was no significant difference in energy, fat and carbohydrate consumption

among the studied groups.

Discussion

The current study showed no difference in body weight, BMI and LBM probably due to the short study period (Halton, & Hu, 2004; Frestedt, Zenk, Kuskowski, Ward, & Bastian, 2008; Tang, Armstrong, Leidy, & Campbell, 2013).We also observed that overweight subjects were more likely to skip breakfast. This suggests a possible relationship between meal timing and body weight. These findings are consistent with prior observation that people who consume a large daily meal at breakfast are more likely to lose body weight and waist fat than those who consume a large dinner (Jakubowicz, Barnea, Wainstein, & Froy, 2013). Our study confirmed that FBM was significantly decreased in NWG subjects who were supplemented with a high protein diet. This is similar to previous observation (Halton, & Hu, 2004; Frestedt, Zenk, Kuskowski, Ward, & Bastian, 2008; Arciero et al., 2013). The NWG and OG group showed a significant increase in the RMR after whey protein supplementation. An increase in RMR over a period of time can lead to a reduction in body weight. Similar results were obtained from previous observations (Mikkelsen, Toubro, & Astrup, 2000; Acheson et al., 2011; Tsani, Kim &Kim, 2012). The potential mechanism for this in the experimental groups (NWG, OWG, and OG) could be the increased oxygen consumption observed clearly in this study. This is also consistent with prior observation that replacing carbohydrates by an equivalent amount of calories from animal or plant protein resulted in greater energy expenditure. A high protein diet enhances satiety and fullness and reduces hunger thus leading to reduction in food intake and weight (Brennan et al., 2012). We propose that the public require more education on the safety and benefit of increased protein intake as well as the benefit of not missing breakfast as a strategy to tackle the obesity and overweight epidemic in many communities.

Conclusion

Overweight and obese subjects are more likely not to eat breakfast. Dietary whey protein supplementation even during a 3-week intervention showed significant increase in resting metabolic rate amongst normal weight and obese female subjects. It also induced a decrease in fat body mass in normal weight subjects.

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