Effect of Intermittent and Continuous Exercise in Water and Land on Visfatin in Pre and Post Menopausal Obese Women

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Original Article

Abstract

Introduction: Physical activity and obesity affect the release of effective adipokines. In this regard, the present study investigated the effects of intermittent and continuous exercise in water and land (running on a treadmill) on visfatin, insulin, and blood glucose in pre and post menopausal obese women.

Methods: In this quasi-experimental study, 18 obese women of Bandar Abbas City were divided into two groups of postmenopausal and premenopausal. The subjects performed 4 intermittent and continuous exercises in water and land. Land sports activities included running on a treadmill and water sports activities included aerobic movements with an intensity of 70-80% of the maximum heart rate for 30 minutes. Before and after the implementation of exercise protocols, serum levels of visfatin and insulin were measured through ELISA and those of glucose through colorimetric method. The collected data were analyzed using dependent *t*-test, analysis of covariance (2×4), and post hoc Bonferroni test with a significance level of pvalue <0.05.

Results: After 4 types of physical activity, serum levels of visfatin did not change significantly compared to before activity and there was also no significant difference between the two groups of women (pvalue<0.05). The amount of insulin after intermittent (in water and land) and continuous (land) exercise reduced significantly (pvalue<0.05).

Conclusion: It seems that women's menopausal status have no effect on response of visfatin, insulin, and blood glucose to intermittent and continuous exercise in water and land. However, intermittent exercise leads to a better response in these variables compared with continuous exercise.

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Introduction:

Lifestyle changes as reduced physical exertion and increased consumption of high-fat diet has become one of the most important problems in health and wellness by developing obesity and overweight. This, in turn, is one of the most important factors in susceptibility to metabolic and cardiovascular diseases and mortality. In addition, loss of balance of ovarian hormones and dysfunction of thyroid gland during menopause can result in further weight gain and obesity. During this period of women's lives, the body's fat cells increase, the metabolism slows down, and the mass ratio of muscle to fat reduces. In this regard, it has been reported that the increase in body weight and waist circumference in postmenopausal women may reduce the amount of estrogen and progesterone production and release in this period, leading to accumulation of fat mass and central obesity (1). Also, in parallel to these hormonal changes, declined participation in daily physical activity and regular physical exercise can lead to weight gain and obesity due to decreased bone density and muscle mass, as well as mood and behavioral changes (2,3).

As an active endocrine organ, adipose tissue not only has a central effect on appetite, satiety and hunger, body weight balance, and energy homeostasis through synthesis and secretion of peptides called adipokines, but also affects lipid, metabolic, inflammatory, and cardiovascular profiles (4). In this regard, Fukuhara *et al*. (2005) identified an adipokine and called it visfatin regarding its expression and secretion from visceral adipose tissue (5). Visfatin is a positive adipokine secreted from adipocytes (mainly from visceral fat tissue), plays an important role in insulin sensitivity, and exerts anti-diabetic properties and insulin-like effects (5). It has been shown that biosynthesis of NAD^+ (nicotinamide adenine dinucleotide) by visfatin has a vital role in the regulation of glucose-stimulated insulin secretion (GSIS) by beta cells (6, 7). Visfatin also converts nicotinamide to NMN^+ in blood and cellular subdivisions, such as nucleus, cytoplasm, and mitochondria, and as a systemic signaling molecule, controls important cellular pathways through producing NAD^+ and increasing the activity of sirtuins family (8). The effect of this adipokine on adipose and muscle tissues increases glucose utilization, stimulates triglycerides storage, and in liver tissue, prevents the release of glucose into the bloodstream (9).

On the other hand, the role of exercise in improving insulin, metabolic function, and vascular sensitivity of fat mass and body weight are well documented (10). Acute exercise can change synthesis and release of adipokines via changing the energy balance (11). Although the majority of studies have evaluated the effect of exercise on visfatin, some studies examined the response of visfatin to acute physical exercise.

In this regard, Ghanbari Niaki et al. (2010) reported that a session of high intensity intermittent exercise in six young male athletes increased their serum levels of glucose, insulin, and visfatin. They claimed that the increase in insulin and visfatin levels can sensitize tissues to absorb glucose and store glycogen after exercise. It has been also shown that an increase in insulin, visfatin, and blood glucose levels after exercise creates a temporary and short-term post-exercise anti-anorexia state (12). In addition, an increase in expression of visfatin gene in subcutaneous adipose tissue of healthy subjects after a session of acute endurance exercise has been reported (13). However, in a study by Rupas et al. (2013), circulatory levels of athletes' visfatin after an endurance ultramarathon race (180 kilometers) showed no significant change, this is while, resistin was increased and leptin was decreased along with a state of negative energy balance after this activity (14).

However, no study was found regarding the response of serum visfatin of obese women, in particular postmenopausal women, to exercise. Also, the answers to these questions are not clear; does the status of menopause obese women affect the response of this adipokine to exercise? Does intermittent and continuous activity have the same effect on plasma visfatin? Does the exercise environment (water or land) affect the release of visfatin from adipose tissue into the bloodstream? Therefore, this study aimed at evaluating the efficacy of two methods of intermittent and continuous exercise in water and land on the levels of visfatin in premenopausal and postmenopausal obese women.

Methods:

Among available obese women, with an age range of 30 to 55 years, in Bandar Abbas who were volunteered to participate in this project, 18 persons (9 postmenopausal obese women of 45 to 55 years and 9 premenopausal obese women of 30 to 44 years) with inclusion criteria were selected and divided into two groups after matching based on obesity (body mass index and weight). Inclusion criteria included body mass index (BMI) of 30 or higher (a sign of obesity), lack of cardiovascular and metabolic diseases, not participating in regular physical activity, lack of osteoporosis, and ability to carry out acute exercise. The exclusion criteria were signs of infectious and metabolic diseases and intolerance to exercise.

Both pre and post menopausal obese women performed two types of intermittent and continuous physical activity in two different environments (water and land). Therefore, each group performed 4 types of activity (intermittent in water and land and continuous in water and land). The continuous exercise on land consisted of uniformly running on a treadmill with an intensity of 70-80% of the maximum heart rate for 30 minutes. The intermittent exercise on land was performed with an intensity of 70-80% of the maximum heart rate in 3 courses of 10 minutes (totally for 30 minutes) with an interval of 2 minutes rest between each period. Regarding the activity in water, the participants performed already taught aerobic movements with a same duration, frequency, and severity as the land exercise, while they were stood in a shallow pool. Aerobic activities included simple movements, leap, and jump with a combination of walk front, walk back, March, easy step, step touch, mambo, and step and knee. Warming up and cooling down (each for 5 minutes) included stretching and limbering were the fixed parts of any exercise test. To measure serum glucose, insulin, and visfatin, venous blood was sampled before and after each exercise test. The levels of insulin and visfatin were measured through ELISA using Uppsala kit (Sweden) and BT kit (with sensitivity 0.227 ng/mL, China), respectively, and that of glucose through colorimetry using Vadodara kit (India).

The collected data were analyzed with SPSS-19 using analysis of covariance (2×4), post hoc Bonferroni test, and dependent t-test, with a significance level of pvalue <0.05.

Results:

The anthropometric data in pre and postmenopausal obese women are shown in the following table, and there was no significant difference between the two groups in terms of weight and body mass index (pvalue <0.05).

The results of ANCOVA and the adjusted values showed that the response of serum glucose and visfatin to four types of physical activity (both intermittent and continuous activity on treadmill and in water) was not statistically significant in post and premenopausal women (pvalue<0.05), while the amount of insulin reduced significantly after intermittent exercise in water and land (pvalue<0.05). Also, according to the dependent t-test, no significant difference existed between the levels of visfatin, insulin, and glucose in four types of physical activity in both pre and postmenopausal obese women (pvalue <0.05).

Table 1- Anthropometric measurements of obese pre and postmenopausal women

Group	Age	Weight	Height	BMI
Obese postmenopausal women (n=9)	51.37±6.04	82.7±11.8	158.7±4.7	33.16±3.3
Obese premenopausal women (n=9)	42.7±2.9	88.95±10.9	159.3±5.1	34.98±3.46

Table 2- Levels of visfatin (ng/mL), insulin (mU/L), and glucose (mg/gL) in pre and postmenopausal obese women

Variable	Obese women		Intermittent		Continuous	
			Water	L:and	Water	Land
Visfatin (ng/ml)	Postmenopausal (n=9)	Before	58.45±43.04	50.5±43.06	50.9±43.04	55.36±40.92
		After	56.18±43.36	48.3±42.28	51.02±43.5	58.67±42.38
		Adjusted [1]	36.78±2.37	36.84±2.09	39.17±2.1	42.35±2.35
	Premenopausal (n=9)	Before	27.4±31.9	23.1±27.4	22.02±23.5	26.07±29.7
		After	25.92±29.9	24.7±29.6	23.94±27.6	26.23±30.2
		Adjusted [1]	37.58±2.21	40.67±2.22	40.98±2.23	39.23±2.21

Table 2 continue - Levels of visfatin (ng/mL), insulin (mU/L), and glucose (mg/gL) in pre and postmenopausal obese women

Variable	Obese women		Intermittent		Continuous	
			Water	L:and	Water	Land
Insulin (μU/mL)	Postmenopausal (n=9)	Before	26.22±13.91	27.54±13.95	24.65±18.73	33.98±13.63
		After	15.69±8.51	19.89±9.26	15.81±11.43	21.7±11.75
		Adjusted	16.39±3.0*	19.99±2.68*	17.25±2.69	18.79±3.02*
	Premenopausal (n=9)	Before	30.95±18.9	24.18±23.22	21.48±14.52	33.82±19.11
		After	16.47±16.72	14.22±8.49	10.37±6.54	19.88±16.35
		Adjusted	14.98±2.83*	15.87±2.83*	13.28±2.85	17.15±2.85*
Glucose (mg/dL)	Postmenopausal (n=9)	Before	85.87±23.22	85.7±16.99	80.7±17.29	84.63±13.14
		After	73.0±7.75	77.5±16.31	76.8±9.34	72.75±8.08
		Adjusted	71.48±2.45	76.05±2.19	77.34±2.18	71.72±2.44
	Premenopausal (n=9)	Before	84.4±16.08	77.11±9.7	76.55±13.81	81.88±15.8
		After	71.22±9.4	66.5±4.36	69.88±6.09	71.66±7.2
		Adjusted	70.27±2.3	68.53±2.31	72.08±2.32	71.73±2.3

[1] The adjusted value; Statistical elimination of the effect of pre-test and post-test amounts to study the interaction between menopause variables and physical activity

*Significant difference before and after exercise

Conclusion:

Menopause is associated with various physiological changes such as hormonal, metabolic, and behavioral disturbances. Weight gain, obesity, and reduced willingness to participate in social and group activities are some effects of menopause. As an adipokine with insulin-like effects, visfatin is involved in the pathogenesis of certain obesity-related diseases such as insulin resistance, diabetes, and cardiovascular disease. Most studies performed regarding exercise and visfatin have investigated the effect of exercise and physical activity on the amount of this adipokine and have shown that long-term exercise can reduce circulatory visfatin (16,17).

The findings of this study has shown that intermittent and continuous exercise and sport environment (water or land) cannot affect blood visfatin in premenopausal and postmenopausal obese women, and menopausal status cannot affect the response of visfatin, insulin, and glucose to various sports activities in obese women. However, in obese postmenopausal women, the response of visfatin to the intermittent exercise on treadmill (land) and water was higher than other activities and the response of visfatin to intermittent and continuous exercise in non-menopausal women tend to increase, but these differences were not statistically significant.

In terms of comparison of the obtained findings with those of previous investigations, it should be noted that no study was found regarding the interaction of two variables of exercise and menopause as well as analysis of the response of obese women to exercise. However, studies investigating the response of visfatin to acute physical exercise have reported conflicting results. In this regard and in contrast to the findings of this study, Ghanbari Niaki et al. (2010) reported that a session of high intensity intermittent exercise significantly increased levels of visfatin, insulin, and glucose in young athlete men (12). Also, another study found a 3-fold increase in visfatin gene expression after 3 hours of bike cycling exercise (13). The reason for the inconsistent findings of studies with the present research may be due to difference in the intensity and duration of exercise and the type of subjects. Accordingly, it has been shown that visfatin gene expression is higher in muscles of active people than untrained, overweight, and diabetes people (18,19). In addition, some researchers reported that prolonged or intensive exercise can increase insulin and visfatin levels after exercise through consumption of glucose and glycogen, and this condition increases the sensitivity of tissues to absorb more glucose and store glycogen after exercise (12,13). Accordingly, no significant change in levels of visfatin, insulin, and glucose after both intermittent and continuous exercise in the present study was probably due to low intensity and short duration of exercise. In fact, one can conclude that exercise in this study was not probably enough to increase the activity of hepatic glycogenolysis and gluconeogenesis, and to stimulate the release of visfatin and insulin into the bloodstream to uptake glucose by tissues following the increase in blood glucose. On the other hand, Kastfird et al. (2010) reported that visfatin is increased more after activity in people with higher physical readiness (15). Therefore, another possible reason for the lack of a significant change of visfatin in the present study may be low readiness of the participating subjects. Moreover, in line with the findings of the study, Rupas et al. (2013) reported that circulatory visfatin of athletes was not significantly changed after endurance ultramarathon race (race 180km) (14). Although the type and duration of exercise as well as subjects in both studies were different, it seems that long-term ultra-maximum physical activity is associated with different responses (14).

In addition, Rosa et al. (2010) stated that since visfatin is mainly infiltrated from macrophages and secreted in adipose tissue, it is likely that increased visfatin is independent of obesity and adipose tissue (9). Therefore, increased serum visfatin may arise from activation of inflammatory pathways and infiltration of macrophages to adipose tissue due to high-intensity exercise (20) or metabolic disorders associated with obesity, such as reduced anti-oxidative power along with increased production of free radicals (21). Accordingly, one could claim that the intensity of physical activity in this study was not enough to result in infiltration of macrophages to adipose tissue, activation of inflammatory pathways, production of free radicals, and finally, increased expression and release of visfatin into the bloodstream. Also, previous studies have shown that interleukin-6 and growth hormone can suppress the expression of visfatin gene in mature adipocytes, and these compounds are referred as negative regulators of visfatin (22,23).

Although these two variables were not measured in this study, the increase in IL-6 and growth hormone has been well documented after a variety of acute exercise (24,25). Accordingly, lack of significant change in visfatin levels after exercise in the present study may be in part due to the effect of these two peptides. On the other hand, studies have reported that hyperglycemia increases plasma insulin levels (26). In addition, it was shown that insulin injection to human subjects prevents increasing in visfatin (27). Accordingly, in the present study, two determinants of the circulating levels of visfatin, i.e. insulin and glucose, reduced after intermittent exercise in water and land and continuous exercise on land, and the decrease in insulin was significant. This shows the use of blood glucose as a source of energy for muscle activity, in particular for intermittent exercise. However, some studies have reported that visfatin reduces glucose to enter the blood stream through affecting the liver tissue and facilitates the entry of glucose into skeletal muscle cells (9). Therefore, it seems that an interaction exists between these three variables, namely visfatin, insulin, and glucose towards their balance and maintaining energy and metabolic homeostasis. However, it is suggested to investigate the response of visfatin to exercise with a higher intensity and longer duration in this group of women in future studies and after resolving the limitations of the present study which included low sample size, lack of control of mental and behavioral states, and lack of precise control of diet.

Overall, the findings of this study showed that menopause does not affect the response of visfatin, insulin, and glucose to two types of exercise in two different environments. In addition, no significant difference existed in the response of visfatin to intermittent and continuous exercise in two environments of water and land between obese postmenopausal and premenopausal women. The data of this study showed that intermittent exercise compared with continuous exercise and activity in water compared with activity on land lead to a better response of these variables. However, it is recommended to include intermittent exercise in the training programs of physical activity of obese women.

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تأثیر فعالیت ورزشی تناوبی و تداومی در آب و خشکی بر میزان ویسفاتین سرم زنان چاق یائسه و غیریائسه

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چکیده

مقدمه: فعالیت ورزشی و چاقی بر میزان رهایش آدیپوکاین‌ها مؤثر است. بنابراین، هدف مطالعه‌ی حاضر تأثیر فعالیت ورزشی تناوبی و تداومی در آب و خشکی (دویدن روی تردمیل) بر میزان ویسفاتین، انسولین و گلوکز خون زنان چاق یائسه و غیریائسه بود.

روش‌کار: در این مطالعه‌ی شبه تجربی، ۱۸ نفر از زنان چاق بندرعباس به دو گروه یائسه و غیر یائسه تقسیم شدند. آزمودنی‌ها چهار نوع فعالیت ورزشی تناوبی و تداومی در آب و خشکی را اجرا کردند. فعالیت ورزشی در خشکی شامل دویدن روی تردمیل و در آب شامل حرکات ایروبیک با شدت ۷۰ تا ۸۰ درصد ضربان قلب بیشینه را به مدت ۳۰ دقیقه بود. قبل و پس از اجرای پروتکل‌های ورزشی میزان سرمی ویسفاتین، انسولین به روش الایزا و گلوکز به روش کالریمتریک اندازه‌گیری شدند. داده‌های جمع‌آوری شده با استفاده از روش آماری t وابسته، تحلیل کواریانس (۲×۴) و تعقیبی بن فرونی با pvalue<۰/۰۵ تجزیه و تحلیل شدند.

نتایج: میزان ویسفاتین سرمی پس از چهار نوع فعالیت ورزشی نسبت به قبل از فعالیت تغییر معنی‌داری نداشت و نیز بین دو گروه زنان تفاوت معنی‌داری مشاهده نشد (pvalue>۰/۰۵). میزان انسولین پس از فعالیت تناوبی (در آب و خشکی) و تداومی (خشکی) در حد معنی‌داری کاهش یافت (pvalue<۰/۰۵).

نتیجه‌گیری: به نظر می‌رسد وضعیت یائسگی زنان در پاسخ ویسفاتین، انسولین و گلوکز خون به فعالیت ورزشی تناوبی و تداومی در آب و خشکی تأثیر ندارد. اما، ورزش تناوبی نسبت به تداومی به پاسخ بهتری در این متغیرها منجر می شود.

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