

EFFECT OF TRAINING IN WRESTLING AND SAUNA ON TSH AND FT4 HORMONES⁵

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ABSTRACT

The aim of this study is to determine the effects of acute sauna and highly intense wrestling exercise on TSH (Thyroid Stimulating Hormone) and FT4 (Free Thyroxin) hormones.

Fourteen healthy voluntary male wrestlers who had no hormonal disorder and were not using any drug participated in this study. Blood measurement was taken three times from wrestlers' antecubital vein –10 ml at a time- when they rested before exercise, after wrestling exercise and after the sauna program which took place after a two-day rest. Hormone analyses were done via IMMULITE 2000 auto analyzer. For statistical analysis, in comparing groups, Friedman test was conducted while Wilcoxon test was administered in order to determine the differences between the groups.

Within the group, significant increase was found in TSH (P=0.003) and FT4 (P=0.016) levels after the acute wrestling exercise. While it was observed that TSH levels have no important differences after sauna practice and FT4 levels have important increase (P=0.03). When TSH values were compared after the wrestling exercise and sauna, it was determined that the values of exercise group were significantly high (P=0.041) but FT4 values did not have a significant difference.

Acute wrestling training applied to the wrestlers caused significant increase in TSH and FT4 values, however, sauna application just enhanced FT4 values significantly. Consequently; it can be deduced that in wrestling in which anaerobic energy metabolism is dominant, acute wrestling training is more effective in increasing TSH and FT4 values than sauna application.

Key words: TSH, FT4, Wrestling, Sauna

SAUNA VE GÜREŞ EGZERSİZİNİN TSH VE FT4 HORMONLARI ÜZERİNE ETKİSİ

ÖZET

Bu çalışmanın amacı, akut sauna ve yüksek yoğunluklu güreş egzersizinin TSH (Tiroid Stimulan Hormon) ve FT4 (Free Thyroxin) hormonları üzerine etkisini belirlemektir.

Çalışmaya hiçbir hormonal bozukluğu olmayan ve herhangi bir ilaç kullanmayan on dört sağlıklı gönüllü erkek güreşçi katıldı. Dinlenik, egzersiz sonrası ve iki günlük dinlenme sonrası gerçekleştirilen sauna uygulaması sonrası olmak üzere, antekübital venden üç defa 10 ml kan alındı. Hormon analizleri IMMULITE 2000 oto analizörle yapıldı. İstatistiksel analiz için Wilcoxon ve Friedman testleri yapıldı.

Akut egzersiz sonrası TSH seviyelerinde gruplar arasında anlamlı fark bulundu. Sauna sonrası TSH seviyelerinde önemli bir fark görülmezken FT4 seviyeleri önemli derecede arttı. Akut güreş egzersizi ve sauna sonrası TSH değerleri karşılaştırıldığında gruplar arasında bir fark tespit edildi ancak FT4 seviyelerinde bir fark görülmedi.

Güreşçiler uygulanan akut güreş egzersizi TSH ve FT4 değerlerini artırdı ancak sauna sadece FT4 değerlerini artırdı. Sonuç olarak anaerobik enerji metabolizmasının güreş egzersizlerinde baskın olduğu ve akut güreş egzersizinin TSH ve FT4 seviyelerinin artmasında saunadan daha fazla etkili olduğu tespit edildi.

Anahtar kelimeler: TSH, FT4, Güreş, Sauna

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INTRODUCTION

The stress caused by exercise on man's organism leads to an increase in energy metabolism and thereby changes in body functions. Exercise triggers also acute adjustment process to adjust these changes in body functions (Hazar 2010, Viru, 1995). In adjustment to physical exercises, the increase in hypophysis-thyroid activity is of great importance. In response to exercise, the changes in secretory activity are not only related to muscular performance but are also affected by thermal stress (Hazar et al. 2010, Alvero-Cruz et al., 2011). Like exercise, thermal stress caused by sauna results in a series of endocrinological changes in organism affecting mostly glands and hormones. One of the secretory glands affected by thermal stress and exercise is thyroid gland (Ciloğlu et al., 2005; Pilch, Szygula and Torii, 2007).

Thyrotrophin releasing hormone (TRH) secreted from hypothalamus stimulates secretion of thyrotrophin hormone (TSH- thyroid stimulating hormone) from anterior lobe of pituitary gland while TSH leads to secretion of T3 (triiodothyronine) that has three iodine molecules and contains amino acids in its structure as well as T4 hormones (thyroxine) that include four iodine molecules (Patel, Alford and Burger, 1972; Chan et al., 1976; Edwards et al., 1994; Zarzeczny et al., 1996).

Thyroid hormones are effective on several metabolic processes that influence responses of target tissues to various hormones, metabolisms of vitamins, minerals, substrates in addition to the activity and concentration of many enzymes (Larsen PR, Davies, TF, and Hay, 1992). These hormones play an important role in regulation of general metabolism, cell differentiation, growth, temperature generation and oxygen consumption (Edwards et al., 1994;

Yen, 2001). A good many researches with different and conflicting results have been reported on the effect of exercise on thyroid hormones. While TSH does not change in some studies (Limanova et al., 1983; Deligiannis et al., 1993; Fortunato et al., 2008). Others reported the an increase in the level of TSH (Sullo, Brizzi and Maffulli, 2003; Huang et al., 2004; Ciloğlu et al., 2005; Mastorakos and Pavlatou, 2005; Hawamdeh et al., 2012). Mastorakos and Pavlatou (2005), as a result of their study on rats which they applied chronic exercise protocol, stated no increase in thyroid hormones (Mastorakos and Pavlatou, 2005). In another study, Ciloğlu et al (2005) revealed significant increases both in TSH and free T4 (FT4) values in acute aerobic exercises done with 70% and 90% of maximum heart rate (Ciloğlu et al., 2005) The results obtained from these studies show that the effect of exercise on thyroid hormones can vary depending on the intensity and duration of exercise protocols, content and frequency of training programs, age and gender. Moreover, differences in duration in the studies, post-exercise sampling timing, methodological factors in hormone tests and data analysis are reported to account for diverse results (Irvine, 1968; Krotkiewski et al., 1984; Opstad et al., 1984; Smallridge et al., 1985; Hashimoto, Migita and Matsubara, 1986; Rone, Don and Reed, 1992; Fortunato et al., 2008).

Wrestling is a very difficult physical activity and a sport discipline in which anaerobic energy system is heavily used, which also includes various functions such as speed, strength, agility, flexibility, balance, muscular and cardiovascular endurance and coordination (Yoon, 2002; William et al., 2004). On the other hand, sauna is one of the most common weight losing methods in addition to many others in weight sports like wrestling (Astrand

and Rodahl, 1977; Güneş, 2003). The aim of this study is to determine the effect of competitive acute wrestling exercise causing physical stress and of

sauna, which results in thermal stress on TSH (Thyroid Stimulating Hormone) and FT4 (Free Thyroxin) hormones.

MATERIALS AND METHODS

Subject: This study was conducted on 14 voluntary male wrestlers who had no hormonal disorder and were not using any drug.

Procedures: Wrestling training was performed in competition style in three sessions for 3x2 minutes and the athletes were asked to do maximum performance. After the participants rested for two days, they were taken into sauna sessions under 80-100°C where humidity was 10-15 %. The 3 sauna sessions consisted of 20 minute sauna and 2 minute break.

10 ml blood samples of wrestlers during the rest before exercise, after wrestling training and following sauna were withdrawn three times from antecubital vein. After blood samples

were centrifuged under 3500 rpm for 5 minutes, the plasma was put into eppendorf tubes and was preserved under -80 °C until being analyzed. Thyroid hormones were analyzed with chemiluminescence method by IMMULITE 2000 analyzer.

Statistical Analysis: The data collected in the study were analyzed for determination of normality and descriptive statistics was conducted using SPSS 15 program. Since the data did not show normal distribution, for statistical analysis in comparing groups, Friedman test was conducted while Wilcoxon test was administered in order to determine the differences between the groups. The level of significance was set to 0.05, i.e. $P < 0.05$ was considered statistically significant.

RESULTS

The results of this study showed Table 1 and Table 2.

Table 1: Age, Height and Weight of Wrestlers

	N	Min	Max	Median
Age (years)	14	15	30	23.5
Height (cm)	14	167	185	170.5
Weight (kg)	14	57.9	106.3	70.95

Table 2: TSH and FT4 Values of Wrestlers During Rest, After Exercise and Sauna.

	Measurement	N	Min	Max	Median	Chi-Square	P	
TSH (mU/l)	DR (a)	14	0.610	3.289	1.87	9.927	0.007*	a-b (0.003*) b-c (0.041*)
	AE (b)	14	0.867	4.260	2.14			
	AS (c)	14	1.120	3.360	1.73			
FT4 (pmol/l)	DR (a)	14	1.080	3.050	1.251	13	0.002*	a-b (0.016*) a-c (0.03*)
	AE (b)	14	1.230	1.680	1.405			
	AS (c)	14	1.080	1.760	1.37			

* $P < 0.05$ DR: During Rest, AE: After Exercise, AS: After Sauna

Table 2 shows significant increase in both TSH and FT4 levels after acute wrestling exercise ($P < 0.05$), and it suggested no significant increase in TSH level after sauna while significant increase was observed in FT4 levels of wrestlers after sauna ($P < 0.05$), and

revealed that when TSH values were compared after acute wrestling exercise and sauna, the values of exercise group were significantly higher ($P < 0.01$) while no significant difference was observed in FT4 values

DISCUSSION

TSH is a glycoprotein hormone secreted from anterior lobe of pituitary gland, which forms the metabolism of thyroid gland (Berne et al., 2008). TSH is the principal regulatory factor for secretion of thyroid hormone (Patel, Alford and Burger, 1972; Chan et al., 1976). According to literature related to human physiology, thyroid hormones (T3 and T4) lead to an increase in basal metabolism of human body. In parallel with the increase in basal metabolism, an increase is also observed in oxygen consumption. Moreover, both high cardiac output and vasodilatation caused by myocardial chronotropic and inotropic effect lead to an increase in oxygen consumption (Guyton and Hall, 1996). In this study conducted to determine the effect of acute wrestling exercise and sauna on TSH and FT4 hormones, significant increase was observed in TSH and FT4 levels after acute wrestling exercise ($P < .05$).

In a study conducted on healthy individuals, Limanova et al. (1983) stated no change in serum thyroid hormone levels after exercise (Limanova et al., 1983). Another study in which the effect of acute exercise session on thyroid hormones was investigated suggested no change in serum total T4 and TSH levels (Fortunato et al., 2008). Similarly, in another study where responses of plasma, TSH, T3, T4 and cortisol to swimming exercises under various temperatures were examined, no change was reported in TSH level (Deligiannis et al., 1993). Alvero-Cruz et al. (2011) studied the responses of thyroid hormones to sprint decathlon training done in laboratory (20 min sprint-40 min cycle-12 min-sprint) (Alvero-cruz et al., 2011). After the study, no change was reported in T3 and T4 hormone levels while TSH level decreased.

In most relevant studies, significant increases were observed in TSH levels

after exercise (Ciloğlu et al., 2005; Sullo, Brizzi and Maffulli, 2003; Huang et al., 2004). Hawamdeh et al. (2012), in their study where they measured thyroid hormone levels of Jordanian athletes that participated in aerobic and anaerobic activities, found TSH hormone levels of the athletes significantly higher than those in control group (Hawamdeh et al., 2012). In the studies on rats, Mastorakos and Pavlatou (2005) revealed that acute exercise increased serum thyroid hormone levels while no such increase was observed in most studies where chronic exercise protocol was conducted (Mastorakos and Pavlatou, 2005). Boostani et al. (2012) found that T4 hormone value measured after a one-session taekwondo exercise and one hour after the exercise was significantly higher than that before the exercise (Boostani et al., 2012). Similarly, in another study, after acute aerobic exercises done with 70% and 90% of maximal heart rate, significant increases were seen both in TSH and FT4 hormone levels (Ciloğlu et al., 2005). If the results of the studies done by the researchers above are examined, it is clear that exercise has different types of effect on TSH and FT4 hormones. In this study, significant increases in TSH and FT4 hormone levels were not compatible with some of the studies after acute wrestling exercise performed in competition (Limanova et al., 1983; Fortunato et al., 2008; Alvero-cruz et al., 2011). They showed similarity with most researches (Sullo, Brizzi and Maffulli, 2003; Huang et al., 2004; Ciloğlu et al., 2005; Mastorakos and Pavlatou, 2005; Boostani et al., 2012). The increase in TSH level may be due to a possible satisfaction of the need for increasing peripheral thyroid hormone resulting from exercise (Huang et al., 2004). Besides, the changes in exercise induced hypothalamic-pituitary-adrenal axis (HPA or HTPA axis) may lead to

the increase in TSH level (Hawamdeh et al., 2012). In addition, Ciloğlu et al (2005) reported that when exercise intensity rose up to 70% and 90% of maximal heart rate total T4, FT4 and TSH levels continued to increase (Ciloğlu et al., 2005). Wrestling is a discipline where anaerobic energy metabolism is dominantly used and overload intensity is higher (Yoon, 2002; William et al., 2004). Higher levels of FT4 and TSH after wrestling exercise may be due to highly intense overload.

In some studies (Huang et al., 2004; Hawamdeh et al., 2012), negative relationship was found between TSH and FT4 values. In such case, while one of the values was expected to increase, the other was to be decreasing. However, in the present study conducted on wrestlers, both values demonstrated a significant increase.

In the relevant literature, 20% T3 hormone is produced by thyroid gland while 80% is produced by deiodination of T4 hormone (Maia et al., 1995; Yen, 2001). In addition, Fortunato et al. (2008) stated that during adaptation to exercise, the transformation of T4 into T3 was reduced. In this study, the duration of exercise being not too long (3x2 min) suggests that adaptation to exercise continues (Fortunato et al., 2008). Therefore, it is possible that the transformation of T4 into T3 (deiodination) is low and FT4 hormone level is significantly high. No significant change in TSH levels of wrestlers after exposure to sauna was reported and a significant increase in FT4 levels was observed ($P < .01$).

As a result of exposure to thermal stress resulting from single and repetitive exposure to sauna, studies are found to report conflicting results related to the changes in serum TSH and TH (T3 and T4). In some studies, no significant changes were found in TSH and TH secretion after single and repetitive exposure to sauna

(Leppäluoto et al., 1975; Leppäluoto et al., 1986; Sirviö, Jolkkonen J, and Pitkänen 1987). Szygula et al (1990) in their study on the effects of repetitive exposure to sauna on some metabolic and hormonal changes reached similar results (Szygula et al., 1990). In another study on the effect of sauna and glucose intake on TSH and TH levels, Strbak et al (1987) found significant increases in thyroid hormone levels (Strbak et al., 1987). Although in another study no significant changes were observed in TSH level, an increase was seen in serum T3 and T4 concentrations after a few exposures to sauna.³⁷ In this study conducted on wrestlers, the results obtained related to TSH and FT4 levels after three session exposure to sauna taking place for 20 minutes with 2 minute stay are partly compatible with those mentioned above. The results in our study are completely compatible (Leppäluoto et al., 1987).

The most common mechanism that accounts for the responses to stress factors like thermal stress is the activation of hypothalamic-pituitary-adrenal and sempto-adrenal axis (Lammintausta, Syvälahti and Pekkarinen, 1976; Mills, 1985). TSH-thyroid axis functions are believed to have an important role in modulating activation of heat regulation mechanism. The results of relevant studies suggest that TSH secretion is inhibited during thermal stress. This effect could be correlated with both the increase in adrenergic inhibition and sympathetic system activation and also the effect of glucocorticoids on hypophysis and/or hypothalamus (Štrbák et al., 1987; Mills, 1985). In this study, no important change in TSH after exposure to sauna is thought to be related to TSH inhibition resulting from thermal stress. Significant increase in FT4 level after exposure to sauna can be related to the rise in the activation of sympathetic system and to

the effect of glucocorticoids on hypophysis/hypothalamus.

After acute wrestling exercise and exposure to sauna, TSH levels being compared, the values of exercise group were significantly higher ($P<.05$) while no significant difference was observed in FT4 levels.

In most studies conducted, significant increases were seen in TSH levels after exercise (Sullo, Brizzi and Maffulli, 2003; Huang et al., 2004; Ciloğlu et al., 2005). Similarly, Mastorakos and Pavlatou (2005) stated that acute exercise protocols led to an increase in TSH and TH levels (Mastorakos and Pavlatou, 2005). In their study, Ciloğlu et al (2005) found significant increase in TSH and FT4 levels in aerobic exercises done with 70% and 90% of maximal heart rate. In this study, after acute wrestling exercise, significant increase was seen in TSH level in parallel with the studies above (Ciloğlu et al., 2005). Thermal stress caused by temperature rise emerging right after active use of muscle mass in exercise was more effective in increasing TSH level than sauna.

In the studies done on the effects of sauna on thyroid hormones, the results were so common that no change was observed in TSH and TH levels (Leppäluoto et al., 1975; Leppäluoto et al., 1986; Sirviö, Jolkkonen J, and Pitkänen 1987; Szyguła et al., 1990). While Štrbák et al (1987) declared that sauna led to an increase in both TSH and TH levels (Štrbák et al., 1987), Leppäluoto, Tapanainen, and Knip, (1987) stated no change in TSH level though T3 and T4 concentrations

increased (Leppäluoto, Tapanainen, and Knip, 1987). In the study, following three session exposure to sauna 20 minute long with 2 minute stay, no significant change was statistically seen in TSH level. So, TSH values determined after exposure to sauna were in parallel with the relevant literature. Significantly high level of TSH values after exercise compared to sauna exposure could be due to highly intense exercise (Ciloğlu et al., 2005). Increasing peripheral need for higher physical and thermal stress in exercise of muscle mass is actively used compared to sauna (Huang et al., 2004) and inhibition of TSH secretion during sauna (Mills, 1985; Štrbák et al., 1987)

After exercise and sauna, significant increase in FT4 levels showed the fact that no statistical difference was observed in FT4 values between two applications.

CONCLUSION

Consequently, in wrestling where anaerobic energy metabolism is dominantly used, acute wrestling training done in competition style is said to be more effective in increasing TSH and FT4 levels due to intense use of muscular activity compared to sauna exposure.

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