Original Article

Effect of aerobic exercises on the thyroid hormones in treated hypothyroid pregnant women

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ABSTRACT

Background: The aim of this study was to evaluate the effect of aerobic exercises on the thyroid hormones in treated hypothyroid pregnant women. **Subjects and methods:** A total of 42 pregnant women with treated hypothyroidism. Their age was ranged from 25 to 35 years and their body mass index was ranged from 30 to 35 kg/m^2. They were randomly distributed into two groups. The control group received thyroxine replacement doses (100 μg/day), and the exercise group received the same medical treatment and participated in a program of aerobic exercises for 12 weeks. Blood samples were collected for measuring the serum level of thyroid stimulating hormone (TSH) and free thyroxin (FT4) for each pregnant woman before and after 12 weeks of the study course. **Results:** TSH level was significantly reduced (p=0.0001) in the control and the exercise groups post-treatment, this reduction was in favor of exercise group. While FT4 level was significantly increased (p=0.0001) in the exercise group without significant difference (p=0.639) in the control group. **Conclusion:** Regular aerobic exercises decrease TSH level and increase FT4 level in treated hypothyroid pregnant women. So, it can be recommended for every hypothyroid pregnant woman along with the thyroxine replacement doses to improve the thyroid function and avoid the deleterious impact of hypothyroidism on mother and fetus.

Keywords: Aerobic exercise, hypothyroidism, pregnancy, thyroid hormone levels.

Introduction

Hypothyroidism is the commonest type of thyroid dysfunction. [1] The incidence of hypothyroidism in women during the childbearing age is 3–7%. [2] It is common during pregnancy; undiagnosed hypothyroid women can be estimated by 2–3% of all pregnant women. [3]

Pregnancy greatly affect the thyroid gland and its function. [4] Several factors impact the thyroid function in pregnant women and change the levels of thyroid hormones: the relative iodine deficiency during pregnancy, the human chorionic gonadotropin (hCG) stimulates the secretion of thyroid hormones, which could inhibit adenohypophysis function and suppress the levels of thyrotropin. The elevated levels of oestrogen during pregnancy increases serum thyroid binding globulin (TBG) and raises the concentrations of serum total thyroxine. Also, the placenta has an effect on thyroxine deiodination. [1]

Moreover, the fetus is totally dependent on maternal thyroxine supply for normal neurologic development and nervous system maturation during the first trimester of gestation and up to mid gestation. Therefore, thyroid hormones are required to be increased by 40% to 100% to meet the needs of mother and fetus during the physiological changes of pregnancy. [5]

In healthy women, the increased thyroid hormones occur seamlessly due to the stimulatory effects of maternal hCG on the functioning thyroid gland, which are believed to be safe for the maternal-fetal unit. While in hypothyroid women, the glandular production cannot be stimulated to varying degrees depending on the severity of the underlying deficiency. [2] So that hypothyroidism is associated with multiple adverse

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maternal and neonatal outcomes. Anemia, gestational hypertension, placental abruption and preeclampsia are maternal conditions caused by hypothyroidism, increasing the risk of adverse neonatal outcomes including miscarriage, preterm birth, low birth weight, and increased perinatal morbidity and mortality. [6]

Thus, it is important to maintain euthyroidism during pregnancy to avoid the deleterious impact of hypothyroidism on the mother and fetus. [3] As pregnancy increases the requirement of the thyroid hormones increases; an additional 20–40% of thyroxine replacement doses is needed in hypothyroid women during pregnancy to maintain an euthyroid state. The increase of the dose must be in a way that mimics normal physiology of increasing T4 requirements, which occur very early in gestation (4–6 week) and through midgestation (16–20 week). This explain the subsequent requirement of the dose adjustment during pregnancy for many patients. [2]

It is recommended for every hypothyroid patient to do regular exercise along with the thyroxine replacement. Regular exercise can improve the thyroid function and concomitantly decreases dose of the thyroxine replacement. Moreover, it improves the mental and physical status of the hypothyroid patient. Medium-intensity aerobic exercise can result in significant decrease of TSH levels and significant increase in T3 and T4 levels. The improvement in the thyroid function can be attributed to better perfusion of the gland. [7] Therefore, this study aims to evaluate the effect of aerobic exercises on the thyroid hormones in treated hypothyroid pregnant women. It was hypothesized that aerobic exercise would have effects on the levels of the thyroid hormones in treated hypothyroid pregnant women.

Subjects and methods

Subjects

A gynecologist referred 47 pregnant women with hypothyroidism according the following inclusion criteria. They were primipara at their 16 weeks' gestation, their age ranged from 25 to 35 years old, and their body mass index (BMI) ranged from 30 to 35 kg/m^2. They were medically stable. Their TSH and FT4 levels were between: (38–4.3μIU/ml) and (0.82-1.63 ng/dl) respectively. [8]

Pregnant women were excluded from this study if they had orthopedic problems (low back pain, plantar fascitis, sciatica), hypertension or multiple gestations, conditions that contraindicated exercise such as: uncontrolled type 1 diabetes, uncontrolled thyroid disease, other serious cardiovascular or respiratory disorders, taking medications except thyroxine replacement doses during the study course. After meeting the eligibility criteria, 5 pregnant women refused to participate in this study and 42 pregnant women were recruited as study participants. The pregnant women were randomly distributed into two groups using computer generated random numbers. Allocation was concealed in sequentially numbered opaque envelopes. The control group consisted of 21 hypothyroid pregnant women who received thyroxine replacement doses (eltroxine, 100 μg/day). The exercise group consisted of 21 hypothyroid pregnant women who received the same medical treatment and participated in aerobic exercises for 3 sessions/week for 12 weeks.

Based on the study of Bansal et al., [7] sample size was calculated according to the difference between the mean value of TSH measured pre-treatment (2.51 $\pm$ 0.24) and post-treatment (0.61 $\pm$ 0.42) in hypothyroid patients treated with regular physical exercise with an effect size of 0.60. Assuming α=0.05, power of 80%, so a sample size of 21 patients per group would be required.

This study was approved by the Ethical Committee of the Faculty of Physical Therapy no. P.T.REC/012/001776 and registered by PACTR Registry (registration number: PACTR201810729481551). The study protocol was explained to all pregnant women, who had signed an informed consent form.

Assessment procedures

Blood analysis

A volume of 5 ml of venous blood sample was taken from each pregnant woman at 9 AM. Samples were allowed to clot, centrifuged and stored at −20 °C until assay of thyroid hormones (TSH and FT4) using the immunoassay analyzer AIA 360 (TOSOH Biosciences, Inc. 6000 Shoreline ct, Suite 10, South san Francisco cA 94080, USA). Both hormones were analyzed using Fluorescence Enzyme Immunoassay and detected using LED illuminant, non-flow cell/Top-Top photometry method. The reference intervals for TSH and FT4 were as follows: (TSH: 0.38–4.3μIU/ml) and (FT4: 0.82-1.63 ng/dl). [8] The serum levels of TSH and free T4 were measured before starting as well, after the end of this study for each pregnant woman in both groups.

Treatment procedures

Treadmill training program

Treadmill (Multifunctional HX-R200M Motorized Treadmill, Guangdong China) was used to perform aerobic exercises for each pregnant woman in the exercise group. It has the following characteristics: Drive motor: 1.5HP DC; Console feedback: Time, Distance, Speed, Calories, and Programs with heart rate control; Walking area L/W: 1030×360 mm with heart rate control hand grip compatible; Speed: 0.2-8.0 km/h; Product size L/W/H: 1350×600×1250 mm. The treadmill-training program was performed three sessions per week i.e. one every other day for 12 weeks. Exercise intensity was calculated according to the modified heart rate target zones for aerobic exercises in pregnancy. The conventional age-corrected heart rate target zone is 135-150 beats/min for maternal age 20-29 and 130-140 beats/min for maternal age 30-39. [9] Each woman was instructed to stand on the walking area and grasp the heart rate control hand grip, while the treadmill grade elevation was kept at 0%.

Each session included warming up phase for 5 minutes, cooling down phase for 5 minutes and stimulus phase for 15 minutes in the first week sessions. The time of the stimulus phase was increased by 2 minutes each week until a maximum of 30 minutes was reached. This duration was maintained until the end of the study. [10] Each woman's walking speed on treadmill was adjusted according to her prescribed intensity based on the conventional age-corrected heart rate target zone. Each woman finished the exercise with decreasing the walking speed on treadmill to gradually bring the heart rate down to its pre-exercise level.

Statistical Analysis

Statistical analysis was conducted using SPSS for windows, version 22 (SPSS, Inc., Chicago, IL). Data were screened for normality assumption, homogeneity of variance, which assessed by Shapiro-Wilk's test and Levene's test. Accordingly, 2x2 Mixed multivariate analysis of variance (MANOVA) test was used to compare the tested variables of interest at different measuring periods at both groups. Alpha level was set at 0.05.

Results

Table 1 shows the baseline characteristics of the participants in the control and exercise groups. Age, weight, height, and BMI showed no significant difference (p>0.05) between both groups pre-treatment.

Table 1. Physical characteristics of participants in both groups

Items	Control group	Exercise group	Comparison		S
	Mean ± SD	Mean ± SD	t-value	P-value	
Age (years)	31.19±2.27	31.09±2.6	0.126	0.90	NS
Weight(Kg)	81.36±4.71	82.07±4.48	-0.503	0.61	NS
Height (m)	1.56±0.01	1.56±0.02	-0.1431	0.88	NS
BMI(kg/m^2)	33.04±1.4	33.29±1.33	-0.572	0.57	NS

SD: standard deviation, P: probability, S: significant, NS: non-significant.

The MNOVA test showed a significant decrease (p=0.0001) in the TSH level of the control group and exercise group with a percentage of change equal to 9.86% and 46.05% respectively. The exercise group showed a significant decrease (p=0.0001) in TSH level more than the control group (Table 2).

Table 2. The MANOVA test of TSH for the control and exercise groups

TSH (µIU/ml)	Pre test	Post test	MD	%	p-
	Mean± SD	Mean± SD		of change	value
Control group	3.65±0.46	3.29±0.5	0.36	9.86	0.0001*
Exercise group	3.8 ±0.37	2.05±0.2	1.75	46.05	0.0001*
MD	-0.14	1.24			
p- value	0.313	0.0001*			

*Significant level is set at alpha level <0.05, SD: standard deviation, MD: Mean difference, p-value: probability value

Also, the MNOVA test showed a significant increase (p=0.0001) in the FT4 level of the exercise group with a percentage of change equal to 24.4 % without significant difference (p=0.639) in the FT4 level of the control group (Table 3).

Table 3. The MANOVA test of FT4 for the control and exercise groups

FT4 (ng/dl)	Pre test	Post test	MD	%	p-
	Mean± SD	Mean± SD		of change	value
Control group	0.94±0.09	0.95 ±0.09	-0.01	1.06	0.639
Exercise group	0.90 ±0.08	1.12±0.1	-0.22	24.4	0.0001*
MD	-0.04	-0.17			
p- value	0.169	0.0001*			

*Significant level is set at alpha level <0.05, SD: standard deviation, MD: Mean difference, p-value: probability value

Discussion

Given the deleterious impact of hypothyroidism on the health of the mother and fetus, it is important to maintain euthyroidism during pregnancy. [3] The present study evaluated the effect of aerobic exercises on the thyroid hormones in hypothyroid pregnant women who were stable on their respective thyroxine replacement therapy. The study revealed that aerobic exercise decreases TSH level and increases the level of FT4, but no significant increase was observed in the control group.

Regular exercise is important in the treatment of hypothyroidism. Exercise can improve the thyroid function, stimulate the thyroid gland secretion and increase the tissue sensitivity to thyroid hormones. [7] Acute exercise can affect the hypothalamic–pituitary–thyroid axis and cause changes in the hormonal circulating concentrations. [11] However chronic exercise gives the signal to save energy and decreases the level of hypothalamic-pituitary-thyroid axis. [12] When exercise is repeated at certain intervals, there is a pituitary-thyroid reaction that is properly coordinated by increasing turnover of thyroid hormones. [13]

The results of the study were consistent with other studies, which have concluded that aerobic exercises can affect the endocrine function and change the human hormone levels. [14] Previous study demonstrated that, regular exercise along with thyroxine replacement improve thyroid function, decrease serum TSH and increase serum T3 and T4 in treated hypothyroid males. [7] Also Sultan and Rashed., [15] reported that moderate intensity therapeutic exercise on electrical treadmill between 50% and 70% of the maximal heart rate, for one month every other day, cause significant increase in the level of circulating thyroid hormones and significant decrease in TSH level. The accumulated physical stress and the increased action of the plasma catecholamines, which potentiate actions of thyroid hormones result in increasing T3 and T4 levels. Moreover, the peripheral deiodination of T4 and the uptake of T4 in the liver are stimulated by exercise. [16]

Another study found that intense and prolonged exercise program for 20 weeks decrease TSH level in women; this decrease is explained by lower hypothalamic pituitary signaling action. [17] Thyroid hormones speculated a high energy flux during intensified exercise, as they regulate the metabolic processes mainly by binding at peripheral receptors. This causes a depression of hypothalamic thyroid axis, which is associated with exercise intensity. [15]

In this regard, the findings of the present study are inconsistent with a study found that, moderate-intensity aerobic exercise with 50-75% of maximum heart rate for 12 weeks in obese inactive women does not significantly change the plasma concentration of TSH and thyroid hormones (T3 and T4). [18] Along these lines, Rahimi et al., [19] examined the effect of 8 weeks resistance training on men and reported no significant change in TSH and thyroid hormones levels.

The contradictory results may be explained by that the influence of exercise on thyroid function is controversial. The intensity, duration and type of exercise may elicit different patterns of response. [16] Also, the characteristics of the participants such as age and level of fitness can affect the acute and chronic hormonal influences. [19]

One important result is that regular aerobic exercises decrease TSH level, as TSH higher than 2.5 μIU/ml is associated with higher fetal morbidity. [20] In the exercise group, post-treatment TSH level of all participants was ≤2.5 μIU/ml.

Also, regular aerobic exercises increase FT4 level. As pregnancy increases the requirement of the thyroid hormones by 20–40% to maintain an euthyroid state. [2] In the exercise group, an improvement of 24.4 % is observed in FT4 levels, when post-treatment values compared to pre-treatment values. Overall regular aerobic exercises improve the thyroid function, which helps to achieve euthyroidism. Maintenance of an euthyroid state throughout pregnancy is important to avoid the deleterious impact of hypothyroidism on the mother and fetus. [3]

Conclusion

Our study showed that regular aerobic exercises decrease TSH level and increase FT4 level in hypothyroid pregnant women. So, it can be recommended for every hypothyroid pregnant woman along with the thyroxine replacement doses to improve the thyroid function and avoid the deleterious impact of hypothyroidism on mother and fetus.

Conflict of interest

The authors declared no conflicts of interest.

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