The Effect of Hypothyroidism on the Body Weight of Adult Albino Wistar Rats

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Abstract

Background: To study the alteration in the body weight of adult albino rats in hypothyroid state.

Methods: In this experimental animal study, change in the body weight of adult albino wistar rats was measured after they were made hypothyroid. Twenty adult albino wistar rats with average weight of 130-150 gms were randomly assigned into two groups. Group A served as control and Group B served as experimental group. The rats in group A were kept as control and given normal food and water ad libitum whereas Group B were administered Methimazole 0.02% for 22 days in drinking water. Body weight was recorded at the beginning and on alternate days.

Results: MMI treatment produced significant influence on the body weight of the animals. Significant difference was observed in the initial and the final body weight of the control and the experimental group of animals, p<0.01.

Conclusion: Hypothyroidism caused increase in the body weight of the experimental albino rats but decreased as compared to previous experimental studies.

Key Words: Hypothyroidism, Body weight, Wistar rats, Methimazole.

Introduction

Thyroid hormones have a strong impact on the metabolism, cardiovascular system, nervous system, lipid profile, expenditure of energy and body weight regulating basal and total energy consumption.1,4 Thyroid disorders are linked with respiratory distress syndrome, transient tachypnea, sepsis, and apnoea.1,3

Weight gain and loss had been associated with apparent hypothyroidism and hyperthyroidism respectively.2,5,9 It incidence is increased in women and elderly.4 Patients may express dyslipidaemia, mood alteration, cognitive deficit, cardiac dysfunction, osteoporosis, fractures and most importantly weight gain.1,6 In hypothyroidism unexplained weight gain with decreased intake of food and loss of appetite among men was observed.7 Other findings included skin changes particularly dermis breakage, functional alterations, dryness and increased exfoliation.18 It compromised quality of life resulting in stress and depression.5 However, hypothyroidism did not interfere with the energy intake and absorption of food.5 Maternal hypothyroidism had been known to cause an increased risk of neonatal intensive care treatment but this relationship needs more study and insight.5 Thyroidectomy results in significant decrease in the number and weight of the individual fetuses and decreased body weights of fetal organ. There existed an association between maternal hypothyroidism and thyroid hormone deficiency of the conceptus before the fetal thyroid functions.12

Brown adipose tissue (BAT) had recently regained attention from researchers in biomedical sciences.10 It is an important thermogenic tissue that maintains a constant body core temperature.10,22 BAT is thought to be absent in humans since many decades but new researches revealed its presence in humans as well.10 It played an important role in sensitivity of insulin in both rodents and humans.10 There are two varieties of adipocytes; brown and white. White adipocytes contains a single large lipoid droplet and little mitochondria whereas in brown adipocytes, there are multiple small lipid droplets packed with abundant mitochondria.10 BAT is abundantly present between the scapulae and more depots are present along the great vessels and in the retroperitoneum.10 Thyroid hormones are important regulators of development and function of BAT.11 Hypothyroidism produces several changes in thermogenically active state of BAT.22 This capability increased the thermogenic capacity in the BAT of hypothyroid albino rats which led to decreased mobilization of tissue lipids.22 In a previous study hypothyroidism was produced in experimental animals by giving them 0.05% propylthiouracil in drinking water.13 Weight loss or decreased growth could be attributed to somatomedin activity.13 Subclinical hypothyroidism at a single time was not associated with weight change as compared with euthyroidism.14 Overall patients lost weight in hypothyroidism14. The data does not support the view that subclinical hypothyroidism caused a significant impact on the weight change in the elderly.14
Hypothyroidism had a restraining effect on the hyperglycemic state and the elevated serum T₄ level as well as deteriorated antioxidant defense system present in diabetes mellitus.¹⁵ Body weight was decreased in diabetic and hypothyroid diabetic rats.¹⁵ The identification, prevention and treatment of individuals who are at risk of obesity is an important issue of current times.¹⁶ It can be done by research on the altered thyroid function which could result in weight gain.¹⁶ It is documented that humans gained weight in hypothyroidism but the difference in human and animal studies showed that there is another mechanism for energy dissipation.⁸ The presence of BAT in rodents could be correlated to the possible mechanism of decreased weight gained in rats when compared to humans.⁸ BAT mechanism is responsible for energy activation which resulted in decreased weight gain in hypothyroid rats.⁸

**Material and Methods**

This experimental study was carried out in the research laboratory of University of Health Sciences, Lahore. Twenty male Albino rats, 6-8 weeks old, weighing between 130-150 grams were procured from the National Institute of Health, Islamabad. All the animals were examined thoroughly for general health status and weighed before the commencement of the experiment. The rats were housed under controlled conditions of temperature 22 ± 0.5°C, humidity 50 ± 10%, 12 hours light/dark cycle. Animals were fed on rat chow, tap water ad libitum and were acclimatized for a period of one week. Body weight was recorded at the beginning and on alternate days. Health condition of all animals was noted during the investigation. Twenty male Albino rats were divided into two groups of 10 each; Group A served as control whereas Group B was used as an experimental group. Animals were made hypothyroid by giving them 0.02% w/v Methimazole (MMI) for three weeks; one full feeding bottle was consumed daily.²² Control group received distilled water as placebo. On day 22nd; the experimental animals were weighed and euthanized in CO₂ and chloroform chamber. Each animal was taken out of cage by holding its tail and placed in a plastic container containing cotton ball soaked in chloroform. Blood samples for determination of thyroid hormone concentrations in the serum were collected. 6 ml of blood was taken in 10 ml disposable syringe by cardiac puncture. Total serum T₃, T₄ and TSH concentrations were quantitatively determined by enzyme immunoassay. p-value < 0.01 was considered as statistically significant.

**Results**

MMI treatment strongly affected body weight of the animals. Significant difference was observed in the initial and the final body weight of the control and the experimental group of animals, p<0.01. The mean body weight of animals from group A was 140.90±1.66g at the beginning of the experiment and 274.30±4.71g at the end of the experiment; the mean gain of weight was, therefore, 133.40±3.169g (Table 1). Whereas, the mean body weight of group B at the start was 140.80±1.75g and it was 199.70±4.57g toward the end of the experiment, thereby mean weight gain in the group was 58.90±3.10g (Table 1-3).

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Initial Mean ± S.D (n=10)</th>
<th>Final Mean ± S.D (n=10)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body weight(g)</td>
<td>140.90±1.66</td>
<td>274.30±4.71</td>
<td>&lt;0.01*</td>
</tr>
</tbody>
</table>

* p value < 0.05 is statistically significant

**Table 2:** Comparison of the initial and final mean body weight (g) in group B.

<table>
<thead>
<tr>
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**Discussion**

Present study indicates that MMI treated rats gained less body weight than animals from the control group, which are in accord with those previously reported.²² Burstein et al (2013) proved that the weight was markedly decreased from the normal rats in infant and immature hypothyroid rats.¹³ There was hardly any difference in quantity of ingested food and water consumed between the control and the experimental groups. We can accordingly rule out the possibility of MMI producing its effect on the body weight gain in experimental animals through the elements of food or water. Thyroid hormones are known to play an important role in homeothermy; hypothyroid state, presumably induces several alternate mechanisms in...
BAT metabolism, characteristic of an active thermogenic state in response to deficiency of thermogenesis induced by hypothyroidism like the study of Mory et al., 1981. The same mechanism presumably explains reduced weight gain of the experimental animals in our investigations. Fox et al (2008), conducted a study on humans and documented that moderate increase in concentrations of TSH was associated with weight gain unlike the current study. It was assumed by Mory et al., 1981 that BAT metabolism was the mechanism for energy dissipation responsible for the reduction of body weight gain in hypothyroid rats. Therefore, the difference in weight gain in hypothyroidism that exists between rodents and humans is due to the fact that functionally active BAT is present only in rodents but not in adult humans and is the only organ in mammals whose function is to produce heat.

Conclusion
Clinical and histopathological researchers explore the anatomy and physiology of human tissues. The researchers are intrigued in normal structure and functioning of animals used for experimental purposes and procedures. The assumption that humans are the same as rodents is not true and there may be changes in responses and anatomical variations between different organs and functions. In the previous studies, it was evidenced that there was weight gain in patients with hypothyroidism which is not the case with the present experiment with adult albino rats which showed that there was moderate increase in the weight of rats after being made hypothyroid.

References