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Research Article

Correlation study between collagen type 1 C telopeptide and thyroid stimulating hormone at the sedentary lifestyle individuals

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Abstract

Objectives: A sedentary lifestyle can be defined as spending most of your time without physical activity, such as sitting or lying down for long periods during the day. This lifestyle is considered the least energy-consuming state in the body, which means accumulating a lot of calories in the body. Collagen type 1 C-telopeptide (CTX-1) is the C-terminal telopeptide of fibrillar collagens, such as collagen type I, and has an important role in stabilizing protein tertiary and quaternary structures for bone tissues. It is usually used as a biomarker in serum samples to assess the bone turnover rate. Thyroid-stimulating hormone (TSH) is a peptide hormone secreted by the pituitary gland in the brain. TSH is responsible for sending a signal to the thyroid gland to increase or decrease the amount of hormones it secretes. This study aims to show the correlation between CTX-1 and TSH in individuals who have a sedentary lifestyle, which in turn causes osteoporosis in those individuals. This shows the harms of sedentary lifestyle conditions on individuals.

Methods: The study was designed based on selecting two groups of male individuals (the first group: 25 individuals living a sedentary lifestyle, and the second group: 25 individuals who have physical activity regularly). Blood samples were collected from all individuals in the study after obtaining their consent. The blood samples of the individuals were used to measure several parameters, including CTX-1, TSH, T4, and T3. The t-test statistical method was used to determine the clinically important values.

Results: The results of the study, after comparing the individuals of the sedentary lifestyle group and the active lifestyle group by the t-test statistical method, showed the following: A significant increase in the level of CTX-1 in the individuals of the Sedentary Lifestyle Group. A significant decrease in the levels of T3, T4, and TSH in the individuals of the Sedentary Lifestyle Group. The presence of an inverse or negative correlation between CTX-1 and TSH in the individuals of theSedentary Lifestyle Group.

Conclusion: The results of this study concluded the importance of physical activity for the body, as the study showed that a sedentary lifestyle causes several disorders, including secondary hypothyroidism, which in turn can cause osteoporosis in individuals.

Keywords: Collagen type 1C telopeptide, sedentary lifestyle, thyroid stimulating hormone

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A sedentary lifestyle can be defined as spending most of your time without physical activity, such as sitting or lying down for long periods during the day. This lifestyle is considered the least energy-consuming state in the body, which means accumulating a lot of calories in the body [1]. A sedentary lifestyle has many characteristics, including spending most of your time playing electronic games while sitting, lack of physical activity, and others. Recently, the percentage of a sedentary lifestyle has increased due to the technological development that the world is witnessing. A sedentary lifestyle (inactive lifestyle) has many health problems and complications, including an increased incidence of diabetes, obesity,

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osteoporosis, psychological stress, and other complications (Fig.1). Laziness is considered a contributing cause of bone diseases, the most important of which is osteoporosis, for many reasons, including that laziness and a sedentary lifestyle cause hypothyroidism, and thus a decrease in the function of thyroid hormones can cause weakness in the development and growth of bone tissue [2].

Osteoblasts are defined as cells responsible for manufacturing and forming bones by producing the membrane containing many organic compounds, for example, collagen, which makes the bone more flexible, and calcium ions with phosphate ions, which make the bone more solid [3]. This membrane is known as the bone matrix. Osteoblasts play an important role during the formation and growth of skeletal bones. In adults, the body can activate osteoblasts in the event of a need for cell renewal, a defect, or depletion of the cell matrix. Osteoblasts regulate osteoclast cells to maintain bone mass [4].

Collagen type 1 C-telopeptide (CTX-1) is the C-terminal telopeptide of fibrillar collagens like collagen type I and has an important role in stabilizing protein tertiary and quaternary structures for bone tissues. It is usually used as a serum biomarker to assess the bone turnover rate [5]. It is considered a more specific marker of bone resorption than any other test currently available because it is intracellular in osteoblast cells. When these cells begin resorption and degradation under osteoporotic conditions, CTX-1 is released into the bloodstream [6].

Thyroid-stimulating hormone (TSH) is defined as a peptide hormone secreted via the pituitary gland in the brain. TSH is responsible for sending a signal to the thyroid gland to increase or decrease the amount of hormones it secretes, and its amount depends on the amount of thyroxine (T4) and the decrease in triiodothyronine (T3) present in the blood in the normal state. The level of TSH can be affected by many factors, including thyroid hormones, psychological state, some medications, sedentary lifestyle, and others [7]. Low levels of TSH can cause a slow heart rate, joint swelling and stiffness, dry skin, constipation, growth disturbances, and more. The level of TSH decreases and causes secondary hypothyroidism because it leads to inhibition of T4 and T3 production from the thyroid gland. The TSH decrease has several factors and conditions because it is under the control of the hypothalamus and the brain, as any psychological conditions can lead to this [8].

The current study aims to show the health complications resulting from a sedentary lifestyle on individuals. These complications are shown by measuring many biomarkers for all study individuals, then comparing and finding correlations between these biomarkers. The biomarkers included T3, T4, TSH, and CTX-1. In addition, the most important health complications resulting from a sedentary lifestyle are secondary hypothyroidism and osteoporosis.

Materials and Methods

Study design

This study included in its design the selection of two groups of individuals chosen according to specific lifestyles, where individuals were divided into two groups:

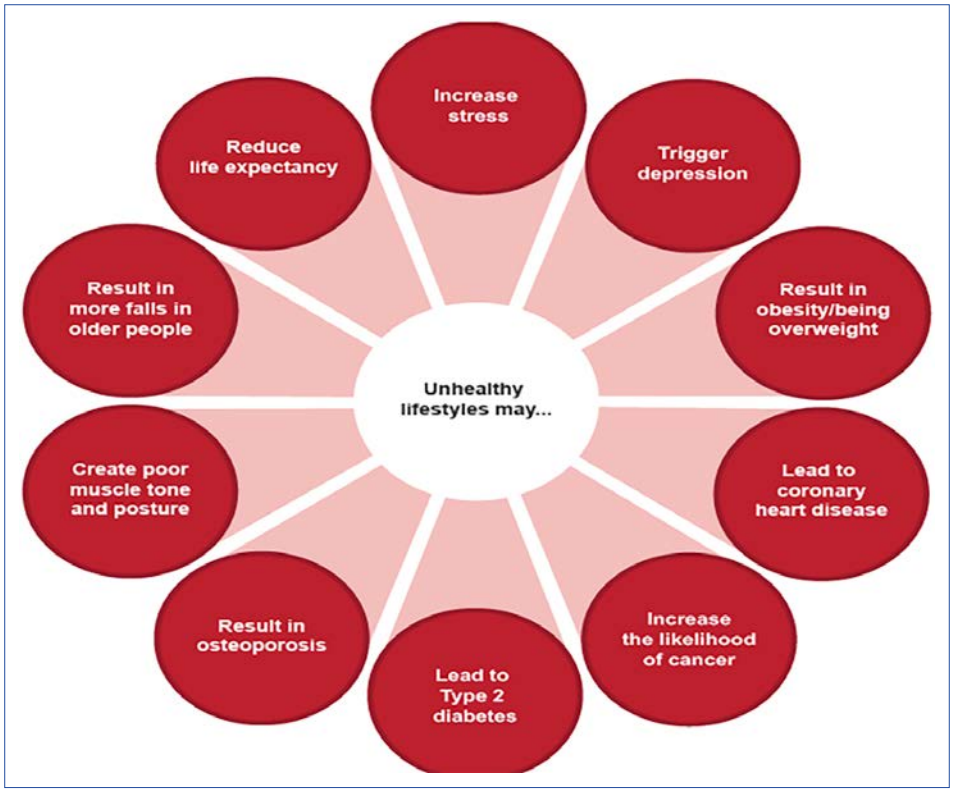

Figure 1. The sedentary lifestyle complications.

Table 1. The biochemical parameters kits details

Biochemical marker	Principle test	Company name for the kit	Lot number
CTX1	Sandwich ELISA	BioVendor	Ac.02
TSH	Kinetic Fluorescence Immunoassay	TOSOH	1007471001-017F - 01/17
T4	Kinetic Fluorescence Immunoassay	TOSOH	1007371001-017E - 01/17
T3	Kinetic Fluorescence Immunoassay	TOSOH	1007271001-110G - 11/20

CTX 1: Collagen type 1 C-telopeptide; TSH: Thyroid-stimulating hormone.

Table 2. Comparison between Sedentary Lifestyle Group and Active Lifestyle Group according to some biochemical parameters

Biochemical parameters	Sedentary Lifestyle Group Mean±SD (n=25)	Active Lifestyle Group Mean±SD (n=15)	Comparison of two groups (p)
CTX 1 (ng/ml)	2.28±1.13	0.91±0.20	0.001*
TSH (µIU/ml)	0.64±0.31	4.15±2.24	0.001*
T4 (nmol/L)	51.5±28.6	107.4±3.7	0.001*
T3 (nmol/L)	0.87±1.5	1.89±0.41	0.01*

*: Significant value is (P-value less than 0.05). SD: Standard deviation; CTX 1: Collagen type 1 C-telopeptide; TSH: Thyroid-stimulating hormone.

- Sedentary Lifestyle Group: Included 25 individuals who had an inactive and sedentary lifestyle and did not practice any sports activity, aged 30–40 years of male gender. These cases were collected from electronic game halls and cafes.
- Active Lifestyle Group: Included 25 individuals who had an active lifestyle and practiced sports activity regularly, aged 30–40 years of male gender. These cases were collected from gyms.

All study individuals were selected according to a special questionnaire directed to them and collected and analyzed statistically (see appendix section), also based on the specifications stipulated in the American College of Rheumatology (ACR) guideline (2022) [9]. The current study was conducted in Baghdad for the period from May to June 2024. Oral and written consent was taken from the individuals to include them in the study in order to achieve research ethics, according to research ethics in my college (No. 312, May 2024). (There is a research ethics committee in my college that approves all research for researchers after being informed of all details through a seminar.) The study was done after the (2013) Helsinki Declaration on the Ethics Approval for Scientific Research.

Measurements and methods

After identifying the study individuals from both groups, their blood samples were taken. These samples were centrifuged to obtain pure serum for use in measuring the specified biochemical parameters, which are CTX-1, TSH, T4, and T3. In this study, we used special kits to measure these biochemical parameters from reputable manufacturers, where all measurement details from the company name, chemical principle of measurement, and other details are shown in Table 1.

Statistical analysis

In the current study, the statistical method known as the t-test was used, which is based on the mean, standard deviation, and p-value to clarify the clinical significance of valuable biochemical parameters. The choice of this statistical method was based on the research characteristics present in the research, as we wanted to compare only two groups. This is consistent with the characteristics of the t-test statistical method. The statistical program, version 18 (2022), was used to analyze the data [10].

Results

Results of the current study showed that there are clinical differences with significant values for biochemical markers when we compared the two groups (first group: sedentary lifestyle and second group: active lifestyle), as the results showed the following:

- Significant increase in the level of CTX-1 in the Sedentary Lifestyle Group compared to the Active Lifestyle Group.
- Significant decrease in the levels of TSH, T4, and T3 in the Sedentary Lifestyle Group compared to the Active Lifestyle Group.

In addition, the correlation curve was made between CTX-1 and TSH to determine whether there is a correlation between them. It was found that there is an inverse or negative relationship between CTX-1 and TSH within the Sedentary Lifestyle Group (Table 2 and Figs. 2-6).

Discussion

A sedentary lifestyle is defined as the lack of physical activity for a person, which means that the individual lives a sedentary lifestyle. These conditions are a source and cause of many disorders, the most important of which are metabolic disorders, which in turn affect several organs in the body, the most important of

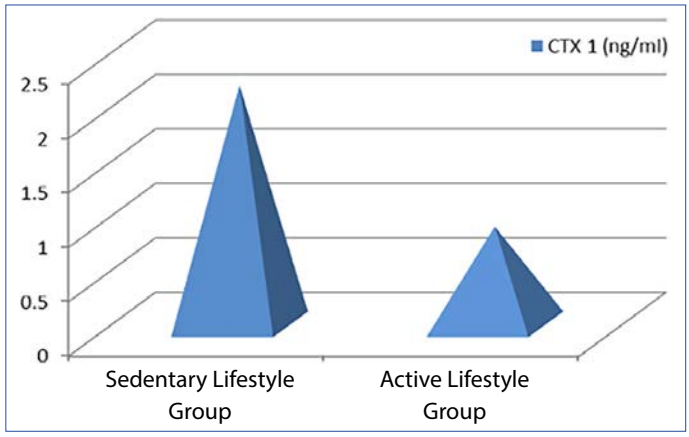

Figure 2. Comparison between Sedentary Lifestyle Group and Active Lifestyle Group according to CTX 1 biochemical parameters.
CTX 1: Collagen type 1 C-telopeptide.

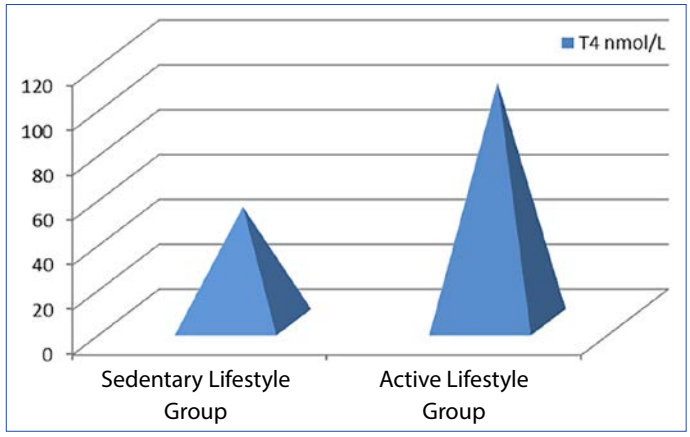

Figure 4. Comparison between Sedentary Lifestyle Group and Active Lifestyle Group according to T4 biochemical parameters.
T4: Thyroxine.

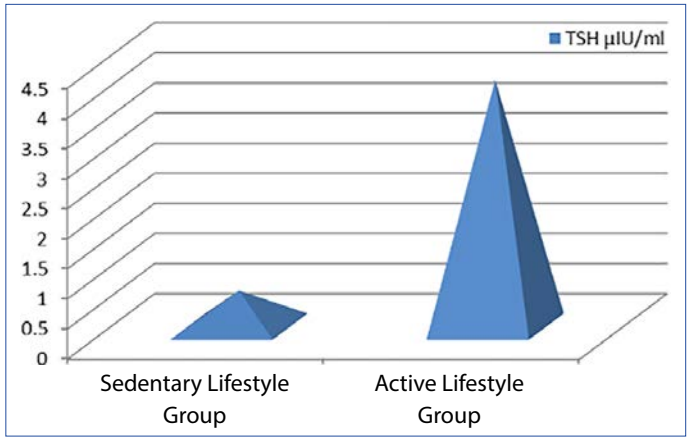

Figure 3. Comparison between Sedentary Lifestyle Group and Active Lifestyle Group according to TSH biochemical parameters.
TSH: Thyroid-stimulating hormone.

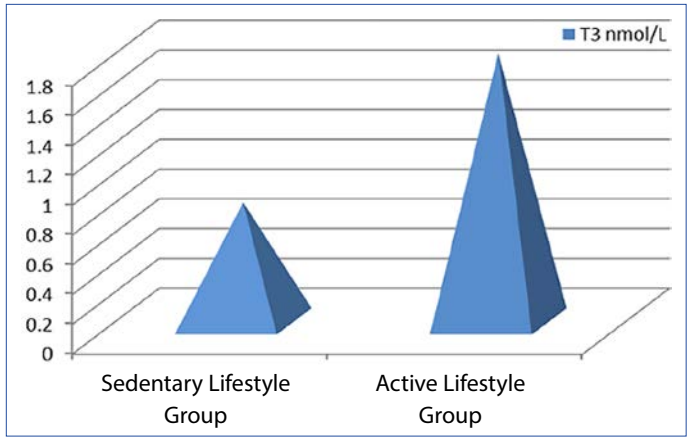

Figure 5. Comparison between Sedentary Lifestyle Group and Active Lifestyle Group according to T3 biochemical parameters.
T3: Triiodothyronine.

which are the bones [2]. Living a sedentary lifestyle suggests to the body that it does not need energy, and this is interpreted by the body as nerve signals sent to the brain to take what is necessary. In such conditions, the brain begins to control the change in metabolic pathways, as we see weight gain through the accumulation of fat in individuals. This is one of the paths that the body takes to get rid of unburned calories to produce energy [11]. On the other hand, the body begins to inhibit the secretion of the TSH hormone, which is the hormone that controls the production of thyroid hormones that play an important role in the process of energy production in biological metabolism. The brain begins sending signals to the pituitary gland via the hypothalamus to inhibit the production of the TSH hormone, and thus the thyroid gland is inhibited and the production of thyroid hormones (T3 and T4), which play an important role in regulating and producing energy in the body, is reduced. This is why we see that individuals who live a sedentary lifestyle sometimes suffer from secondary hypothyroidism [12].

Secondary hypothyroidism causes many disorders and diseases, the most important of which is osteoporosis. Osteo-

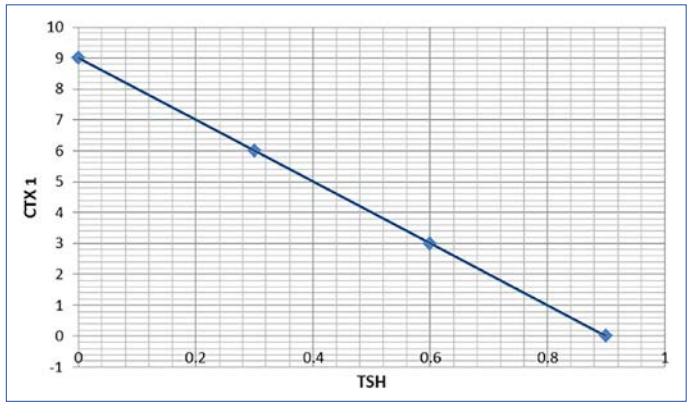

Figure 6. Correlation between CTX 1 and TSH within Active Lifestyle Group.

porosis is a disease that affects the human skeletal system, where there is an imbalance between the activity of osteoblasts and osteoclasts [13]. The decrease in the T3 hormone inhibits the process of bone repair, and therefore bone resorption begins to accelerate due to the destruction of os-

teoblasts. One of the most important compounds that result from this destruction process is CTX-1, which is released into the bloodstream in large quantities. CTX-1 is known as the collagen compound or collagen responsible for binding the bone matrix inside and between cells. The release of CTX-1 into the bloodstream means that it has left the osteoblasts and has no role in the process of building bone tissue, and thus the bone becomes fragile, which is what we call osteoporosis [14].

The results of this study showed that there is an increase in the level of CTX-1 in individuals who live a sedentary lifestyle compared to individuals who practice sports activity regularly. Also, the study found a decrease in the level of TSH in individuals who live a sedentary lifestyle compared to individuals who practice sports activity regularly. These results mean that individuals who have a sedentary lifestyle suffer from secondary hypothyroidism, and this disorder has led to inhibition of the function of osteoblasts and thus increased bone resorption and the release of CTX-1 into the bloodstream. These conditions occur due to the effective role of thyroid hormones in the development and growth of cells in general, and the loss of these hormones means the inactivity of these processes. This was also demonstrated by our current study by proving the negative relationship between TSH and CTX-1 in individuals who live a sedentary lifestyle.

Our current study is consistent with the results of Roberts HM, Law RJ (2019), who also demonstrated high CTX-1 levels in individuals who live a sedentary lifestyle [15]. Also, our study is consistent with Di Blasio, A., and Di Dalmazi, G. (2022), who also demonstrated low TSH levels in individuals who live a sedentary lifestyle and thus suffer from secondary hypothyroidism [16]. This is explained by our study results by the existence of a negative or inverse relationship between CTX-1 and TSH in sedentary lifestyle individuals.

The current research opens up future research horizons on the effects of a sedentary lifestyle on human health, as we hope to conduct research on how to treat secondary hypothyroidism by modifying lifestyle to avoid medications. On the other hand, we hope to conduct in-depth research on osteoporosis, hypothyroidism, and their relationship to lifestyle.

Conclusion

Our current study demonstrated the important function of physical activity for the human body after comparing individuals who engage in physical activity with individuals who have a sedentary lifestyle. The current study concluded that a sedentary lifestyle causes secondary hypothyroidism, which in turn can cause osteoporosis. This conclusion was shown through the results and examinations conducted on all individuals in the study, which included CTX-1, TSH, T4, and T3. In addition, we found through the study the existence of an inverse relationship between CTX-1 and TSH in individuals who have a sedentary lifestyle.

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Ethics Committee Approval: The study was approved by The Ministry of Higher Education and Scientific Research, Health and Research Institutions Ethics Committee (No: 312, Date: 03/05/2024).

Authorship Contributions: Concept – M.S.K.; Design – M.S.K.; Supervision – M.S.K.; Funding – N.B.R.; Materials – M.S.K.; Data collection &/or processing – N.B.R.; Analysis and/or interpretation – N.B.R.; Literature search – M.S.K.; Writing – M.S.K.; Critical review – N.B.R.

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