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# Study the Effect of COVID-19 Disease on Thyroid Hormones (T3, T4, TSH) and the Lipid Profile in Recovering Iraqi Subjects

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## Abstract

The present pandemic of Coronavirus Disease 2019 (COVID-19) causes many lasting impacts on the human body. It has immediate and extensive effects on the human body, particularly the thyroid gland. A rise in adenylyl cyclase 2 (ACE2) and transmembrane serine protease 2 (TMPRESS2) makes it easier for viruses to get into human cells. COVID-19 triggers a hyperactive immune response that produces interleukin-6 (IL-6) and other pro-inflammatory cytokines. This hyperactive immune response leads to severe thyroid malfunction. The current study aimed to research the relationship between the recovering Iraqi subjects of COVID-19 and thyroid hormones and lipid profiles. This study aims to evaluate triiodothyronine (T3), thyroxine (T4), thyroid stimulating hormone (TSH), and lipid profile including cholesterol, high-density lipoprotein (HDL), triglycerides (TG), low-density lipoprotein (LDL), and very low-density lipoprotein (VLDL). A total of 70 recovering subjects with COVID-19 were collected, and 50 were used as a control group. Thyroid hormones showed significant differences, an increase in serum TSH, and a decrease in the levels of T3 and T4 between the two groups ($p$= 0.001). The lipid profile revealed notable variations, as well as an increase in cholesterol, LDL, and VLDL. There was a notable drop in HDL levels between the two groups, as indicated through $p$-values of 0.001. Body mass index (BMI) and age did not show any significant differences. This research concludes that recovered people from COVID-19 had problems with their thyroid hormones and lipid profiles.

**Keywords:** Lipid profile, recovered COVID -19, SARS-CoV-2, , thyroid hormones.

## 1. Introduction

The 2019 coronavirus disease (COVID-19) is an extremely contagious virus that causes severe acute respiratory syndrome and has claimed the lives of more than 3.8 million people so far (SARS-CoV-2). It was in late 2019 when researchers in Wuhan, Central Province, China, first discovered SARS-CoV-2, a respiratory virus. It has now spread swiftly around the world. The Department of Health officially declared the pandemic on March 11, 2020. Since its declaration

as a global pandemic, COVID-19 has wreaked havoc on healthcare systems in several countries. And then there's the epidemic [1]. Under an electron microscope, coronaviruses (CoVs) seem like crowns (in Latin, the word for "crown" is "corona.") because the membrane contains spike glycoproteins. The family Coronaviridae (order Nidovirales) includes the subfamily Orthocoronavirinae, which includes the four genera of CoVs: Alphacoronavirus, Betacoronavirus, Deltacoronavirus, and Gammacoronavirus (ɤ-CoV) [2,3]. Genomic evidence points to birds as the likely origin of gamma and delta coves, whereas bats and rodents are more likely to be the original hosts of α- and β- CoVs. CoVs almost always trigger outbreaks of respiratory diseases. Its diameter ranges from 60 to 140 nm, and it often has a pleomorphic form that is either round or elliptical. It is susceptible to heat and UV radiation, like other CoVs. This is true even though every viral species owes a debt to heat. SARS-CoV-2 deactivation temp studies are now underway [4,5]. It has been suspected that SARS-CoV-2, like SARS and MERS before it, spreads from bats to host species like pangolins and minks [6,7]. Multiple long-term effects on the human body's normal physiological balance have already been linked to the ongoing epidemic of COVID-19. Studies rapidly identified severe and complex impacts on human organ systems, including respiration, digestion, vascular, immune, renal, hepatic, cardiac, and hematological. In terms of the human endocrine system, COVID-19 studies are making slow but steady progress [8,9]. Hormones produced by the thyroid, including thyroxine (T4) and triiodothyronine (T3), play an important role in the brain and body from birth forward, including in cognitive and motor development [10,11]. The brain, heart, liver, and muscle all benefit from substances secreted by the thyroid gland. Thyroid stimulating hormone (TSH) is a hormone that is produced by the pituitary gland, which in turn is controlled by the hypothalamus secreting thyrotropin-releasing hormone (TRH), which in turn controls T3 and T4 synthesis [12-14]. This setup acts as a negative feedback loop. When T3 and T4 drop below normal, the pituitary gland releases TSH to stimulate the thyroid gland to make additional hormones and bring blood levels back up to normal. Once levels have risen, the pituitary gland will stop producing as much TSH. Thyroid hormones enter the circulation and distribute themselves accordingly. Although the majority of hormones are already coupled to proteins in the blood plasma, there are a few that may freely circulate in the circulation and potentially reach cells to drive metabolism [15,16]. With the publication of more studies on the effects of COVID-19 on the human thyroid, our understanding of the cause and treatment of thyroid dysfunction has improved. The thyroid glands produce more adenylate cyclase 2 (ACE2) and serine protease 2 transmembranes (TMPRESS2) than the lungs, and these two proteins work together to allow viruses to enter human cells [17,18]. COVID-19 triggers an overactive immune response that releases inflammatory cytokines, particularly interleukin-6 (IL-6), which modifies deiodinases and thyroid transport proteins, leading to obvious thyroid dysfunction. T3 levels fall as IL-6 concentrations rise, but TSH and T4 levels drop somewhat. This anomaly is characterized by the term "sick euthyroid syndrome" [19,20].

## 2. Materials and Methods

### 2.1 Study subjects

The current research was conducted in Iraq to study the effect of COVID-19 disease on thyroid hormones in recovered Iraqi subjects. This research included 120 individuals after getting patient permission and ethical clearance from the appropriate institutional review board. The subjects ranged in age from twenty to fifty-five years old. We collected 70 subjects with COVID-19 disease and 50 control subjects from Yarmouk Teaching Hospital and Mahmoudia General Hospital

between July 1, 2022, and September 1, 2022. Patients were classified into two groups: group 1 comprised 70 individuals (51 females and 19 males) recuperating from COVID-19; patients with a history of thyroid disease were excluded from the study, while group 2 comprised 50 individuals (37 females and 13 males) serving as the control group.

### 2.2 Blood sample collection

Blood sample collection consisted of drawing five ml of venous blood and putting it in a blank tube at room temperature. Next, centrifuge it at 3000 r.p.m. for 10 minutes to extract the serum. We isolated the sera samples and stored them at -20 °C until we needed them. Serum was used to calculate (T3, T4, and TSH) by the ELISA technique and (cholesterol, TIR, and HDL).

### 2.3 Anthropometric Measurements

Weight (kg) and height (cm): We calculated one's body mass index (BMI) (M2) by dividing one's weight (in kilograms) by one's height squared.

### 2.4 Characteristic of patients and control

Patients with COVID-19 recovered. Disease and control were characterized by age, thyroid hormones, and lipid profile.

### 2.5 Statistical analysis

The findings were all presented. as mean standard error (SE). The Statistical Package for the Social Sciences (SPSS), a computerized statistical tool for the social sciences was used for the analysis. A paired sample t-test was performed for the same group, including a comparison between the two groups. A $p$-value < 0.05 was considered to be statistically significant.

## 3. Results and Discussion

The current study was arranged to evaluate some biochemical parameters in the serum samples of recovered subjects after post-infection COVID-19 and, apparently, the control group. **Table 1** shows the mean ± SE of the age factor [(32.9 ± 1.2) (32.8 ± 1.6)] between recovered subjects and healthy controls, respectively, where the results presented non-significant variation between the two groups ($p \leq 0.05$). While everyone is at risk of contracting COVID-19, those over the age of 65 are more vulnerable [21].

**Table 1.** Demographic factor distribution in studied groups.

| Parameters | Groups | Mean± SE | *p*-value |
|---|---|---|---|
| **Age (Years)** | Recovered COVD19 subjects | 32.90 ± 1.20 | 0.30 |
| | Control | 32.80 ± 1.60 | |
| **BMI (Kg/m$^2$)** | Recovered COVD19 subjects | 28.35 ± 1.00 | 0.06 |
| | Control | 27.40 ± 0.70 | |

two independent t-test were used at 0.05 α level

Clinical symptoms appear in 21% (95% credible interval: 12-31%) of diseases in those ages 10 to 19, and 69% (57-82%) of infections in those over the age of 70. For those under the age of 20, the susceptibility to infection is almost half that of people over the age of 20 [22]. The result of the body mass index (BMI) is shown in **Table 1**. The results show that there was no significant difference between the two groups ($p \leq 0.05$). The mean± SE for recovered patients was

16.51±0.530 and for healthy controls was 16.36±0.715. There is mounting evidence linking obesity to a more severe case of COVID-19 infection and an increased risk of death, according to many studies. After accounting for other factors, clinical research from China on the COVID-19 illness showed an 86% and 142% increased association between obesity and a severe infection compared to normal-weight people [23, 24]. It is necessary to obtain anthropometric data for COVID-19 patients, particularly the younger group, since obesity may have a crucial role in defining the severity of the disease. Future research should investigate the potential link between obesity and hospital mortality in COVID-19 patients [25].

**Table 2.** Comparison between recovered subjects and control in on thyroid hormones.

| Parameters | Groups | Mean± SE | P-Value |
|---|---|---|---|
| **T3** | recovered subjects | 1.73± 0.05 | 0.001 |
| | healthy control | 2.78± 0.07 | |
| **T4** | recovered subjects | 310.31± 13.68 | 0.001 |
| | healthy control | 684.17± 7.73 | |
| **TSH** | recovered subjects | 5.88± 0.22 | 0.001 |
| | healthy control | 2.52± 0.10 | |

Independent T-test were used at 0.05 α level.

**Table 2** shows that there are discernible differences between the groups for T3 level (1.73 ± 0.05) for the recovered patient group and (2.78 ± 0.07) for the healthy control group. The T3 values were significantly different between the two groups, with the recovered participants showing a lower T3 value than those in good health ($p > 0.001$). There are also significant differences between T4 levels (310.31 ± 13.68) for the recovered group and (684.17± 7.73) for the healthy group control. In the mean T4, there were significant differences. There was a decrease in the T4 value in the recovered group ($p > 0.001$). Also, there are big differences between TSH levels (5.88 ± 0.22) for the recovered group and (2.52 ± 0.10) for those in good health. The median TSH levels varied significantly. There was an increase in the TSH value in the recovered group ($p > 0.001$).

Serum levels of T3, T4, and TSH in SARS were shown to be significantly different from those in controls during the progression and recovery phases [26]. The current data revealed that TSH levels were significantly higher in COVID-19 patients who were moderately or severely affected, compared to those who were not [19]. Patients with COVID-19 also had significantly higher TT3 increases than those without the disease, but TT4 levels changed very little [19]. The TSH, fT4, and fT3 levels of another study done 3 months after infection were all within the usual range. It has been observed no significant difference in TSH and FT4 levels from pre-COVID-19 baseline levels and a restoration of individual autonomic set points for fT4 and TSH [27]. In a study conducted in Iraq among individuals infected with COVID-19, blood levels of both TSH and T3 were significantly lower compared to levels of a healthy control group [28].

**Table 3.** Comparison between recovered subjects and control in lipid profile.

| Parameters | Groups | Mean± SE | *p*-Value |
|---|---|---|---|
| **Cholesterol** | recovered subjects | 219.287± 1.009 | 0.001 |
| | healthy control | 184.85± 1.009 | |
| **TG** | recovered subjects | 215.995± 1.063 | 0.001 |
| | healthy control | 189.716± 1.935 | |
| **HDL** | recovered subjects | 29.396± 0.45 | 0.001 |
| | healthy control | 84.617± 2.061 | |
| **LDL** | recovered subjects | 146.692± 0.899 | 0.001 |
| | healthy control | 62.289± 2.268 | |
| **VLDL** | recovered subjects | 43.199± 0.212 | 0.001 |
| | healthy control | 37.943± 0.387 | |

Independent T-test were used at 0.05 α level.

**Table 3** demonstrates that there are discernible differences in cholesterol level between the groups, with (219.287± 1.009) for the recovered patient group and (184.85± 1.009) for the healthy control group. Cholesterol values were significantly different between the two groups, with the recovered participants showing an increased cholesterol value than those in good health ($p > 0.001$). Also, significant differences were found between the two groups with regard to TG level (215.995 ±1.063) for the recovered patient group and (189.716±1.935) for the healthy control group. TG values were significantly different between the two groups, with the recovered participants showing an increased TG value than those in good health ($p > 0.001$). The serum HDL level was significant between the two groups (29.396±0.45) for the recovered patient group and (84.617±2.061) for the healthy control group. HDL values were significantly different between the two groups, with recovered participants showing a lower HDL value than those in good health ($p > 0.001$). Additionally, a significant increase in TSH levels was observed in the recovered group, which set them apart from the control group ($p > 0.001$). The level of VLDL also showed significant differences (43.199 ± 0.212) for the recovered patient group and (37.943±0.387) for the healthy control group. Between the two groups, HDL values were different, with recovered participants showing a lower HDL value than healthy subjects ($p > 0.001$).

Lipid metabolism of recovered individuals has been investigated many years after they had contracted SARS. They discovered that the levels of TG and cholesterol were substantially higher than in people who had recovered [29]. Statistics revealed substantial differences between the recovered subjects and the healthy controls. Triglycerides were significantly higher following recovery compared to the infection's acute phase ($p= 0.0001$) [30]. Statistically significant changes were found when comparing the recovered subjects with healthy controls. Compared to the acute phase of the infection, HDL cholesterol, LDL cholesterol, and TG were considerably higher after recovery ($p= 0.0001$) [30]. Moreover, 12 years after contracting SARS, researchers studied the lipid metabolism of recovered patients and found that TG, VLDL, and cholesterol readings were significantly higher than in recovered participants [29].

## 4. Conclusion

The study's results show that some biochemical parameters are important. For example, serum levels of TSH, cholesterol, TG, LDL, and VLDL increased, while levels of T3, T4, and HDL decreased ($p > 0.05$) in the recovered subjects compared to the control group.

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## Conflict of Interest

The authors declare that they have no conflicts of interest.

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No founding.

## Ethical Clearance

The University of Baghdad's local Ethical Committee approved the project. The Medical Research Ethics Committee of the Ministry of Health, Baghdad Health Department, Al-Karkh, Baghdad, Iraq, approved the research (No. 39563 on 27/7/2022).

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