Research

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Journal of Clinical and Molecular Endocrinology
ISSN 2572-5432

2020
Vol. 5 No. 3:22

DOI: 10.36648/2572-5432.5.3.22

COVID-19 Susceptibility Factors: VLDL, Triglycerides, Free T3, Leptin, Ghrelin, Cortisol and Visceral Adipose Tissue

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Citation: Sofra X. SCOVID-19 Susceptibility Factors: VLDL, Triglycerides, Free T3, Leptin, Ghrelin, Cortisol and Visceral Adipose Tissue. J Clin Mol Endocrinol. 2020, 5:3.22

Abstract

Despite the fact that COVID-19 primarily infects the respiratory track, COVID-19 deaths are primarily clustered around cardiovascular disease (CVD), diabetes and obesity. These disorders' common denominators are high VLDL cholesterol, triglycerides, visceral adipose tissue and its inherent toxicity and inflammation. CVD, diabetes and obesity are also associated with abnormalities in Free T3, leptin, ghrelin and cortisol. Obese individuals manifest respiratory problems that render them susceptible to respiratory disease. Toxicity is enhanced by inactivity, while moderate exercise promotes cardiorespiratory fitness (CRF), safeguarding against most chronic diseases. However, excessive exercise results in an inverse cortisol testosterone relationship leading to hormonal imbalance. Staying home during COVID-19 reinforces stress eating behaviours and weight gain. In search of solutions to proactively protect public health, we conducted a randomized double-blind clinical trial on healthy overweight adults, before implementing it on COVID-19 patients. The innovative methodology used resulted in a decrease of visceral adipose tissue, VLDL and triglycerides, and an inverse relationship between both testosterone/cortisol and leptin/ghrelin. Testosterone and leptin climbed to the peak of the normal range, juxtaposed by cortisol and ghrelin that decreased but without dipping into abnormality. Increased skeletal muscle mass was accompanied by IGF-1 and Free T3 increases that peaked within the normal range.

Keywords: COVID-19, VLDL cholesterol, Triglycerides, Visceral adipose tissue, Diabetes mellitus, Thyroid

Received: June 30, 2020; **Accepted:** July 14, 2020; **Published:** July 22, 2020

Introduction

COVID-19 is an infectious disease affecting the lower respiratory track. COVID 19 death rate by pre-existing condition is 10.5% for cardiovascular disease (CVD), 7.3% for diabetes, 6.3% for chronic respiratory disease, 6.3% cancer and 0.9% for patients with no pre-existing conditions [1]. According to Italy's National Institute of Health in March 2020, 99% of COVID-19 patients had at least one preexisting condition and one third of them had heart disease [2]. Increased levels of the very low-density lipoprotein (VLDL) is associated with a high risk of CVD due to increased inflammation, hardened plaque that narrows the arteries, and increased blood pressure. A 15-year multi-provincial cohort study found that high VLDL cholesterol was an independent risk factor of coronary heart disease (CHD) that elevated CVD risk [35]. Increased VIDL and triglyceride concentrations have been confirmed in both Type 1 and Type 2 diabetes mellitus [32]. To date, no research studies have explored the correlation between VLDL, triglycerides and COVID-19 vulnerability. Research has indicated that primary infection patients showed lower high-density lipoprotein (HDL) levels (1.10±0.04 mmol/L) when compared to secondary infection patients, however, this study did not specifically look at VLDL or triglycerides [3]. Increased levels of VLDL and triglycerides are also associated with obesity. Recent reports [4,5] suggest that a high percentage of the population who will contract COVID-19 will also have a BMI over 25. Research on 4,000 patients in New York City found that after age, obesity was one of the most significant factors associated with poor prognosis and case severity of COVID-19 patients [4,5]. Early statistics from Britain's independent Intensive Care National Audit and Research Centre on COVID-19 patients in intensive care confirm that 73.4% of these patients are classified as overweight [5]. Abdominal obesity is also associated with respiratory problems which contribute significantly to the burden of respiratory disease [17].

COVID-19 binds to target cells through ACE2 receptors therefore, hypertension and diabetes patients who may have increased ACE2 expression may be more vulnerable to COVID-19 infection, ultimately increasing the risk of fatality [18].

FeiZhou et al. [6] examined the clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan and found that mortality rate was higher in aged patients with diabetes or coronary heart disease as a result of increased inflammation, toxicity and immune deficiency. Inflammation was demonstrated by the elevated alanine aminotransferase (ALT), and interleukin 6 protein (IL-6). A declining immune system was identified by the evidence of lymphopenia, the abnormally low level of lymphocytes in the blood, and leukocytosis that reflects a higher leukocyte count of white cells [6,7,24]. High ALT and high LDH-4 and LDH-5 signified liver or muscle tissue damage suggesting excess toxicity, an inference reinforced by the evidence of increased creatinine, a waste product produced by the muscles [6].

Recent research on 150 COVID-19 patients suggested that mortality may be due to virally driven hyperinflammation on the basis of elevated ferritin, IL-6, and interferon-γ inducible protein 10 indicating increased inflammation. The interferons trigger cascades of antiviral activity, however, in the process they shut down host protein synthesis inducing cell death [8]. Doctors on the ground report that severe cases don't develop a high "viral load" but a "cytokine storm" syndrome, an immune reaction in which the body releases too many cytokines into the blood, resulting in hyperinflammation that turns out to be lethal for the patient [9]. Diabetes may make COVID-19 worse because inadequate amounts of insulin result in high glucose concentrations in the blood, facilitating the virus' tendency to increase glucose metabolism reinforcing the "cytokine storm" [10-11]. Diabetics have impaired immune-response to infection both in relation to cytokine profile and to changes in immune-responses including T-cell and macrophage activation [15].

Diabetes mellitus (DM) and Thyroid dysfunction influence each other, suggesting metabolic issues and deficient production of Free T3 [12-13]. Thyroid hormones modulate every component of the cardiovascular system necessary for normal cardiovascular development and function, again, highlighting a correlation between Free T3 abnormalities and CVD [33]. Many patients with CVD and type 2 diabetes are obese and obesity is also associated with metabolic abnormalities [15-16].

Cortisol increase is more pronounced in patients with diabetes complications [26]. Cortisol abnormalities have been associated with heart disease [34]. The recently published list of people considered vulnerable by the UK Chief Medical Officers includes steroids dependent individuals with an adrenal insufficiency, a condition associated with inadequate amounts of steroid hormones, primarily cortisol [31]. Cortisol increase is associated with overeating, weight gain and obesity [38].

All viral infections cause elevated cytokine-3 signalling expression which inhibits leptinsignalling, an event that is highly correlated with obesity [36]. Visceral adiposity results in toxicity that overloads hepatic detoxification systems promoting insulin and leptin resistance disorganising central inhibitors and stimulators of appetite including ghrelin that ultimately promote increased caloric intake [37]. A minor increase in leptin concentrations reduces appetite inducing weight loss [44]. However, excess of leptin is indicative of leptin resistance and is associated with obesity [43]. Leptin resistance develops due to a defect in intracellular signalling and subsequent decreases in leptin transport across the blood–brain barrier (BBB) [45]. In common forms of obesity hyperphagia, hyperinsulinermia and hyperleptinermia coexist [46]. On the other hand, clinical research associates low plasma leptin to cardiovascular mortality [40]. Importantly, both excess and leptin deficiency underlies pathology. Leptin appears to exert actions related to cardiovascular homeostasis [41]. Leptin also regulates cholesteryl esters that play an important role in cholesterol metabolism [42]. Ghrelin, is an orexigenic hormone that stimulates appetite. Research has shown that ghrelin-producing cells seem to be more abundant in morbidly obese patients [47].

Extensive quarantine is the best measure to stop the rapid spread of COVID-19. However, lockdown restricts physical activity (PA) that is necessary to maintain an adequate health status, thus counteracting the negative consequences of diabetes, hypertension, cardiovascular disorder (CVD), respiratory diseases and obesity. Exercise can reduce the risk of generalized loss of skeletal muscle mass, otherwise known as sarcopenia, in older individuals [9]. PA enhances detoxification and fitness proving to be an effective therapy for chronic diseases directly affecting both mental and physical health [11-21]. Inactivity results in low-grade inflammation as indicated by elevated plasma of IL-6 and C-reactive protein which are identified as inflammation markers [24]. This urges the adoption of lifestyle behaviour that promote cardiorespiratory fitness (CRF) on the basis of a statistically significant inverse relationship between CRF and all-cause mortality ($p<0.05$) [22]. Exercise has been shown to improve immunity [23], however crowded places like gymnasia or swimming pools are either closed during a quarantine period or are to be avoided. Moreover, excessive exercise is perceived by the body as a form of stress and stimulates the release of cortisol that may cause tissue breakdown with over training. Cortisol is involved in the conversion of protein to glucose potentially predisposing older individuals to type II diabetes [26]. Strenuous exercise, necessary to reduce visceral adipose tissue, is associated with a negative relationship between cortisol and testosterone. As cortisol increases, testosterone decreases resulting in weight gain, and other complications that offset the benefits of exercise [27-18]. During overtraining muscle-derived IL-6 is released into the circulation in high amounts leading to increased inflammation [39], one of the main risks associated with COVID-19. The outcome of exercise appears to range from enhancing health to increasing COVID-19 susceptibility depending on the intensity and duration of physical activity.

In search of solutions that can proactively protect public health, the current research focused on levels of visceral adipose tissue, skeletal muscle mass and IGF-1, as well as plasma levels of VLDL cholesterol, triglycerides, leptin, ghrelin, T3 and cortisol, which are associated with obesity and its inherent inflammation and toxicity that underlie the disorders with the highest COVID-19

susceptibility. We used an effortless exercise method invented and build in London University in 1994. London University professor Goldspink[29], used an earlier modified version of stimulation exploring gene expression in fast and slow muscle fiber phenotypes. The stimulation method resulted in rapid hypertrophy of adult skeletal muscle that reflected an increase of up to 250% in RNA content associated with the repression of the fast and the activation of the slow myosin heavy chain genes.

Methodology

The device used was completed in 2008 after 29 years of empirical research by Dr Gerald Pollock who was also involved in the invention of the first pacemaker in London University, and Dr Donald Gilbert, a molecular biology London University professor. The device was originally built in London University and was then modified and upgraded at the EU funded Business Innovations Centre in London for muscle wasting conditions and multiple sclerosis. The device offers a voltage driven signal that results in 1000 full body musculature contractions, each sustained for 8 seconds with 2-sec rest time. It has a maximum voltage of 25V at 500 Ω, 100V at 10K Ω, and a net charge of 0.001A at 500 Ω, 0.004A at 2K, and 0.00025A at 10K Ω. The leakage is 0.007µa (µa = 10−6A). The device's voltage driven signal is emitted from 16 channels isolated by separate transformers. It reaches the skin via 16 silver plated tour grade microphone cables connected to gel pads which are attached onto the body. The device has two waveform control knobs that are controlled manually. Each waveform knob has twelve options corresponding to twelve square complex waveforms, each composed out of 4,000 sine frequencies added onto each other on the basis of Gerald Pollock's formula that he patented in 1983 in London University.

The twelve waveforms on the left are manually combined with the twelve waveforms on the right to form 144 combinations that give different types of 8-secs contractions every 2-secs, some offering deep contractions like strength and resistance exercises and others offering fast contractions like aerobic exercises. All 24 sine complex waveforms are rectangular in shape and have their own specific resultant frequencies that vary from 55Hz to 888 Hz. The technology is custom-made and hand-made analogue in the UK with no digital components to emit an unlimited resolution voltage driven signal. It is classified as IEC class I according to the IEC60601-1 standard and it is used with 3-pin din and 4-pin din IEC 60601-1 compliant cables. It has a CE marketing directive of Class I with electromagnetic compatibility regulations applied standards EN50081-1 and EN50082-1. Additionally, it complies with the EEC UK directive of electrical equipment safety applied standard EN 60601-1. The technology has had no known side effects in the past 20 years that is has been used in clinical practice by over 5,430 physicians and aesthetic practitioners. The only contraindication, according to the FDA, is having an implanted device like a pacemaker. The main caution is pregnancy. Adverse reactions are limited to temporary skin redness from the pads that occurs sporadically and usually dissipates within an hour. Earlier versions of this technology with the same hardware design have been cleared by the FDA in 2012 (K132158) and 2013 (K123157). FDA clearance is specific to the indication of muscle conditioning.

Additional measuring instruments included a conductance scale that calculated visceral adipose tissue and skeletal muscle mass.

Procedure

10 subjects of Chinese descent, ages 35–45 years with an average BMI of 26 participated and completed the clinical trial. Subjects were randomly selected out of a list of 18 eligible candidates. The only exclusion criteria were pregnancy and an implanted device like a cardiac pacemaker which were assessed on the basis of a comprehensive health questionnaire completed by all subjects. Every precaution was taken to protect the subjects' privacy and the confidentiality of their personal information. Subjects were informed that they had the right to refuse participation at any time. All subjects were presented with the consent form which they had to read thoroughly and sign after confirming that they had clearly understood its contents. None of the subjects were in a dependent relationship with the technology operators, the lab and measurement technicians or the author. The subjects did not receive a specific diet or instructions regarding changes in their lifestyles.

The five individuals that were randomly selected as technology operators were given basic training on how to operate the technology without disclosing the experimental hypotheses. None of the operators had a dependent relationship with the author. None of them had any known bias or any personal interest in the direction of the results.

Two independent labs were assigned to take blood samples from all subjects before and after 12 one-hour treatments that took place three times a week, for four weeks.

The trial was conducted in a private clinic. Each subject received the treatment in a private room by a randomly chosen technology operator. Subjects' appointments were arranged at least 30 minutes apart so neither the subjects nor the operators of the previous treatment group could meet. Two physicians with no prior experience with the technology, bias, or personal interest in the direction of the results, were available during the entire course of this trial to make sure that none of the subjects had any adverse reactions.

Subjects were asked to fast for twelve hours before getting their blood tests that were obtained prior to the first treatment and ten days after the last treatment. The scale measurements were performed before the first treatment in a separate room by the independent technician with no prior experience in the technology or conflicts of interest, and ten days after the last treatment.

Following blood tests and measurements each subject went to their private treatment room andlayon the massage bed while the gel pads and cables from the 16 channels of the device were being attached onto his/her body by the technology operator. The cables from ten of the channels were attached onto the gel pads of the waist and abdomen, and the cables from the six remaining channels were attached onto the gel pads placed along the lymphatic system pathways of the legs and arms, to enhance lymphatic drainageduringtreatment.

All subjects gave a detailed report of their subjective experience

during, ten days after and a month after the last treatment. Theprocedure was performed in accordance with the ethical standards and principles for medical research involving human subjects.

Results

The data was analysed with the Analysis of Variance for repeated measures and T-tests for two dependent means. Results indicated an inverse testosterone/cortisol relationship where testosterone increased while cortisol decreased. This was the opposite of the cortisol/testosterone correlation observed after strenuous physical exercise, where cortisol increases while testosterone decreases, leading to inevitable weight gain.Testosterone increase reflected a p value of p=0.00157 and a significance level of p<0.01. For cortisol decrease the p value was p=0.00041. Cortisol significantly decreased at the p<0.01 level.

All variables' statistical significance values are displayed on table 6. IGF-1, skeletal muscle mass (SMM) and Free T3 significantly increased at a probability level of p<0.01. Visceral Adipose tissue, VLDL and triglycerides showed a statistically significant decrease at p<0.01. Importantly, Testosterone, Cortisol, IGF-1 and Free T3 increases were within the normal range (**Table 1**).

Both testosterone increase and cortisol decrease remained within the normal range. Testosterone showed a mean average of 35.36% increase for males and a mean average of 90.04% for females. Cortisol showed a mean average decrease of 7.33% (**Table 2**).

Mean average percentage increase of IGF-1 was 25.85%. IGF-1, remained within the normal range. Mean average percentage increase for Skeletal muscle mass was 36.45% (**Table 3**).

The Analysis of Variance showed statistically significant results for both Triglycerides and VLDL at p<0.01. Mean average percentage decrease of Triglycerides was 40.7%. Mean average percentage decrease of VLDL was 71.88% (**Table 4**).

The Analysis of Variance showed statistically significant results for both Visceral Adipose Tissue and Free T3 at p<0.01. Average percentage decrease of visceral adipose tissue was 30.5% Average percentage decrease of Free T3 was 30% After their last treatment, the subjects reported that they experienced a large variety of 8-secs long vigorous contractions some of them resembling resistance exercises, others like body twists or aerobics. Contractions were involuntary and inless involving the entire body's musculature contracting in a coordinated fashion (**Table 5**).

Table 1. Blood Plasma Subjects' Results on Testosterone and Cortisol for each subject.

GENDER	TESTO STERONE PRE	TESTO STERONE POST	Normal Range (nmol/L)	% Increase	CORTISOL PRE	CORTISOL POST	Normal Range (nmol/L)	% decrease
MALE	10.92	14.6	8.64-29	33.6%	198	181	80-477.3	8.5%
MALE	12.16	15.43	8.64-29	26.9%	177	163	80-477.3	7.9%
FEMALE	0.3	0.71	0.29-1.6	136.6%	135	128	80-477.3	5.2%
FEMALE	0.4	0.9	0.29-1.6	125%	168	153	80-477.3	8.9%
MALE	15.38	21.6	8.64-29	40.4%	229	198	80-477.3	13.5%
MALE	13.41	19.92	8.64-29	48.5%	160	149	80-477.3	6.8%
FEMALE	0.64	0.92	0.29-1.6	43.7%	116	109	80-477.3	6.4%
FEMALE	0.4	0.71	0.29-1.6	77.5%	87	82	80-477.3	5.7%
MALE	11.3	14.4	8.64-29	27.4%	221	214	80-477.3	3.1%
FEMALE	0.43	0.72	0.29-1.6	67.4%	197	189	80-477.3	4.%
Mean Average Testosterone % Increase				62.18%	Mean Average Cortisol % Decrease			7.33%

Table 2. Blood Plasma Subjects' Results on IGF-1 and Scale Results on SMM.

GENDER	IGF-1 PRE	IGF-1 POST	Normal Range (nmol/L)	% Increase	SKELETAL MUSCLE MASS PRE	SKELETAL MUSCLE MASS POST	% Increase
MALE	25.97	30.35	15.08-32.5	16.86%	36.40	43.80	20.3%
MALE	23.98	31.12	15.08-32.5	29.77%	30.30	38.60	27.39%
FEMALE	16.33	20.75	11.25-28.8	27.06%	18.40	27.00	46.79%
FEMALE	15.14	19.21	11.25-28.8	26.88%	17.00	26.80	57.64%
MALE	22.27	28.11	15.08-32.5	26.22%	37.80	44.80	18.5%
MALE	26.98	30.52	15.08-32.5	11.80%	29.40	38.30	30.27%
FEMALE	15.86	21.08	11.25-28.8	32.91%	17.20	26.80	55.81%
FEMALE	18.55	23.50	11.25-28.8	26.68%	19.80	28.80	45.45%
MALE	24.56	31.34	15.08-32.5	27.60%	29.80	37.22	25.89%
FEMALE	19.34	25.66	11.25-28.8	32.67%	17.95	26.63	48.35%
Mean Average IGF-1 % Increase				**25.85%**	**Mean Average % Increase for SMM**		**36.45%**

Table 3. Blood Plasma Results on VLDL and Triglycerides for each subject.

GENDER	TRIGLY CERIDES PRE	TRIGLY CERIDES POST	Normal Range (nmol/L)	% Decrease	VLDL PRE	VLDL POST	Normal Range (nmol/L)	% Decrease
MALE	2.90	1.23	<1.7	55%	1.48	0.24	<1.6	83.78%
MALE	2.34	0.94	<1.7	59.8%	1.55	0.64	<1.6	58.7%
FEMALE	2.50	1.50	<1.7	40%	0.80	0.20	<1.6	75%
FEMALE	2.00	1.44	<1.7	28%	0.86	0.27	<1.6	68.6%
MALE	0.80	0.53	<1.7	33%	0.52	0.04	<1.6	92.3%
MALE	0.90	0.64	<1.7	41.1%	1.36	0.24	<1.6	82.35%
FEMALE	1.00	0.60	<1.7	40%	0.68	0.05	<1.6	92.64%
FEMALE	0.90	0.58	<1.7	35%	0.53	0.26	<1.6	50.9%
MALE	1.32	0.92	<1.7	30%	1.53	0.67	<1.6	56.20%
FEMALE	0.98	0.54	<1.7	44.9%	1.75	0.73	<1.6	58.28%
Mean Average Triglycerides Decrease				40.7%	Mean Average VLDL Decrease			71.88%

Table 4. Scale Results on Visceral Adipose Tissue and Blood Plasma Results on Free T3 for each subject.

GENDER	VISCERAL FAT PRE	VISCERAL FAT POST	% Decrease	FREE T3 PRE	FREE T3 POST	Normal Range (nmol/L)	% Increase
Decrease	139.30	93.80	32.66%	2.98	4.22	2.63-5.7	41%
PRE	102.20	69.30	32.19%	3.69	4.98	2.63-5.7	34.95%
POST	93.50	58.30	37.64%	4.77	5.37	2.63-5.7	12.5%
Range	85.50	61.40	28.30%	4.56	5.31	2.63-5.7	16.44%
(nmol/L)	76.40	48.80	36.12%	4.15	5.47	2.63-5.7	31.80%
Increase	118.60	89.30	24.70%	3.29	4.86	2.63-5.7	47.7%
FEMALE	98.80	70.60	28.54%	4.36	5.64	2.63-5.7	29.35%
FEMALE	102.70	77.30	24.73%	3.66	4.79	2.63-5.7	30.87%
MALE	145.30	104.34	28.18%	3.19	4.12	2.63-5.7	29.15%
FEMALE	109.80	74.67	31.99%	4.09	5.12	2.63-5.7	25.18%
Mean Average Visceral Fat % Decrease				**30.34%**	**Mean Average Free T3 % increase**		

Table 5. Blood Plasma Results on Leptin and Ghrelin for each subject.

GENDER	LEPTIN PRE	LEPTIN POST	Normal Range (nmol/L)	% Increase	GHRELIN PRE	GHRELIN POST	Normal Range (nmol/L)	% Decrease
MALE	1.38	1.84	1.63-2.54	33.5%	5.83	4.14	4.12-4.89	28.9%
MALE	1.25	2.03	1.63-2.54	62.4%	4.88	4.14	4.12-4.89	15.16%
FEMALE	5.43	7.22	5.69-7.26	32.96%	6.12	5.34	5.06-5.98	12.74%
FEMALE	5.98	7.09	5.69-7.26	20.73%	5.99	5.43	5.06-5.98	9.34%
MALE	1.53	1.94	1.63-2.54	26.79%	5.02	4.53	4.12-4.89	9.76%
MALE	1.22	1.97	1.63-2.54	61.47%	6.03	4.76	4.12-4.89	21.55%
FEMALE	4.87	5.84	5.69-7.26	19.9%	5.87	5.12	5.06-5.98	12.77%
FEMALE	5.89	6.54	5.69-7.26	11.03%	6.23	5.65	5.06-5.98	9.30%
MALE	1.47	2.01	1.63-2.54	36.73%	4.89	4.32	4.12-4.89	11.65%
FEMALE	4.99	5.83	5.69-7.26	16.83%	6.34	5.13	5.06-5.98	19.08%
Mean Average Visceral Fat % Decrease				**30.34%**	**Mean Average Free T3 % increase**			**30%**

Table 6. T-Tests Statistical Significance Results on Blood Plasma and Measurement Variables.

	Mean	S^2 =SS/df	$S^2M = S^2/N$	SM= √S2M	T Value	p Value	Probability
VLDL	-0.77	0.09	0.01	0.1	-7.95	0.00001	**P<0.01**
Triglycerides	-0.67	0.26	0.03	0.26	-4.2	0.00115	**P<0.01**
Free T-3	1.11	0.08	0.01	0.09	12.1	0.00001	**P<0.01**
Leptin	0.83	0.16	0.02	0.13	6.52	0.00005	**P<0.01**
Ghrelin	-0.86	0.16	0.02	0.12	-6.92	0.00003	**P<0.01**
Cortisol	-12.2	59.96	6	2.45	-498	0.00038	**P<0.01**
Testosterone	2.46	6.14	0.61	0.78	3.14	0.006	**P<0.01**
Visceral Adipose Tissue	-32.43	47.62	4.76	2.18	-14.86	0.00001	**P<0.01**
Skeletal Muscle Mass	8.47	0.89	0.09	0.3	28.39	0.00001	**P<0.01**
IGF-1	5.27	1.47	0.15	0.38	13.72	0.00001	**P<0.01**

Table 7. Analysis of Variance Statistical Significance Results on Blood Plasma and Measurement Variables.

	F-Ratio Value	p-Value	Significance Level
Testosterone/Cortisol	F= 154.22073	0.00001	P<0.01
IGF-1/SMM	F= 37.86392	0.00001	P<0.01
VLDL/Triglycerides	F= 14.02706	0.000011	P<0.01
Visceral Fat/Free T3	F= 191.86419	0.00001	P<0.01
Leptin/Ghrelin	F= 7.9841	0.000573	p<0.01

There was an inverse relationship between leptin and ghrelin where leptin significantly increased and ghrelin significantly decreased. Mean average percentage leptin increase was 32.23% and ghrelin decrease was 14.57%. Importantly, leptin and ghrelin values increased and decreased respectively within the normal range (**Table 6**).

The Analysis of Variance yielded statistically significant results for all variables. All hormones' values were significant but without spiking outside the normal range (**Table 7**).

In all three of their interviews, after the last treatment, ten days after their last treatments and a month later, the subjects consistently reported a sustainable weight reduction, enhanced fitness and an inhibition of cravings for sweets and fatty foods.

Discussion

This randomised double-bind pilot study was based on a small sample of subjects and was performed on healthy overweight subjects before implementing it on COVID-19 patients.

Reducing obesity by decreasing visceral adipose tissue, VLDL and triglycerides, while regulating appetite by 'normal range' increases and decreases of leptin and ghrelin respectively, is significant in light of the adverse effects of obesity on respiratory function, contributing to the burden of respiratory diseases [17].

Increasing IGF-1 and skeletal muscle mass may counteract the muscle tissue damage identified in COVID-19 patients as a result of high LDH-4 and LDH-5 [6]. The metabolic increase of Free T3 may be beneficial in all COVID-19 high susceptibility conditions such as CVD, diabetes and obesity.

This clinical trial suggests an alternative to exercise at a time when gyms and other physical activity facilities are closed due to COVID-19. In our sample testosterone increased while cortisol decreased but without spiking outside the normal range, in contrast to the adverse cortisol/testosterone inverse relationship observed after strenuous exercise that undermines fitness by increasing food consumption [11]. Our subjects reported reduced cravings for sugar and fatty foods, yet, normal appetite, possibly signifying a combination of optimal cortisol levels combined with a decrease in systemic toxins, hence enhancing optimum function of the hypothalamic satiety modulation mechanisms of central inhibitors and stimulators of appetite such as ghrelin and leptin. More research to validate the results of this study may be necessary before implementing this method of effortless exercise with COVID-19 patients.

Conflict of Interests

The author has no conflicts of interests to disclose

Acknowledgement

The author received no funding for this research project. The author would like to thank Dr Gerald Pollock and Dr Donald Gibson, both deceased, for their London University invention used in this clinical trial.

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