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Sukces czy porażka? Czyli jak wygląda sytuacja w zakresie szczepień ochronnych w Polsce?

Cztery uczelnie – Centrum Medyczne Kształcenia Podyplomowego, Warszawski Uniwersytet Medyczny, Akademia Leona Koźmińskiego i Uniwersytet SWPS zorganizowały konferencję naukową w ramach Projektu „Budowanie zaufania do szczepień ochronnych z wykorzystaniem najnowszych narzędzi komunikacji i wpływu społecznego".

Podczas czterech paneli dyskusyjnych eksperci, naukowcy, lekarze, psycholodzy, przedstawiciele instytucji publicznych dyskutowali na temat szans i wyzwań stojących przed system szczepień w Polsce.

Nie da się zaprzeczyć faktom – szczepienia ochronne są najefektywniejszą metodą zwalczania chorób zakaźnych. Podnoszenie zaufania do szczepień, które przekłada się na poziom wyszczepienia populacji, jest więc kluczowym wyzwaniem stojącym przed wszystkim odpowiedzialnymi za zdrowie publiczne w Polsce.

Dużym sukcesem i krokiem w dobrym kierunku było wprowadzenie szczepień w aptekach – podkreślił prof. Jarosław Pinkas, Konsultant Krajowy w dziedzinie zdrowia publicznego.

Niemniej, mimo szeroko prowadzonej kampanii medialnej, Polska należy do krajów o najniższym poziomie wszczepienia przeciw COVID-19 w Europie (niespełna 60% populacji zostało w pełni zaszczepionych). Co roku w naszym kraju przeciw wirusowi grypy szczepi się jedynie 4-6% osób. Według danych PZH-NIPZ liczba uchyleń od szczepień obowiązkowych wśród dzieci w okresie od 2016 do 2020 roku wzrosła 2-krotnie z 23 tys. do 50.5 tys.

„Szczepienia przeciwko grypie u pracodawców bardzo zmniejszają absencję w pracy, ta sama prawidłowość dotyczy szczepień rotawirusowych" – mówił prof. Marcin Czech

Z danych uzyskanych przez Warszawski Uniwersytet Medyczny wynika, że postawy mieszkańców Polski wobec szczepień nie są spójne. Może to w przyszłości spowodować dalszy spadek poziomu wyszczepienia populacji, a w dalszej perspektywie wzrost zagrożenia epidemiologicznego.

W ramach panelu prowadzonego przez Uniwersytet SWPS zastanawiano się nad przyczynami postaw wobec szczepień. Pierwszym skojarzeniem, jakie większość Polaków wypowiada po haśle „szczepienia" jest „koronawirus". I choć rzeczywiście od końca 2020 roku szczepienia przeciwko COVID-19 stały się jednym z bardzo ważnych elementów debaty publicznej, to przecież rosnąca liczba osób uchylających się od szczepień na takie choroby jak odra czy krztusiec była ważną kwestią społeczną już przed marcem 2020 roku.

Jednym z kluczowych wyzwań stojących przed system szczepień w Polsce jest walka z fake newsami, podkreślali eksperci Akademii Leona Koźmińskiego.
Czy dezinformację naukową można interpretować w kategoriach cyberwojny?
Czy jest to zagrożenie porównywalne z katastrofą klimatyczną, bądź rozwojem technik AI? Jaką rolę odgrywają w tym procesie media społecznościowe? To pytania z którymi musimy się jak najszybciej zmierzyć.

Mimo wszystko wysoka wyszczepialność w Polsce to sukces wszystkich profesjonalistów medycznych i osób działających na rzecz zdrowia publicznego. Wciąż zdecydowana większość Polaków dokonuje właściwych wyborów zdrowotnych. To optymistyczny wniosek płynący z konferencji CMKP, WUM, SWPS i ALK. Jednak nic nie jest dane raz na zawsze – pojawiające się wyzwania powinny mobilizować lekarzy, naukowców, edukatorów, przedstawicieli administracji publicznej do szukania nowych sposobów dotarcia z komunikatem zachęcającym do szczepień i podejmowania zdecydowanych działań na rzecz walki z dezinformacją.

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Effect of moderate continuous aerobic training versus cryolipolysis on stress hormone and aerobic capacity in central obesity

Wpływ umiarkowanego treningu aerobowego w porównaniu z kriolipolizą na hormon stresu i wydolność tlenową w otyłości trzewnej

Samy Kamal Mohamed Elgendy[1(A,B,C,D,E,F,G)], Zahra Mohamed Hassan Serry[2(B,C,D,E)], Mervat Gaber Elnany[3(A,B,E,F)], Rana Hesham Mohamed Elbanna[2(A,C,D,E,F)]

[1]Department of Physical Therapy, El Zawia El Hamra One Day Surgery Hospital, Ministry of Health, Cairo, Egypt
[2]Department of Physical Therapy for Cardiovascular/Respiratory Disorder and Geriatrics, Faculty of Physical Therapy, Cairo University, Giza, Egypt
[3]Clinical Pathology Department, Faculty of Medicine, Cairo University, Giza, Egypt

Abstract

Purpose. This is the first comparative study aimed to find out the effect of moderate continuous aerobic exercise versus the widely popular body reshaping intervention, cryolipolysis, on cortisol (stress hormone), aerobic capacity (VO_2max), 6-minute walking test (6MWT) in central-obesity (CO) patients.

Methods. Sixty CO patients (30 men and 30 women) were recruited from El Zawia El Hamra One Day Surgery Egyptian Hospital with a body mass index (BMI) ranged from 35–39.9 kg/m^2 to be randomly assigned to the aerobic continuous moderate-intensity exercise group (thirty patients who received 30 minutes of treadmill walking, 3 sessions per week) and cryolipolysis group (thirty patients received on-abdomen one session for 60 minutes weekly). Both groups were ordered to reduce their daily diets to 1500–1800 Kcal/day (the diet was revised by a diet specialist every 14 days to consider the inclusion of fat (20–25%), carbohydrate (high complex, 50–60%), and protein components (25–30%). Anthropometry (weight, BMI, and waist circumference), plasma cortisol, VO2max, and 6MWD were assessed before and after 12-week cryolipolysis and exercise.

Results. A significantly improved difference was extracted using paired tests either within-exercise or with-cryolipolysis groups regarding the patients' weight, BMI, cortisol, VO_2max, and 6MWT. In favor of the exercise group, the post-treatment comparison between exercise and cryolipolysis groups showed a more marked significant statistical difference ($p < 0.05$) regarding the patients' weight, BMI, VO_2max, and 6MWD. In favor of the cryolipolysis group, post-treatment waist circumference showed a more marked significant decrease when compared to its post-treatment level of the exercise group. Regarding post cortisol levels between exercise and cryolipolysis groups, a non-significant difference was reported.

Conclusion: After the addition of aerobic exercise or cryolipolysis to a 12-week supervised DR plan, both therapeutic interventions can improve central fat deposition, weight, cortisol, VO_2max, and 6MWT in CO patients.

Keywords

aerobic exercise, cryolipolysis, cortisol, aerobic capacity, six minute walk test, central obesity

Streszczenie

Cel. Jest to pierwsze badanie porównawcze mające na celu ustalenie wpływu umiarkowanych ćwiczeń aerobowych w porównaniu z popularną interwencją modelującą sylwetkę, kriolipolizą, na poziom kortyzolu (hormon stresu), wydolność tlenową (VO_2max), test 6-minutowego marszu (6MWT) u pacjentów z otyłością trzewną.

Metody. 60 pacjentów z otyłością trzewną (30 mężczyzn i 30 kobiet) zostało zrekrutowanych ze szpitala w Egipcie (El Zawia El Hamra One Day Surgery Egyptian Hospital) ze wskaźnikiem masy ciała (BMI) w zakresie 35–39,9 kg/m^2 i losowo przydzielonych do grupy ćwiczeń aerobowych o umiarkowanej intensywności ciągłej (trzydziestu pacjentów, którzy wykonywali 30 minut marszu na bieżni, 3 sesje tygodniowo) i grupy kriolipolizy (trzydziestu pacjentów; jedna sesja na brzuch przez 60 minut tygodniowo). Obydwu grupom polecono zmniejszenie dziennej diety do 1500–1800 Kcal/dzień (dieta była korygowana przez dietetyka co 14 dni pod kątem włączenia tłuszczu (20–25%), węglowodanów (złożonych, 50–60%) oraz składników białkowych (25-30%). Antropometria (masa ciała, BMI i obwód talii), kortyzol w osoczu, VO_2max i 6MWD oceniano przed badaniem i po 12 tygodniach.

Wyniki. Znaczącą różnicę zaobserwowano dzięki testom sparowanym w grupie ćwiczeń i w grupie kriolipolizy w odniesieniu do masy ciała pacjentów, BMI, kortyzolu, VO_2max i 6MWT. Na korzyść grupy ćwiczącej wypadło porównanie między grupą ćwiczącą i grupą kriolipolizy po leczeniu, które wykazało bardziej wyraźną istotną statystycznie różnicę ($p < 0,05$) w odniesieniu do masy ciała pacjentów, BMI, VO2max i 6MWD. Na korzyść grupy kriolipolizy wypadło porównanie pod kątem obwodu talii po leczeniu, które wykazało bardziej wyraźny znaczący spadek w porównaniu z poziomem po leczeniu w grupie wykonującej ćwiczenia. Różnica była nieistotna w odniesieniu do poziomu kortyzolu w grupie wykonującej ćwiczenia i grupie poddawanej kriolipolizie.

Wniosek: Po dodaniu ćwiczeń aerobowych lub kriolipolizy do 12-tygodniowego nadzorowanego planu dietetycznego okazało się, że obie interwencje terapeutyczne mogą pomóc w uzyskaniu poprawy w zakresie odkładania tłuszczu trzewnego, wagi, kortyzolu, VO2max i 6MWT u pacjentów z otyłością trzewną.

Słowa kluczowe

ćwiczenia aerobowe, kriolipoliza, kortyzol, wydolność tlenowa, test 6-minutowego marszu, otyłość trzewna

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Introduction

Obesity is usually associated with increased adipocytokine secretion, elevated pro-inflammatory activity, increased rates of insulin resistance and diabetes, hyperlipidemia, hypertension, ischemic heart diseases, and increased mortality rates [1].

Obesity, a serious state globally characterized by the gigantic accumulation of general and/or localized bodily fat buildup, resulting in a bodyweight that is at least 20% higher than the person's ideal weight. Obesity rates have grown more than three-worldwide folds since 1980, owing to physical-activity low rates, consumption-increased rates of high-energy foods (carbohydrates, sugars, and saturated fats), and low-nutrition-value foods [2].

Abdominal obesity defined as the subcutaneously- and viscerally-accumulated fats in the abdomen, usually manifests with the so-called functional-hypercortisolism syndrome [3]. The easily repeated obesity-induced sensitivity of the hypothalamic–pituitary–adrenal-axis complex (HPA axis) from stressor stimuli, as well as increased induction of peripheral cortisol production from enlarged-size adipose tissue lead to hypercortisolism syndrome. Cortisol levels that are too high have been associated with an early projection of metabolic syndrome and psychiatric problems including sadness and anxiety [4, 5].

Obesity also disrupts skeletal muscle mitochondrial activity and its enzymatic and oxidative capabilities. Obesity accelerates the shift from type-I oxidative skeletal-muscle fibers to type-II glycolytic fibers. This shift negatively affects muscular aerobic capacity and physical functions such as walking abilities, stair climbing capacities, and chair raising abilities [6].

Dietary restrictions (DR), exercising, pharmaceuticals, and body reshaping are all alternatives for effective fat and/weight loss [7]. An acute-intensity exercise, a type of metabolic stress precursor, can activate the HPA axis and lead to leave high levels of circulating cortisol. The long-term regularity of structured exercising, on the other hand, sometimes can depress the HPA axis [8]. Furthermore, studies have demonstrated that combining DR with exercise improves exercise-related physical and aerobic capacities in obese people [6].

A variety of noninvasive technologies have gotten a lot of attention in the past few years and are pervading the aesthetic market since they are profitable body-contouring treatments with low disposable costs [9]. In order to skip surgery and its complications, cryolipolysis is one of these new technologies that can reduce or remove fat deposits especially central abdominal adiposities [10].

However, considering the huge-spectrum cortisol changes that occur in obese people, especially central-obese ones, the impact of weight loss on cortisol secretion deserves more research [5]. No previous studies have evaluated or compared the cryolipolysis cooling effect versus exercise on stress hormone cortisol, 6-minute walking test (6MWT, a measure for physical function), and VO_2max (as a measure for aerobic capacity) in visceral adiposity patients.

Subjects and methods

Design

Pre- and post-comparative study was conducted over one year (August 2020 to August 2021). The details of this study protocol were introduced to the standing committee of Cairo-University human research ethics, located in the physical therapy faculty. The committee approved the protocol. The number of approval was P.T.REC/012/002681. Written informed permission was acquired and obtained from all patients before the trial began, and each patient was given a thorough description of the study protocols. All international Helsinki medical research policies on humans were followed in this study.

Participants

From El Zawia El Hamra One Day Surgery Hospital, sixty central-adiposity men and women who exhibited a waist circumference (WC) > 102 cm or > 88 cm respectively were enrolled in the study. Being a class-II obesity patient with a BMI (the standard abbreviation for body mass index) ranging from 35 to 39.9 kg/m^2 was the main criterion for enrolling patients in the study. Also, the designed age of patients' recruitment extended from 40–50 years old.

During the recruitment, any obese patient-reported malignancies, nephrotic syndrome, cardiac dysfunction, implantable cardiac devices (pacemakers), thoracic disorders, neurological or endocrine deficits, cerebrovascular or systemic illness, psychological and eating disorders, pregnancy or baby feeding (in females), personal habits (alcohols, smoking, and addiction), common arthritic issues of lower limbs, hepatic or vascular illness, and abdominal scarring or surgeries were excluded from the procedure.

Cold-sensitive participants who suffered Raynaud's syndrome, cryoglobulinemia-based diseases, cold urticarial complaints, dermatitis, severe varicose veins complicating dermatitis, vasculitis, defected skin continuity induced by prolonged exposure to the local abdominal cold inducer, and rheumatologic disorders were also excluded from the study.

Randomization

After completion of the above-designed patients' recruitment, a senior physiotherapist developed a random-block two-group waitlisting on a computer. In this waitlisting, the senior physiotherapist randomly assigned the recruited central-obese participants equally to one of the two study groups (Figure 1). The protocol details were anonymous from this therapist who was predesigned to be excluded from the application of study interventions).

Interventions

For group A (16 men and 14 women), intervention was performed for 12 weeks, the patients were supervised for 30 minutes during the 3-time weekly performance of continuous on-treadmill moderate-intensity aerobic exercising. The intensity was estimated at 60–75% of participants' maximal heart rate, 220-age). Group B, cryolipolysis group (14 women and 16 men), for 12 weeks, received one on-abdomen 60-minute cryolipolysis (LiopFreez, made in Korea) session weekly.

A diet-restriction protocol was applied on both groups to receive only 1500 to 1800 kcal per day for every participant. This was dependent on each participant's requirement. The diet was tailored based on the age and eating habits of every man and wo-

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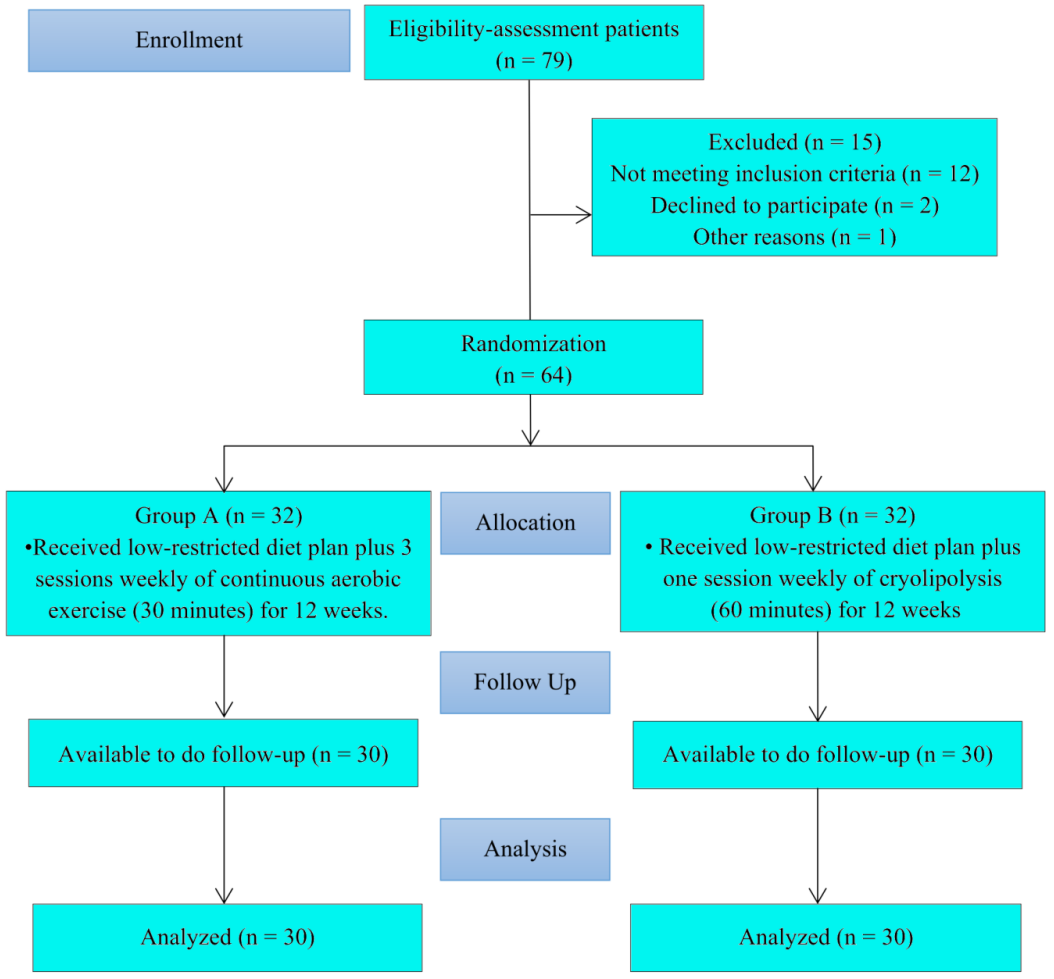

Figure 1. Flow chart of the study

man. The diet was revised by a diet specialist every 14 days to consider the inclusion of fat (20–25%), carbohydrate (high complex, 50–60%), and protein components (25-30%) [11].

Measurements

Pre and post 12-week completion of assigned exercise and cryolipolysis interventions, the measurements concerning: weight, BMI, WC, plasma cortisol, 6MWT, and VO_2max were evaluated. VO_2max was considered from the following equation: VO_2max (marked with mL/(kg × min)) = 70.161 + (0.023 × 6MWT [meter]) − (0.276 × weight [kilogram]) − (6.79 × sex, where male = 0, female = 1) − (0.193 × resting heart rate [beat per minute]) − (0.191 × age [year]) [12].

Statistical analysis

The normal arrangement of data was confirmed by the SPSS 25 program so paired and unpaired tests of this program calculated the significant differences within and between participant groups respectively.

Results

The assignment of basal demographic data (BMI and patients' weight) to pretreatment unpaired statistical test showed a non-significant difference between exercise and cryolipolysis groups (Table 1). Regarding cortisol, 6MWT, and VO_2max, the same test showed the same pretreatment non-significance between groups. A significant improved difference was extracted using paired tests

Table 1. Demographic data of exercise and cryolipolysis groups

Items	Exercise group Mean ± SD	Cryolipolysis group Mean ± SD	P-value
Age [year]	44.87 ± 3.014	43.9 ± 3.294	0.240
Body weight of participants [kg]	102.27 ± 11.61	103.67 ± 9.8	0.615
Body mass index [kg/m2]	37.39 ± 1.56	37.46 ± 1.39	0.860
Waist circumference [cm]	123.93 ± 13.15	124.07 ± 10.95	0.966

SD: standard deviation; The data is non-significant when its reference P-value is > 0.05

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either within-exercise or with-cryolipolysis groups regarding the patients' weight, BMI, cortisol, VO_2max, and 6MWT.
In favor of exercise group, the post-treatment comparison between exercise and cryolipolysis groups showed a more marked significant statistical difference ($p < 0.05$) regarding the patients' weight, BMI, VO_2max, and 6MWD. In favor of cryolipolysis group, post-treatment WC showed a more marked significant decrease when compared to its post-treatment level of the exercise group. Regarding post cortisol levels between exercise and cryolipolysis groups, a non-significant difference was reported (Table 2).

Table 2. Before and after 12-week data comparison between exercise and cryolipolysis groups

		Exercise group Mean ± SD	Cryolipolysis group Mean ± SD	P-value (between groups)
Weight [kg]	Pre	102.27 ± 11.61	103.67 ± 9.8	0.615
	Post	83.7 ± 13.42	91 ± 10.46	0.0222*
	P-value	0.0001*	0.0001*	
Body mass index [kg/m^2]	Pre	37.39 ± 1.56	37.46 ± 1.39	0.860
	Post	30.53 ± 2.955	32.88 ± 2.443	0.0014*
	P-value	0.0001*	0.0001*	
Waist circumference [cm]	Pre	123.93 ± 13.15	124.07 ± 10.95	0.966
	Post	113.4 ± 10.97	107.13 ± 7.83	0.0136*
	P-value	0.0001*	0.0001*	
Corisol [µg/dl]	Pre	11.837 ± 4.49	12.58 ± 4.65	0.531
	Post	10.34 ± 3.57	9.933 ± 4.097	0.683
	P-value	0.0001*	0.0001*	
Six-minute walk test [m]	Pre	313.3 ± 50.6	299.27 ± 41.79	0.246
	Post	365.2 ± 46.66	331.03 ± 41.59	0.004*
	P-value	0.0001*	0.0001*	
VO_2max [mL/(kg × min)]	Pre	22.39 ± 4.69	21.27 ± 4.65	0.354
	Post	28.67 ± 4.43	25.61 ± 4.37	0.0093*
	P-value	0.0001*	0.0001*	

** = the data is significant because its reference P-value is < 0.05; SD = standard deviation.*

Discussion

This the first study aimed to compare cryolipolysis versus exercise effects on cortisol, physical function, and aerobic capacity in central obesity. This study reports that the combination of a 12-week exercise or cryolipolysis with a diet-restriction program can document a significant improved differences in central-obese patients' weight, BMI, WC, VO_2max, cortisol, and 6MWT.
Cortisol levels can be reduced by eating diets that are low in fatty nutrients and high in fruits and vegetables [13]. These recommendations are significant in light of researches indicating that diets high in fat calories, animal proteins, and salt can cause large amounts of acid in the body (metabolic acidosis), resulting in increased cortisol production. As a result, metabolic acidosis and the resulting changed cortisol levels have been linked to an increased risk of insulin resistance, type 2 diabetes, inflammatory, osteoporotic, sleep, and cognitive issues in addition to poor quality of life [14].
As a result of diet-restriction-induced cortisol reduction, participants in diet restriction programs may experience less anxiety as a result of improvements in psychological factors such as self-efficacy and perceived control over their health, as well as changes in their food choices [13].
Cortisol regulates other chemicals released during stress, including corticotrophin-releasing hormone (CRH), leptin, and neuropeptide Y (NPY), which impact hunger indirectly. Appetite is stimulated by high levels of NPY and CRH, and leptin. Suppression of high cortisol levels during long-term exercise may disrupt this vicious cycle, reducing hunger, improving eating habits, and increasing refusal of high-calorie meals, resulting in weight loss [15].
Stress habituation occurs when repeated exposure to the same stressor (such as prolonged repetitive exercise) occurs. Reduction of HPA axis activity occurs in response to a prolonged repeated exercise stressor. So, stress habituation is believed to be an essential strategy for maintaining good physiological and psychological functioning in the face of recurrent stress [16]. Cortisol inactivation to cortisone appears to be another HPA-axis adaptation mechanism to long-term exercise. This mechanism may be a supporting explanation for low cortisol levels after long-term exercising [17].
Increased VO_2max following a lifestyle intervention (diet and

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exercise) is linked to many physiological changes in skeletal muscle, including better mitochondrial activity and increased muscle oxidative capacity which can increase aerobic capacity and physical functions [6].

In the context of cryolipolysis, the significant decrease of weight, WC, and BMI after combined cryolioplysis and diet regimen may be the cause of improved aerobic capacity (VO_2max) and, consequently 6MWD in central-obese patients. This is the first cryolioplysis 12-week study that reports a significant cortisol decrease in central-obesity patients. The greater decrease of cortisol by 21.04% in cryolipolysis group when compared with the exercise group (12.64%) can be easily related to the greater WC loss in cryolipolysis group.

In patients with central obesity, body fat centralization in the abdominal area is closely linked to an abnormal HPA axis control and perceived stress-dependent cortisol levels [18]. The mechanism of cryolioplysis-induced loss of local fat depots including central adiposity is not fully explained. There is evidence that cytoplasmic "lipid ice" exists at around 10.0°C (as opposed to water ice at 0°C). The presence of lipid ice might have a role in the death or late apoptosis of fat cells. Other known ways that increase cell death include osmoregulation (cellular edema), decreasing Na-KATPase functioning and adenosine triphosphate levels, and cytoplasmic lactic acidosis by cold ischemia injury [19].

Another theory proposes that ischemia-reperfusion damage enhances the initial cold ischemic insult and the crystallization injury produced by cryolipolysis, resulting in the production of reactive oxygen species, stimulation of signaling pathway, and a boost in cytosolic calcium levels. Consequently, cold ischemia and crystallization damage to the targeted adipocytes causes apoptosis and significant inflammatory response, resulting in the cells being removed from the treatment location after many weeks [20].

Supporting our exercise group's results, the central obese men and women who were involved in six weeks of unsupervised exercise program acquired a significant decrease of blood cortisol, WC, and BMI with other additional gained benefits as decreased fat storage and increased endorphin concentrations that improved the mood state of the participants [21].

The significant cortisol and anthropometric decreases after exercise were also reported by Soori et al. [22] who involved sedentary obese men (48–60 years) in concurrent resistance (weight lifting) and endurance exercise (treadmill running) for 12 weeks. Also, as a result of 12 weeks of combined exercises (resistance and aerobic types), salivary cortisol levels were found to be significantly reduced in elderly Korean women [23].

In sedentary males, an acute effect of 40 minutes of continuous (60 percent heart rate reserve) or intermittent (at one-minute 50 percent heart rate reserve alternating with one-minute 80 percent heart rate reserve) aerobic activity on the treadmill revealed a substantial drop in serum cortisol [24].

In obese patients with mean BMI and age 40.3 kg/m^2, 42.2 years respectively, The 75-week long-term intensive lifestyle modification program (exercise, diet restriction, behavioral and cognitive rehabilitation) for weight loss produced a significant decrease in weight, BMI, WC, and hair cortisol [25].

The conducted 4-week 20-to-75-min aerobic training session (performed thrice weekly at 45–75% maximum heart rate) in girls with central precocious puberty ((aged 6 to 8 years) showed a significant cortisol decline [26].

The significant declining effect of acute exercise on cortisol was approved after the participation of eight obese females in one session of 30-minute aerobic exercise conducted at an estimated intensity with 60-70% from every woman's maximal heart rate [27].

In terms of diet adjustment, our results are consistent with correlational studies approving that young adults and postmenopausal females with a lower dietary fat consumption and a higher fruit and vegetable consumption had a higher decline in their cortisol levels throughout the day [28].

After a mean 7.3-month weight reduction program (diet restriction in addition to pieces of advice to increase activity) in 129 obese adults, BMI, WC, weight, and 6MWT significantly improved [29]. In overweight/obese adolescents (13–17 years), the results of participation in 3-month multi-disciplinary lifestyle modification (nutrition, diet, and exercise) supported its effect in significant improvements of weight, BMI, WC, VO_2max, and 6MWD [30].

Besides improved results of weight, WC, BMI, and VO_2max, a previous study has shown that aerobic 12-week training increased the 6MWD of obese women without intentional weight loss (not going on diet restriction) [31].

Lining with our cryolipolysis results, in teenage abdominal obesity, a substantial reduction in weight, BMI, and WC was found after combination therapy of 2-month diet and cryolipolysis (60-min session/week) [32]. Clinical studies by El-Desoky et al. [33] and Akram et al. [34] reveal that cryolipolysis devices are safe and effective for body contouring and reducing abdominal obesity. Cryolipolysis can decrease extra subcutaneous adipose tissue in the abdomen, as measured by the WC and skinfold measures of the subjects. In central obese women (35–45 years old), adding cryoliolysis to their diet dramatically lowered WC, weight, BMI [2], and intra-abdominal fat as assessed by ultrasonography [35].

Opposite to our results, despite significant improved VO_2max in obese and overweight young women, despite the tendency to be decreased, serum cortisol did not show a significant decrease either after high-threshold interval exercise (n = 10 individuals) or moderate-threshold (n = 8 individuals) 20-session aerobic exercise for five weeks may be due to small sample (n = 10 individuals) [36].

Due to an irresponsive adaptive mechanism of the HPA axis caused by long-term alcohol use, eight weeks of supervised aerobic exercise did not induce substantial cortisol and VO_2max alterations in eleven overweight individuals [37]. In overweight/obese adolescents (5-12 years), the results of participation in 6-month multi-disciplinary lifestyle modification (nutrition, diet, and exercise) supported its effect in significant improvements of weight, BMI, and WC but VO_2max, and 6MWD did not improve [30].

Also, a non-significant decrease of cortisol in the blood, despite significant decreases of weight, BMI, and fat percentage, was reported after eight weeks of interval training in 9–11 year

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obese girl (the small number of girls may be the cause of cortisol non-decrease, n = 12) [17].
Opposing our cryolipolysis results, the selection of women with a BMI of less than 26 kg/m^2, as participants used 10 sessions of ultrasonic body contouring for local fat accumulation did not result in substantial improvements in waist-hip ratio, visual analogue scale of stress, or functional performance [38].

Study limitations

The main shortcoming of this research is that there are no different categories in obesity and age to compare the parameters' response to exercise versus cryolioplysis interventions.

Conclusion

After the addition of aerobic exercise or cryolipolysis to a 12-week supervised diet restriction plan, both therapeutic interventions can improve central fat deposition, weight, stress hormones, aerobic capacity, and physical function in central-obese patients.

Adres do korespondencji / Corresponding author

Samy Kamal Mohamed Elgendy

E-mail: samyelgendy.010390752@gmail.com

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Piśmiennictwo/ References

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