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Effect Of Cryoliopolysis Versus Low Level Laser Therapy On Postnatal Abdominal Adiposity.

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ABSTRACT
The purpose of this investigation was to compare cryolipolysis and low-level laser effectiveness on postnatal abdominal adiposity. The study enrolled sixty postnatal women from Al Mataria Teaching Hospital's Physical Therapy Department Outpatient Clinic, aged 35-40 years, with BMI ≥30kg/m² and waist-hip ratio (WHR) ≥0.85, who were randomly allocated into two cohorts (A, B). Participants in cohort A received cryolipolysis therapy plus calorie-restricted diet, whereas cohort B participants received low-level laser therapy plus calorie-restricted diet. Assessment procedures included pre-post study measurements of WHR via tape measurement, abdominal skinfold via body fat calipers, BMI via standard weight-height scales, and body fat percentage via bioelectrical impedance analysis. Results indicated significant decreases in BMI, WHR, skinfold thickness, and body fat percentage across both cohorts A and B, with cohort A demonstrating superior results. In conclusion, cryolipolysis is a superior technique for reducing abdominal adiposity postnatal.
Keywords: *Cryolipolysis, low level laser, abdominal adiposity, low caloric diet*

1. INTRODUCTION

It has been conclusively demonstrated that elevated intra-abdominal fat deposits represent one of the most common characteristics of a constellation of metabolic disturbances known as metabolic syndrome, which serves as a predictor for heightened cardiovascular disease susceptibility (1).
Excess body weight creates additional mechanical stress on the vertebral column, potentially resulting in discomfort. Long-standing evidence indicates that body weight elevation produces exponential increases in spinal pressure, with spinal injury risks becoming substantially greater. This phenomenon stems from degenerative alterations within the vertebral structure. Such pressure elevation may heighten susceptibility to disc herniation, degenerative disc pathology, and dorsal strain (2).
Visceral adipose accumulation may therefore represent a downstream effect of neuroendocrine dysregulation, potentially exacerbating metabolic manifestations through hepatic exposure to abundant free fatty acids liberated from lipolytically active enlarged visceral fat repositories. Abdominal obesity demonstrates statistically significant associations with elevated cardiovascular disease risk, hypertensive conditions, insulin resistance, and type 2 diabetes mellitus (3).
This study was conducted to add new information that may help the field of physical therapy and the women that suffer from abdominal adiposity.
There are many treatment methods in obesity, but no method is proved to be the best. So the need of such study to detect a good method for treatment, also this study may provide information for physical therapy who deals with postnatal women to reduce their abdominal fat and so improve their quality of life and self-wellness.

2. METHODS

Design of the study:
The design of this study was prospective, randomized controlled study.
Sample size calculation
Sample size was calculated based on a pilot study. The calculation considered the significant difference in mean body fat value differences. The cryolipolysis group showed 14.26 ± 3.28. The low-level laser therapy group showed 7.31 ± 2.50. A two-tailed unpaired t-test was used. The parameters included α=0.05, 80% power, and 0.74 effect size. Therefore, 30 women per group would be required. This was

increased to 35 women to allow for a 15% dropout rate (GPower 3.01 http://www.psycho.uni-duesseldorf.de). (Figure 1).

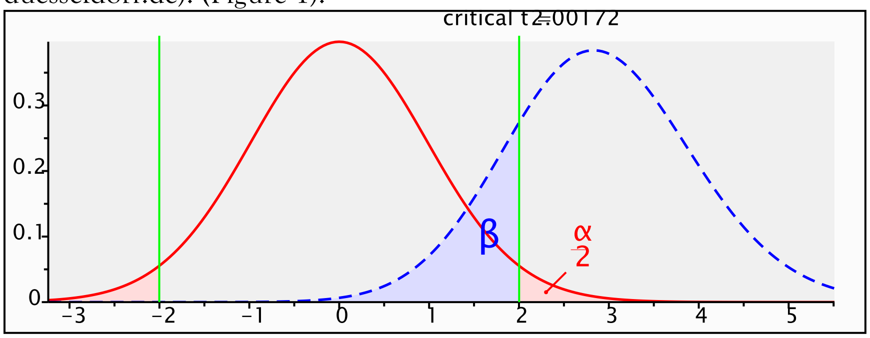

Figure 1. Sample size calculation

Subjects: -

Sixty obese postnatal women shared in this study. They were selected randomly from Out Patient Clinic of Physical Therapy Department at Al Matria Teaching Hospital in Cairo on the following criteria:

Inclusion criteria:

Their ages were ranged from 35 to 40 years.
Their BMI was > 30 kg/m2.
Their waist circumference (WC) was > 90 cm.
Their waist hip ratio (WHR) was > 0.85.
All women were multiparous women.

Exclusion criteria:

Malignancies or receiving radiotherapy.
Kidney or liver disease.
Circulatory dysfunction.
Fatty liver.
Post-surgical abdominal scar.
Metabolic disorders.
Implanted medical device as pace maker.
All women were divided into two equal groups:

Group A:(Cryolipolysis group):

It consisted of 30 obese postnatal women. They were treated by cryolipolysis, one session every 3 weeks and low caloric diet 1200 kcal/ day for 3 months.

Group B:(Low level laser therapy group):

It consisted of 30 obese postnatal women. They were treated by low level laser therapy, two sessions per week and low caloric diet 1200 kcal/ day for 3 months.

Ethical committee:

This study was conducted under the acceptance of the ethical committee of Faculty of Physical Therapy Cairo University No: P.T.REC/012/004767

Materials: -

Informed consent form:

Name, age, address, occupation, parity……etc.

Recording data sheet:

Standard weight-height scale:

This instrument served to assess weight and height for BMI calculation for each participant before and after treatment.

Tape measurement:
This tool assessed waist and hip circumferences to establish WHR for each participant before and after treatment.
Body fat caliper:
This tool assessed abdominal skin fold thickness for each participant before and after treatment.
Bioelectrical impedance analysis (InBody 230):
Body composition estimation commonly employs bioelectrical impedance assessment (BIA). This technology demonstrates relative simplicity, rapidity, and non-invasive characteristics.
Although public perception suggests BIA quantifies "body fat," the technology actually measures electrical impedance of bodily tissues, providing total body water (TBW) estimates. BIA-derived TBW values enable subsequent estimation of fat-free mass (FFM) and adipose content.
The InBody 230 model MW 160, manufactured in Korea, represents a highly precise instrument with 330 microampere electrode specifications and finds extensive application in obesity evaluation.
Cryolipolysis 3max cool shaping device:
Group A participants received treatment using this equipment. Cryolipolysis operates on the principle that adipocytes demonstrate greater susceptibility to energy depletion—specifically cooling—compared to adjacent tissues.
Consequently, cryolipolysis destroys fat cells while preserving surrounding tissue integrity. Following cooling, adipocytes experience apoptosis, representing programmed cellular death. Apoptosis causes adipocyte membrane deterioration, resulting in intracellular lipid release.
The lymphatic drainage network transports these lipids for processing and systemic elimination, mirroring dietary fat elimination pathways. This gradual process prevents lymphatic system overload. The 3Max cool shaping equipment (model ESM-8100MO), manufactured in Korea, achieves fat crystallization without dermal damage.
Low level laser therapy:
It was used for treatment of all women in group B. B VEN 6000 Therapeutic HE-NE digital laser type.
Procedures: -
Evaluation procedures:
Body mass index (BMI):
To calculate BMI, the weights and heights of women from both groups (A and B) were recorded while they wore light clothing. The BMI was determined using the formula: BMI = weight divided by height squared (Kg/m^2). Measurements were taken before and after the treatment.
Waist-hip ratio:
Patient in standing position and abdominal muscles completely relaxed.
Obtaining WC by tape measurement midway between lower ribs and iliac crests.
Obtaining hip circumference by tape measurement at the o greater trochanter level.
Then detect WHR by dividing WC on hip circumference.
All women in groups A and B underwent the procedure both prior to and following the treatment.
Skin fold thickness:
Patient in standing position with abdominal muscles completely relaxed
Subcutaneous fat will be pulled away (with thumb and index fingers) from the muscle 2cm to the side of umbilicus with the caliper's tongues situated at their ends, the skin fold will be pulled diagonally and taken and measured in mm), this was called suprailiac skin fold.
All women in groups A and B underwent the procedure both prior to and following the treatment.
Abdominal fat percentage:
Abdominal fat percentage was determined by using Bioelectrical impedance analysis (InBody analysis). Measurements were conducted approximately two hours following food consumption. Participants maintained a standing position while all skin contact areas underwent alcohol cleaning. Aluminum foil spot electrodes were positioned on the dorsal hand surfaces at the distal metacarpals, with participants standing barefoot on the distal electrodes with feet properly positioned. Height, weight, age, and gender data were entered into the analyzer. Following machine calibration, a painless localized electrical signal

traveled through body tissues, with current flow impedance being determined and converted to represent total body weight, WHR, BMI, and abdominal fat percentage.

This procedure was performed for all participants in both groups (A and B) before and after treatment.

Treatment procedures:

Cryolipolysis:

Group A participants received cryolipolysis treatment.

Participants were instructed to empty their bladders to ensure relaxation during sessions. Participants assumed supine positioning and achieved complete relaxation. The abdomen was segmented into three primary areas: right, left, and center. Session duration was equally distributed among these areas (each area received 20 minutes of cryolipolysis).

The targeted fatty area received initial coverage with a cooling gel pad for skin protection.

A large cup-shaped applicator was then positioned over the treatment zone. Vacuum application through this applicator resulted in aspiration of the targeted adipose roll. Subjects experienced firm tugging sensations during this procedure.

Throughout the initial ten-minute period, applicator temperature was progressively decreased until achieving a predetermined temperature of approximately -7 to -8 degrees Celsius, gradually solidifying adipose cells within the targeted roll. The cup applicator sustained contact with the treated adipose roll via aspiration for 20 minutes. Each treated zone with any individual applicator necessitated 30 minutes of cooling. Each subject underwent one session every three weeks for three months (comprising five total sessions).

Subjects experienced mild burning sensations in the region as temperature normalized.

As the affected region's temperature normalized, some women reported a mild burning sensation in the area.

Low level laser therapy:

LLLT was used for treatment of all women in group B.

Woman was in supine lying and completely relaxed and laser application is stimulating with frequency 13280Hz, duration 10 minutes wave length 904 nm pulse duration 200 m.sec and peak power between 14 w and 27w.

Statistical analysis:

Data presentation utilized mean ± standard deviation format. Distribution assessment of pre-treatment measurements employed Kolmogorov-Smirnov normality testing. Unpaired t-tests facilitated comparison of normally distributed variables between groups. Analysis of covariance (ANCOVA) enabled pre-treatment value comparisons between groups while controlling pre-treatment effects on post-treatment value comparisons. Paired t-tests compared pre- and post-treatment data within individual groups. Statistical Package for Social Sciences (SPSS) computer software (version 19 for Windows) conducted data analysis. $P \leq 0.05$ indicated statistical significance.

3. RESULTS

I-General characteristics of the two studied groups:

Group A exhibited mean age, height, and weight values of 37.3 ± 1.62 years, 159.47 ± 2.11 cm, and 83.19 ± 5.31 kg, respectively. In comparison, group B presented corresponding mean values of 37.63 ± 1.50 years for age, 159.70 ± 2.93 cm for height, and 84.76 ± 6.70 kg for weight. Statistical analysis showed no significant difference between the two groups regarding age ($t = -0.827$, $p = 0.412$), height ($t = -1.583$, $p = 0.119$), or weight ($t = -1.006$, $p = 0.318$) (Table 1).

Table (1): General characteristics of the two studied groups.

	Group A (n= 30)	Group B (n= 30)	t value	p value
Age (yrs.)	37.30 ± 1.62	37.63 ± 1.50	-0.827	0.412 (NS)
Height (cm)	159.47 ± 2.11	159.70 ± 2.93	-1.583	0.119 (NS)
Weight (kg.)	83.19 ± 5.31	84.76 ± 6.70	-1.006	0.318 (NS)

Data are expressed as mean ± SD. NS= p> 0.05= not significant

II-Body mass index (BMI)

Within groups:

Group A exhibited statistically significant BMI mean value decreases from pre-treatment (32.65 ± 1.86) to post-treatment (29.40 ± 1.86) measurements, with t = 13.142 and p = 0.001 (Table 2).

Group B demonstrated statistically significant BMI mean value decreases from pre-treatment (32.77 ± 2.03) to post-treatment (30.33 ± 2.01) measurements, with t = 16.064 and p = 0.001 (Table 2).

BMI decrease percentages in groups A and B reached 9.95% and 7.45%, respectively (Table 2).

Between groups:

Pre-treatment BMI mean values (± SD) in groups A and B measured 32.65 ± 1.86 and 32.77 ± 2.03, respectively. No statistically significant difference occurred between groups (F = 0.057 & p = 0.812) (Table 2)

Post-treatment comparisons showed statistically significant differences between groups A and B (superior decrease in group A) with F = 8.898 & p = 0.004 (Table 2).

Table 2: Inter- and intra-groups comparison between values of BMI in the two studied groups measured at pre- and post-treatment.

	Group A (n= 30)	Group B (n= 30)	F value	P value
Pre-treatment	32.65 ± 1.86	32.77 ± 2.03	0.057	0.812 (NS)
Post-treatment	29.40 ± 1.86	30.33 ± 2.01	8.898	0.004 (S)
Mean difference	3.25	2.44		
% change	9.95 ↓↓	7.45 ↓↓		
t value	13.142	16.064		
p value	0.001 (S)	0.001 (S)		

Data are expressed as mean ± SD. F value= ANCOVA test; t value= paired t test.
NS= p> 0.05= not significant; S= p≤ 0.05= significant.

III-Waist-Hip Ratio (WHR):

Within group:

Group A demonstrated a statistically significant WHR reduction, with post-treatment mean values (0.85 ± 0.10) being significantly lower than pre-treatment measurements (1.20 ± 0.20), showing t = 11.167 and p = 0.001 (Table 3).

Group B similarly exhibited a statistically significant WHR reduction, with post-treatment mean values (1.06 ± 0.19) being significantly lower than pre-treatment measurements (1.21 ± 0.22), demonstrating t = 9.324 and p = 0.001 (Table 3).

WHR reduction percentages for groups A and B were 29.17% and 12.40%, respectively (Table 3).

Between groups:

Pre-treatment WHR mean values (± SD) for groups A and B were 1.20 ± 0.20 and 1.21 ± 0.22, respectively. No statistically significant difference existed between groups (F = 0.003 & p = 0.957) (Table 3).

Post-treatment analysis revealed a statistically significant difference between groups A and B (greater reduction in group A) with F = 69.501 & p = 0.001 (Table 3).

Table 3: Inter- and intra-groups comparison between mean values of WHR in the two studied groups measured at pre- and post-treatment.

	Group A (n= 30)	Group B (n= 30)	F value	P value
Pre-treatment	1.20 ± 0.20	1.21 ± 0.22	0.003	0.957 (NS)
Post-treatment	0.85 ± 0.10	1.06 ± 0.19	69.501	0.001 (S)
Mean difference	0.35	0.15		
% change	29.17 ↓↓	12.40 ↓↓		

t value	11.167	9.324	
p value	0.001 (S)	0.001 (S)	

Data are expressed as mean ± SD. F value= ANCOVA test; t value= paired t test.
NS= p> 0.05= not significant; S= p≤ 0.05= significant.

IV-Skin fold thickness:

Within group:

Group A showed a statistically significant skin fold thickness reduction, with post-treatment mean values (122.27 ± 5.41) being significantly lower than pre-treatment measurements (132.40 ± 17.90), yielding t = 3.073 and p = 0.005 (Table 4).

Group B also demonstrated a statistically significant skin fold thickness reduction, with post-treatment mean values (132.07 ± 7.99) being significantly lower than pre-treatment measurements (136.20 ± 7.78), producing t = 15.550 and p = 0.001 (Table 4).

Skin fold thickness reduction percentages for groups A and B were 7.65% and 3.03%, respectively (Table 4).

Between groups:

Pre-treatment skin fold thickness mean values (± SD) for groups A and B were 132.40 ± 17.90 and 136.20 ± 7.78, respectively. No statistically significant difference existed between groups (F = 1.137 & p = 0.291) (Table 4).

Post-treatment analysis showed a statistically significant skin fold thickness decrease in group A (122.27 ± 5.41) compared to group B (132.07 ± 7.99) with F = 30.073 & p = 0.001 (Table 4).

Table 4: Inter- and intra-groups comparison between mean values of skin fold thickness in the two studied groups measured at pre- and post-treatment.

	Group A (n= 30)	Group B (n= 30)	F value	P value
Pre-treatment	132.40 ± 17.90	136.20 ± 7.78	1.137	0.291 (NS)
Post-treatment	122.27 ± 5.41	132.07 ± 7.99	30.073	0.001 (S)
Mean difference	10.13	4.13		
% change	7.65 ↓↓	3.03 ↓↓		
t value	3.073	15.550		
p value	0.005 (S)	0.001 (S)		

Data are expressed as mean ± SD. F value= ANCOVA test; t value= paired t test.
NS= p> 0.05= not significant; S= p≤ 0.05= significant.

V-Body fat percentage:

Within groups:

Group A demonstrated a statistically significant body fat reduction, with post-treatment mean values (19.68 ± 2.27) being significantly lower than pre-treatment measurements (34.06 ± 4.18), showing t = 24.778 and p = 0.001 (Table 5).

Group B similarly exhibited a statistically significant body fat reduction, with post-treatment mean values (26.44 ± 4.52) being significantly lower than pre-treatment measurements (34.16 ± 3.77), demonstrating t = 16.027 and p = 0.001 (Table 5).

Body fat reduction percentages for groups A and B were 42.22% and 22.60%, respectively (Table 5).

Between groups:

Pre-treatment body fat mean values (± SD) for groups A and B were 34.06 ± 4.18 and 34.16 ± 3.77, respectively. No statistically significant difference existed between groups (F = 0.009 & p = 0.923) (Table 5).

Post-treatment analysis revealed a statistically significant difference between groups A and B (greater reduction in group A) with F = 103.218 & p = 0.001 (Table 5).

Table 5: Inter- and intra-groups comparison between mean values of body fat in the two studied groups measured at pre- and post-treatment.

	Group A (n= 30)	Group B (n= 30)	F value	P value
Pre-treatment	34.06 ± 4.18	34.16 ± 3.77	0.009	0.923 (NS)
Post-treatment	19.68 ± 2.27	26.44 ± 4.52	103.218	0.001 (S)
Mean difference	14.38	7.72		
% change	42.22 ↓↓	22.60 ↓↓		
t value	24.778	16.027		
p value	0.001 (S)	0.001 (S)		

Data are expressed as mean ± SD. F value= ANCOVA test; t value= paired t test.
NS= p> 0.05= not significant; S= p≤ 0.05= significant.

4. DISCUSSION

Obesity incidence and prevalence are rising globally, particularly in developing and newly industrialized countries. Diabetes mellitus, hyperlipidemia, and cardiovascular disease are associated with obesity. Obesity has become a global epidemic and prevalent health issue (4).

Aging women experience metabolic slowdown, reducing their caloric needs. Weight gain may occur if their dietary and exercise patterns remain unchanged (5). Multiple factors contribute to postnatal weight gain, including genetic factors, neuropeptides, adrenergic nervous system activity, and hormonal influences. Additionally, weight gain during this period typically involves abdominal fat accumulation (6). Egyptian abdominal obesity prevalence based on International Diabetes Federation (IDF) guidelines is 30.2% for males and 70.9% for females, while new Egyptian criteria indicate 37.1% prevalence in males and 50.8% in females. Positive correlations exist between WC and most cardio-metabolic risk factors (7).

Multiple techniques have been suggested to assist in reducing fat cell numbers and/or volume and adipose tissue volume. This study involved sixty postnatal women aged 35-40 years with BMI ≥ 30 kg/m² and WHR ≥ 0.85, allocated into two equal groups (A, B) to assess differences between cryolipolysis and LLLT effects on postnatal abdominal adiposity. All women in both groups (A, B) underwent assessment before and after the three-month study program using standard weight-height scales for weight and height measurement, BMI calculation pre- and post-treatment, tape measurement for WHR determination, body fat calipers for abdominal skin fold thickness measurement, and bioelectrical impedance analysis for body composition estimation.

Within groups, the results revealed that there was significant reduction in body mass index 29.40 ± 1.86, 30.33 ± 2.01 respectively and WHR 0.85 ± 0.10, 1.06 ± 1.9 and body fat 19.68 ± 2.27, 26.44 ± 4.52 and Skin fold thickness

Post-treatment comparative analysis between the two groups demonstrated that Group A showed superior outcomes, with both groups experiencing notable reductions in BMI, WHR, adipose tissue percentage, and skinfold measurements.

Weight reduction was observed in both groups (A and B) when pre-study measurements were contrasted with post-study findings. Several mechanisms may account for this weight loss phenomenon. Caloric restriction typically results in glycogen depletion and central adipose tissue reduction. These outcomes align with findings by (De luis et al, 2015) who demonstrated that hypocaloric dietary interventions reduce anthropometric parameters (weight, BMI, and WHR) while enhancing metabolic profiles. The decrease in WHR can be attributed to abdominal fat mass reduction, potentially linked to regional variations in lipoprotein lipase (LPL) activity within abdominal adipose tissue, facilitating free fatty acid mobilization from centrally located fat deposits., This corresponds with research by Astrup and Rossner (2002), indicating that postpartum women preferentially lose abdominal fat during dietary interventions.

These findings support the research conducted by Ferraro et al. (2012), establishing cryolipolysis as an effective and well-tolerated non-invasive approach for body sculpting and fat layer reduction. Their study documented a 6.86cm reduction in abdominal circumference following three months of cryolipolysis treatment. Similarly, Shek et al. (2012) reported a 4.9mm decrease in caliper-measured fat thickness after two months of abdominal cryolipolysis treatment. Macedo et al. (2012) confirmed cryolipolysis efficacy for treating excess adipose tissue in flanks and abdominal areas through fat remodeling. Furthermore, Dierickx et al. (2013) and Sasaki et al. (2014) validated cryolipolysis as a safe, comfortable, and effective subcutaneous fat reduction method. Research by Dover et al. (2009) and Riopelle et al. (2009) revealed that non-invasive cooling triggers adipocyte apoptosis, resulting in gradual fat layer thickness reduction as adipose tissue volume decreases over time through inflammatory mediator-induced phagocytosis responsible for adipocyte elimination and fat tissue loss. Ferraro et al. (2012) noted that this process leads to gradual removal of damaged adipocytes without affecting blood lipid levels or hepatic function.

Current study findings align with research conducted by Eldesouky et al. (2016), who implemented two-month cryolipolysis treatment and documented substantial reductions: body weight decreased by 5.8%, BMI declined by 5.83%, WC showed significant reduction, and suprailiac skinfold (SISF) decreased by 17.41% following treatment. These outcomes were consistent with findings by Mahgoub and El Shafey (2016), who similarly observed significant reductions in WHR, SISF, and WC after eight weeks of cryolipolysis application, alongside notable decreases in MRI-measured abdominal subcutaneous adipose tissue (p-value = 0.001). They explained this reduction through crystallization processes and cold ischemic damage to targeted adipocytes, inducing cellular apoptosis and pronounced inflammatory responses, ultimately leading to cell removal from treatment areas over subsequent weeks.

Sasaki et al. (2015) proposed an additional mechanism, suggesting that initial crystallization and cold ischemic damage from cryolipolysis becomes intensified by ischemia-reperfusion injury, generating reactive oxygen species, elevating cytosolic calcium concentrations, and triggering apoptotic pathways. Preciado (2008) emphasized circumferential reduction in treated areas through fat thickness decrease, attributing this to cryolipolysis-induced fat layer reduction resulting from fatal apoptotic adipocyte injury during cold temperature exposure.

These results receive complete support from Krueger et al. (2014), who demonstrated up to 1cm or 40% abdominal fat layer thickness reduction following single treatment exposure without damaging overlying skin. Manstein et al. (2008) identified abdominal fat thickness reduction through ultrasonographic measurement, explaining this decrease through lipid-containing mononuclear inflammatory cells and localized fibrous septae thickening at two weeks post-procedure, indicating apoptosis and phagocytosis. Conversely, Jalian et al. (2012) reported paradoxical adipose hyperplasia as an uncommon delayed adverse outcome following cryolipolysis, where excess fat develops at treatment sites approximately six months after treatment cessation.

Regarding the LLLT group (Group B), significant BMI and skinfold thickness reductions occurred. LLLT demonstrates biochemical activity on adipocytes, apparently mediated through cytochrome oxidase effects—a large mitochondrial membrane enzyme facilitating electron transfer from cytochrome c to oxygen (Neira et al, 2002).

Specifically, LLLT stimulates adipocyte mitochondria to enhance adenosine triphosphate (ATP) production with consequent cyclic adenosine monophosphate (cAMP) upregulation. Elevated cAMP activates cytoplasmic lipase, converting triglycerides to fatty acids and glycerol that can traverse through cellular membrane pores (Karu et al, 2008).

The results current study supported by (Maher Ahmed El Keblawy et al, 2017) who found the LLLT effective in treatment abdominal obesity by reducing weight of body, WHR, abdominal fat thickness.

5. CONCLUSION

The current study concluded that both cryolipolysis and LLLT treat abdominal adiposity postnatal but cryolipolysis more effect so that improve women quality life.

Availability of data and materials: The datasets used and analyzed during the current study are available from the corresponding author upon reasonable request.

Competing interests: The authors confirm there are no known competing interests associated with this

publication.

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