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Evaluation of the effectiveness of laser acupuncture in management of obesity in Down syndrome children

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Abstract

Introduction: Children with Down syndrome have a physically inactive lifestyle which, in conjunction to poor nutritional selections cause pathophysiological development of cardiovascular diseases, osteoarthritis, diabetes mellitus, and obesity.
Aim of the study: Evaluating the efficacy of laser acupuncture as a mode of weight reduction in obese Down syndrome children.
Patients and methods: A prospective research trial in which 68 obese Down syndrome cases, ages ranged from 7 to 15 years had been recruited. IQ scoring, echocardiography, changes in eating, triglycerides, BMI and body composition had been performed for each patient. The cases were divided in two groups, each 34 cases. Group A had undergone laser acupuncture and diet regime. Group B was used as control with only diet regime.
Results: Body fat, BMI and serum triglycerides were more significantly decreased in laser group than the control group.
Conclusion: Laser acupuncture proved efficiency in management of obesity in Down syndrome children.

Keywords: Down syndrome, obesity, laser acupuncture

1. Introduction

Down syndromeis one of the commonest clinical genetic disease faced by pediatricians all over the globe. Down syndrome (DS) is the most frequent chromosomal disorder occurring due to a complete trisomy 21 or a partial trisomy involving the critical region 21q22.3. As a leading cause of intellectual disability globally, prevalence of Down syndrome is around 1 in 1,000 children. **(1)**

Obesity is defined as excessive accumulation of fatty tissue within the bod. It is accompanied by hormonal imbalances, disturbed eating patterns, and genetic background that may worsen the pathophysiological issues and sequel of the disease. Obesity raises the risk of chronic conditions such as : type 2 diabetes , cardiovascular disease, and asthma. (**2)**

Comorbidities such as obesity in down syndrome raise the challenges in clinical management protocols since mental retardation in down syndrome cases alters the eating behavior and habits that add to the nutritional health issues in that particular class of cases. Children with down syndrome have a physically inactive lifestyle which in conjunction with poor nutritional selections cause pathophysiological development of obesity (**3,4)**

Another explanation for the development of obesity and overweight in this population seems to lie in different pathophysiological conditions, such as systemic inflammation, metabolic diseases and hypotonia. Clinical management scenarios mainly depend on diet and exercise particularly when trying to modify body composition in people with down syndrome **(5).** However, acupuncture with diet planning have raised the capabilities of physicians to reduce the impact of obesity on the metabolic systems of cases with Down syndrome**. (6)**

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Aim

Investigating efficacy and effectiveness of laser acupuncture as a mode of weight reduction management protocol in obese Down syndrome children

Methodology

A prospective research trial in which 68 down syndrome cases, aged 7 to 15 years (SD= 10.6±1.9) . with obesity issues had been recruited. The trial was performed in genetic clinic in pediatric hospital Cairo university from September to December 2022.A full history and clinical examination for all patients had been made: IQ scoring, echocardiography, changes in feeding, lipid profile (triglyceride level) with normal thyroid profile (free T3, T4 and TSH), BMI, body composition by OMERON device were performed for each case every month for 3months. All cases had been instructed via their parents to increase water intake to a minimum of 1.5 liters, decrease bulky food and sweets. The cases had been categorized into two groups, ethical approval number 20016 from ethical committee in National Research Centre of Egypt, each included 34 cases. Group A had undergone laser acupuncture and diet control. Group B went on diet regime only and the patients included were used as control.

Cases with heart failure, leukemia, or undergone a recent operation were excluded from the study. Children who were taken herbal medications to reduce weight were also excluded because these herbs are not approved by the food and drug administration (FDA) of the United States of America. IQ level in our study groups was ranged between 65 and 73 as they were cooperative in comparison with children with lower IQ.

Laser acupuncture sessions had been implemented for three months, 2 sessions per week for a total of 24 sessions. Low power laser (cold laser) Aculaser 100 mill watts power was applied with continuous 650 nm wavelength and 8 joules energy for each acupoint. The acupuncture points subjected to laser were as follows: Zusanli(ST36), Renzhong(GV26), Zhongwan(CV12), Xuehai(SP10), Xaiwan (CV10), Tianshu(ST25), Daheng(SP15),Fujie(SP14), Daimai(GB26).Hegu(LI4).

Omeron

Omeron is a fullsensor body composition monitor and scale that calculates the probableindices such as body fat , skeletal muscle and visceral fat percentages. Omeron uses a bioelectricalimpedancein which a weak electric current flow through the body in order to calculate resistanceof thevarious bodytissues. Most body water is stored within the muscle, so a muscularindividualhas a high probability to have more body water, causing lower impedance values.

Sample size calculation

A pilot sample size31 children was made. We found that Mean±SD of change in BMI was -0.38±0.37 and-0.06±0.40 in LASER and control groups respectively.Assumingthat the power= 0.80 and α=0.05, and by using PASS 11th release (Hintze, 2011) the minimal sample size for a clinical trial to detect a significant statistical difference was 31 in each group. We included 34 cases in each group for possible attrition.

Statistical references

Hintze J. (2011): PASS 11. NCSS, LLC. Kaysville, Utah, USA.

Statistical methods

The collected data were coded, tabulated, and statistically analyzed using IBM SPSS statistics (Statistical Package for Social Sciences) software version 28.0, IBM Corp., Chicago, USA, 2021. Quantitative data tested for normality using Shapiro-Wilk test, then described as mean±SD (standard deviation), and then compared using independent t-test and RMANOVA test. Qualitative data described as number and percentage and compared using Chi square testand Fisher's Exact test according to expected numbers in cells. The level of significance was taken at p-value <0.050 was significant, otherwise was non-significant.

Results

Table (1) showed that: No significant statistical difference between the study groups regarding age, gender, joining school, IQ score and echo findings. Table (2) and figures (2 and 3) showed that: Bulky and sweet food eating behavior changes in LASER group in months 1, 2 and 3 were mainly reduction, while in control group were variables of elevations, stability and reduction, the difference between the study groups were statistically significant. Table (3) and figure (4) showed that: No significant statistical difference between the study groups regarding baseline BMI. BMI significantly decreased after intervention in LASER group only. BMI was lower in LASER group during follow up times, the differences were significant only in month 3. BMI significantly more reduced in LASER group in months 1,2 and 3. Table (4) and figures (5, 6 and 7) showed that: No significant statistical difference between the study groups regarding baseline Fat, muscle and water components. Fat significantly decreased after intervention in LASER group only. BMI was lower in LASER group during follow up times, the differences were significant only in month 3. Fat significantly more reduced in LASER group in months 1,2 and 3.Muscle and water components did not significantly change throughout time points. No significant statistical difference between the study groups regarding Muscle and water components in months 1,2 and 3. Table (5) and figures (8) showed that: No significant statistical difference between the study groups regarding baseline triglycerides. Triglycerides significantly decreased after intervention in LASER group only. Triglycerides was lower in LASER group during follow up times, the differences were significant only in months 2 and 3.Triglycerides significantly more reduced in LASER group in months 1,2 and 3.

Table (1): Demographic characteristics between the study groups

Variables		LASER Group (Total=34)	Control Group (Total=34)	p-value
Age (years)		10.6±1.9	10.3±2.1	^0.544
Gender	**Male**	20 (58.8%)	22 (64.7%)	#0.618
	Female	14 (41.2%)	12 (35.3%)	
Joined a school		7 (20.6%)	8 (23.5%)	#0.770
IQ score		65.9±6.3	64.3±7.6	^0.344
Echo findings	**ASD**	10 (29.4%)	11 (32.4%)	#0.793
	VSD	24 (70.6%)	23 (67.6%)	

#Chi square test. ^Independentt-test.

Table (1) showed that: No significant statistical difference between the study groups regarding age, gender, joining school, IQ score and echo findings.

Table (2): Changes in eating behavior between the study groups

Time	Change	LASER Group (Total=34)	Control Group (Total=34)	p-value
Bulky food				
Month-1	**Decreased**	17 (50.0%)	3 (8.8%)	**§<0.001***
	Stable	17 (50.0%)	27 (79.4%)	
	Increased	0 (0.0%)	4 (11.8%)	
Month-2	**Decreased**	21 (61.8%)	3 (8.8%)	**§<0.001***
	Stable	13 (38.2%)	27 (79.4%)	
	Increased	0 (0.0%)	4 (11.8%)	
Month-3	**Decreased**	29 (85.3%)	4 (11.8%)	**§<0.001***
	Stable	5 (14.7%)	26 (76.4%)	
	Increased	0 (0.0%)	4 (11.8%)	
Sweet food				
Month-1	**Decreased**	19 (55.9%)	5 (14.7%)	**§<0.001***
	Stable	15 (44.1%)	25 (73.5%)	
	Increased	0 (0.0%)	4 (11.8%)	
Month-2	**Decreased**	23 (67.6%)	3 (8.8%)	**§<0.001***
	Stable	11 (32.4%)	27 (79.4%)	
	Increased	0 (0.0%)	4 (11.8%)	
Month-3	**Decreased**	31 (91.2%)	4 (11.8%)	**§<0.001***
	Stable	3 (8.8%)	27 (79.4%)	
	Increased	0 (0.0%)	3 (8.8%)	

§Fisher's Exact test. *Significant.

Table 2 shows that Bulky and sweat food eating behavior changes in LASER group in months 1, 2 and 3 were mainly reduction, while in control group were variables of elevations, stability and reduction, the difference between the study groups were statistically significant.

Table (3): Changes in BMI (kg/m^2) behavior between the study groups

Category	Time	LASER Group (Total=34)	Control Group (Total=34)	^p-value (Groups)
Fat component				
Levels	**Baseline**	33.6±5.6	33.9±5.6	0.805
	Month-1	32.8±5.6	33.8±5.7	0.443
	Month-2	32.1±5.6	33.9±5.6	0.191
	Month-3	31.1±5.5	33.9±5.6	**0.043***
	¤p-value (times)	**<0.001***	0.635	
Changes	**Month-1**	-0.8±0.3	-0.1±0.2	**<0.001***
	Month-2	-1.5±0.4	0.0±0.2	**<0.001***
	Month-3	-2.4±0.5	0.0±0.2	**<0.001***

^Independent t-test. ¤RMANOVA. *Significant.

Table (4): Changes in body composition between the study groups

Category	Time	LASER Group (Total=34)	Control Group (Total=34)	^p-value (Groups)
Fat component				
Levels	**Baseline**	70.0±8.1	71.1±8.3	0.586
	Month-1	68.7±8.1	70.9±8.0	0.269
	Month-2	67.2±8.1	71.1±8.2	0.053
	Month-3	65.8±8.1	71.0±8.0	**0.010***
	¤p-value (times)	**<0.001***	0.528	
Changes	**Month-1**	-1.3±0.4	-0.2±1.0	**<0.001***
	Month-2	-2.8±0.7	-0.1±0.9	**<0.001***
	Month-3	-4.2±0.9	-0.1±0.9	**<0.001***
Muscle component				
Levels	**Baseline**	25.5±5.5	26.4±5.7	0.521
	Month-1	25.4±5.5	26.5±5.7	0.436
	Month-2	25.5±5.5	26.3±5.6	0.572
	Month-3	25.5±5.6	26.2±5.8	0.644
	¤p-value (times)	0.809	0.229	
Changes	**Month-1**	-0.1±0.8	0.1±0.7	0.311
	Month-2	0.0±0.7	-0.1±0.7	0.486
	Month-3	0.0±0.8	-0.2±0.8	0.209
Water component				
Levels	**Baseline**	67.2±5.3	66.5±5.8	0.631
	Month-1	67.4±5.5	66.9±5.8	0.684
	Month-2	67.2±5.5	66.4±6.0	0.559
	Month-3	67.5±5.8	66.9±6.0	0.652
	¤p-value (times)	0.494	0.150	
Changes	**Month-1**	0.2±1.7	0.3±1.2	0.802
	Month-2	0.0±1.2	-0.2±1.2	0.537
	Month-3	0.4±1.3	0.4±1.3	0.999

^Independent t-test. ¤RMANOVA. *Significant.

Table (5): Changes in Triglycerides (mg/dL) between the study groups

Category	Time	LASER Group (Total=34)	Control Group (Total=34)	^p-value (Groups)
Levels	**Baseline**	110.7±14.1	111.3±14.5	0.872
	Month-1	108.7±14.2	111.4±14.4	0.443
	Month-2	103.8±14.3	111.3±14.6	**0.036***
	Month-3	102.1±14.2	111.4±14.4	**0.009***
	¤p-value (times)	**<0.001***	0.264	
Changes	**Month-1**	-2.0±1.4	0.1±0.4	**<0.001***
	Month-2	-6.9±1.7	0.0±0.4	**<0.001***
	Month-3	-8.7±1.5	0.1±0.4	**<0.001***

#Chi square test. §Fisher's Exact test. *Significant.

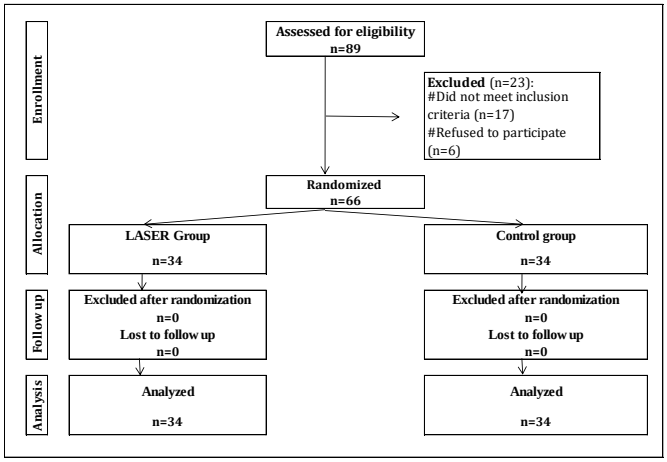

Figure (1): CONSORT flow chart of the studied cases

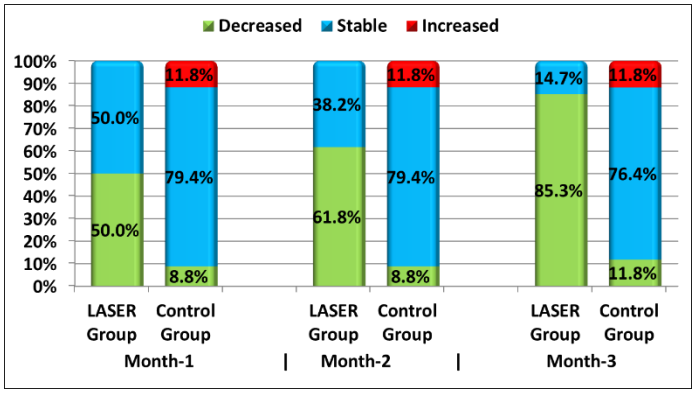

Figure (2): Changes in bulky food eating behavior between the study groups

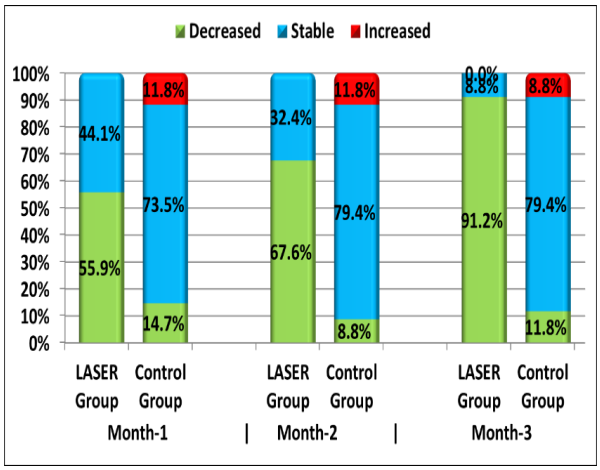

Figure (3): Changes in sweet foodeating behavior between the study groups

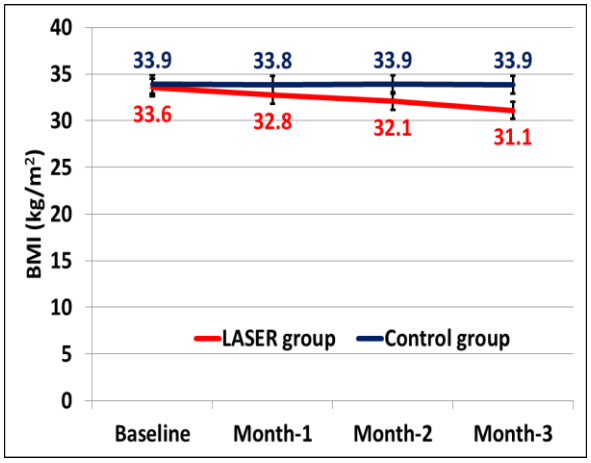

Figure (4): Changes in BMI between the study groups

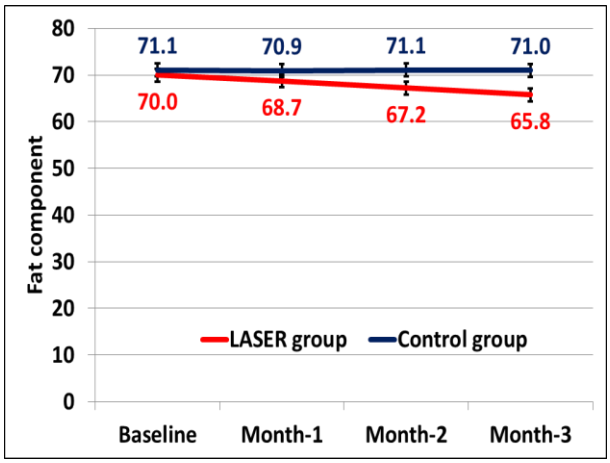

Figure (5): Changes in Fatcomponent between the study groups

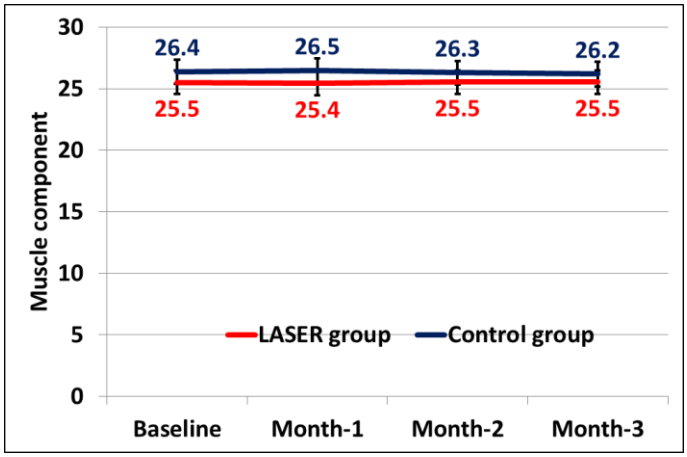

Figure (6): Changes in Muscle component between the study groups

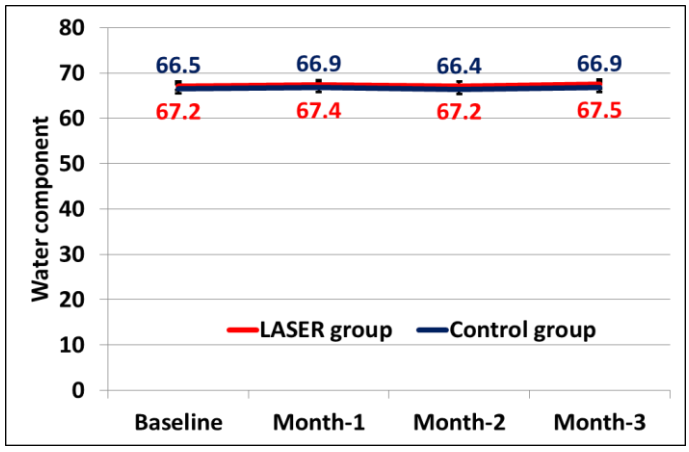

Figure (7): Changes in water component between the study groups

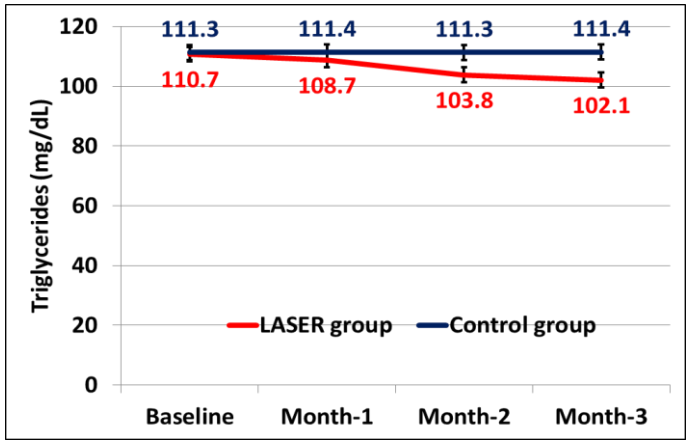

Figure (8): Changes in Triglycerides between the study groups

Discussion

Down syndrome is a genetic disease characterized by an extra 21 chromosome affecting the brain leading to mental retardation and the heart causing many congenital anomalies. Down syndrome is considered a great challenge for pediatricians since there is multisystem affection. (**7)**

Obesity, which is commonly found in children with Down syndrome, would further put a burden on the systems that cause more clinical deterioration. Introducing management protocols such as laser acupuncture could improve the management course of obesity in children with Down syndrome. Low power laser is a noninvasive tool, free from health hazards and showed promising results by various research groups all over the globe**. (8)**

In the current research, we used low power laser, wavelength 650 nm continuous wave, power 100 milliwatts, energy 8 joules for each acupoint. We performed 2 sessions per week for 3 months for a total of 24 sessions. The acupoints subjected to laser were as follows: Zusanli (ST36), Renzhong (GV26), Zhongwan (CV12), Xuehai (SP10), Xaiwan (CV10), Tianshu(ST25),Daheng(SP15),Fujie(SP14),Daimai(GB26).Hegu(LI4).

Our results showed that Bulky and sweat food eating behavior changes in LASER group in months 1, 2 and 3 were mainly reduced in amount. Statistical difference between laser and control group was significant. These findings are in harmony with those concluded by Tseng et al., 2016**(4)** which proved a positive impact of laser acupuncture therapy on anthropometric and appetite scoring in obese cases. Those results showed a significant difference in appetite score in a treatment group compared to a control group (*Pvalue*< 0.0001). A change in appetite score can be expected to change patients' lifestyle behaviors.(**9)**

Therefore, we conclude that laser photo modulation to specific sites reduced and corrected the eating patterns and habits of those cases. We could justify those results by the fact that laser acupuncture causes triggering of the autonomic nervous system in a manner that improves the satiety center activity and hunger sensation in a neurohormonal modulatory manner. **(10.11)**

Prior research efforts implemented on acupuncture in obesity showed that acupuncture reduces BMI in a statistically significant fashion **(12,13,14).** In the current study, our results had shown that BMI was lower in LASER research group during follow up times, the differences were statistically significant only in the 3rdmonth. BMI was statistically reduced in LASER research group in 1st, 2nd and 3rd month more than the control group. These research study findings is justified by the fact that laser acupuncture, when modulating satiety center activity, improves the pattern of weight loss that is reflected on the BMI measurements. Furthermore, it was revealed, in the current research study, that fat was significantly decreased after intervention in LASER group only. Therefore, the laser photo modulation caused by the intervention had reduced the weight in a healthy pattern that could improve the all over body metabolism. Furthermore, it was shown that lipid metabolic profile has been improved in a manner that could improve the overall clinical scenario. Triglycerides were statistically significantly decreased after intervention in LASER group only. These findings are in similarity to results and data analyzed by a similar study that investigated acupuncture effect at ST 36 acupoint**.** Acupuncture reduced levels of TNF-*a* and IL-6 which consequently decreases triglyceride serum levels since fatty acids are not converted to triglycerides via the acetyl-CoA carboxylase metabolic pathway **(12).**

Furthermore, HDL serum level shave raised because pro- HDL can be converted to HDL. Interestingly it has been shown that Acupuncture at CV 12 *Zhongwan* reduces gastric-acid secretory levels through sympathetic pathways (**15).** These findings justify the current study results concerning the changes in bulky and sweet intake results. Furthermore, a prior research study has shown that triggering CV 12 *Zhongwan*and ST 36 *Zusanli*acupoints decreases serum leptin levels which reduces appetite. **(16,17)**

Laser acupuncture at CV 12 *Zhongwan* have revealed to trigger *b*-endorphin secretion via the *l*-opioid receptors within the cerebrum, hepatobiliary system, and pancreatic tissue. This enhances insulin secretion that reduces fasting serum glucose levels. (**17).**

At a molecular and cellular levels, it was shown - as mentioned before- that Laser acupuncture at CV 12 *Zhongwan* decreases serum levels of TNF-*a* and IL-6, thereby increasing the insulin-signaling pathway via IRS-1/GLUT4.These findings support the conclusion that acupuncture promotes the neurohormonal signaling in obese cases enhancing the metabolic performance which helps weight reduction. (12**)**

Conclusion and recommendations

Laser acupuncture appears to be a promising tool in weight reduction of obese and over weight Down syndrome cases. However future research should be implemented in a multicenteric fashion with larger sample sizes to verify the most effective number of sessions and time interval of treatment.

References

1. **de Graaf, G., Vis, J. C., Haveman, M., van Hove, G., de Graaf, E. A. B., Tijssen, J. G. P., & Mulder, B. J. M. (2011).** Assessment of Prevalence of Persons with Down syndrome: A Theory-based Demographic Model. Journal of Applied Research in

Intellectual Disabilities, 24(3), 247–262. https://https://doi.org/10.1111/j.1468-3148.2010.00593.x

2. **Apovian CM, Aronne LJ, Bessesen DH, McDonnell ME, Murad MH, Pagotto U, et al..** Pharmacological management of obesity: an Endocrine Society clinical practice guideline. *J ClinEndocrinolMetab* (2015) 100(2):342–62. doi: 10.1210/jc.2014-3415
3. **Martínez-Espinosa, R. M., Molina Vila, M. D., &ReigGarcía-Galbis, M. (2020).** Evidences from Clinical Trials in Down Syndrome: Diet, Exercise and Body Composition. International journal of environmental research and public health, 17(12), 4294. https://https://doi.org/10.3390/ijerph17124294
4. **Tseng CC, Tseng A, Tseng J, Chang CH.** Effect of laser acupuncture on anthropometric measurementsand appetitesensations in obese subjects. *Evid Based Complement Alter-natMed*.2016;2016:9365326.
5. Quan, Tingwei;Su, Qi ; Luo, Yu; Su, Xin ; Chen, Qiuxuan ; Yang, Jingjun ; Tang, Hongzhen. Does acupuncture improve the metabolic outcomes of obese/overweight children and adolescents?: A systematic review and meta-analysis.Medicine 102(40):pe34943,October06,**2023.**DOI:10.1097/MD.0000000000034943
6. Yu-Mei Zhong, Xiao-Chao Luo, Yang Chen, De-Li Lai, Wen-Ting Lu, Ya-Nan Shang, Lin-Lin Zhang, and Hai-Yan Zhou.Acupuncture versus sham acupuncture for simple obesity: a systematic review and meta-analysis.Postgrad.Med.J. 2020 Apr; 96(1134): 221–227.
7. Bull, Marilyn J. (11 June 2020). "Down Syndrome". New England Journal of Medicine. 382 (24): 2344–2352. doi:10.1056/NEJMra1706537
8. Pierce, M.; Ramsey, K.; Pinter, J. (2 April 2019). "Trends in Obesity and Overweight in Oregon Children With Down Syndrome". Global Pediatric Health, SAGE Publications. 6: 2333794X19835640.
9. **El-Mekawy HS, ElDeeb AM, Ghareib HO.** Effect of laser acupuncture combined with a diet–exercise intervention on metabolic syndrome in post-menopausal women. J Adv Res. 2015;6(5):757–763.
10. **deGraaf, G., Buckley, F. &Skotko, B.G. (2021).** Estimation of the number of people with Down syndrome in Europe. Eur J Hum Genet, 29, 402–410. https://https://doi.org/10.1038/s41431-020-00748-y
11. **Alesi, M., Giustino, V., Gentile, A., Gómez-López, M., &Battaglia, G. (2022).** Motor Coordination and Global Development in Subjects with Down Syndrome: The Influence of Physical Activity. Journal of clinical medicine, 11(17), 5031. https://https://doi.org/10.3390/jcm11175031
12. Li Wang, 1 Chao-Chao Yu, 2 , 3 Jia Li, 1 Qing Tian, 4 and Yan-Jun Du 1 ,Mechanism of Action of Acupuncture in Obesity: A Perspective From the Hypothalamus.Front Endocrinol (Lausanne). 2021; 12: 632324.
13. Hea-Sun Chun, Dong-Hwan Kim, and Ho-SeubSong .Study of Latest Trend on Acupuncture for Obesity Treatment. J.Pharmacopuncture. 2021 Dec 31; 24(4): 173–181.
14. JiaxinChen, Johannah L Shergis, Xinfeng Guo, Anthony Lin Zhang, Hanlin Wang, Chuanjian Lu, Charlie C Xue, and ChangcaiXieAcupuncture Therapies for Individuals with Overweight or Obesity: An Overview of Systematic Reviews.
15. **DANIEL MEDINA-REBOLLO , JESÚS FERNÁNDEZ-GAVIRA, VIRGINIA ALCARAZ-RODRÍGUEZ , EDUARDO JOSÉ FERNÁNDEZ-OZCORTA**An updated look at physical exercise and its effect on overweight and obesity in children and adolescents with down syndrome: a comprehensive systematic review Journal of Physical Education and Sport ® (JPES), Vol. 23 (issue 2), Art 38, pp. 319 - 327, February 2023
16. **Hassan, N. M., Landorf, K. B., Shields, N., &Munteanu, S. E. (2019).** Effectiveness of interventions to increase physical activity in individuals with intellectual disabilities: A systematic review of randomised controlled trials: Interventions to increase physical activity in people with intellectual disabilities. Journal of Intellectual Disability Research, 63(2), 168-191. https://https://doi.org/10.1111/jir.12562.
17. **Alesi, M., Giustino, V., Gentile, A., Gómez-López, M., &Battaglia, G. (2022).** Motor Coordination and Global Development in Subjects with Down

Syndrome: The Influence of Physical Activity. Journal of clinical medicine, 11(17), 5031. https://https://doi.org/10.3390/jcm11175031