International Journal of Medical Science and Clinical Inventions 4(8): 3146-3152, 2017
DOI:10.18535/ijmsci/v4i8.04 **ICV 2015: 52.82**
e-ISSN:2348-991X, p-ISSN: 2454-9576

Review Article

EFFICACY OF LOW LEVEL LASER THERAPY TO TREAT OBESITY

Tahmina Islam Amin

PhD Scholar at Maharaja Vinayak Global University

Abstract:

Background: Obesity has been identified as one of the major concern all over the world in recent times. On one hand obesity is the fundamental cause of cardiovascular complications, diabetes etc and on the other hand, this contemporary health issue also exerts a plethora of negative psychosocial impact. Therefore, wide range of researches are being conducted worldwide for integral management of obesity. This study, in particular is one of those types; delving deeper to identify the efficacy of low-level laser therapy for reducing obesity.

Purpose: In recent times, low level laser therapy (LLLT) has been recognised as one of the promising methods for the treatment of obesity. Therefore, this study holds high significance as this has concentrated towards identifying the impact of LLLT on waistline fat as compared to control individuals.

Subjects: 400 obese subjects were randomly divided into two groups: **experimental and control group**.200 in experimental and 200 in control.

Design: Randomised experimental control design.

Method: The control group was treated only with exercise twice a week for 4 weeks and the experimental group was treated with both low level laser therapy as well as exercise twice a week for 4 weeks. Waistline circumference were measured with inch tape prior and after treatments in both the groups.

Result: LLLT strategy was found to have reduced the waist line circumference to a considerable extent over a period of 4 weeks as in comparison to the control. group with an identifiable pattern of waistline fat thickness alteration.

Conclusion: This research work, from thorough analysis of results obtained from both dataset, has concluded that, low level laser therapy, as compared to traditional approaches is much more effective and consistent. In addition, for individual with higher fat amount, it is beneficial to combine both exercise, diet and laser therapy to obtain the best outcome.

KEY WORDS: Obesity, low level laser therapy, waistline, inch tape.

Introduction:

In terms of health and medicine, obesity[1] can be defined as a health complication characterised by overweight with a body mass index [2]of more than *23 Kg/m*^{2}. A plethora[3] of research studies have depicted obesity as one of the most significant factors exerting its negative impact on physical, social and psychological aspect of an individual. According to the statistics published by World Obesity Federation**,** more than 25% of men are suffering from obesity in India, whereas, this percentage is even higher in case of women leading to severe depression and anxiety with a possible risk of suicidal tendencies as well.

National Health Services[4] have made significant contribution in this genre of research by decoding the influence of several medical treatments such as *low calorie diet, exercise, medication, surgery* etc. *Obesity Foundation of India,* in this context has put forth a statistics[5] stating the obesity percentage in different states of India. According to this list, Punjab has been placed at the top with male obesity percentage of 30.0% followed by Kerala with 24.3% male obese population. In terms of male obesity, West Bengal has been placed at the 26th rank with a male obesity percentage of 5.4 preceded by only two states Jharkhand and Tripura. On the contrary, this ranking is slightly different in the context of women obese population. *West Bengal* has been placed at the rank of 16 with average percentage of 7.1% (Aiaaro.in, 2016).

Even though surgeries have been found to be the most effective treatment of obesity[6], however, it has got negative effects associated with invasive techniques. Therefore, researchers have delved deeper into formulating non-invasive[7] efficient technologies and came up with strategies such as cryolipolysis, use of radio frequency and low-level laser therapy (LLLT).

This study, in particular has focused on illustrating the effect of low-level laser therapy against spot fat reduction from the waist line. LLLT has been found to be highly effective in a number of medical conditions[8], such as hair loss, musculoskeletal conditions, teeth complications,etc. However, its efficiency and mechanism of action against obesity is yet to be deciphered. Till date, LLLT has been employed in several wavelengths such as 660 nm, 780 nm, 635 nm etc.But this study specifically has concentrated towards analysing the effect of LLLT with a frequency of 635-680 nm on waist adipose reduction.[9]

Research aim

The aim of this study is to investigate the impact of LLLT with the wavelength of 635 nm-680 nm on spot fat reduction. Gaining a deeper insight into the working principle of LLLT has also been included as an aim of the study.

Research objectives:

The research objectives are:

- To comprehend the emerging applications of LLLT in lipolysis in order to reduce adipose tissue present in fatty regions of obese individuals
- To illustrate the working principle and mechanism of action of Low-Level Laser Therapy in fat tissue reduction or spot fat reduction

Method

Sample

A total of 400 patients in the age group of 30-45 years were included in the study.

The subjects were recruited from the Astique clinic, Kolkata .

An informed consent was obtained from the subjects participating in the study.

The criteria for selection of subjects were:

Inclusion criteria

- Subjects with age 30 to 45 years.
- Subjects with waist circumference of 35-50cm .
- Subjects should have a constant body weight.

Exclusion criteria

- Those who had cardiovascular diseases such as cardiac arrhythmias, congestive heart failure
- Those who had cardiac surgeries as cardiac bypass, heart transplant surgery, pacemakers
- People who had initially reduced their weight with the help of surgeries such as liposuction, abdominoplasty, stomach stapling, lap band surgery, etc.
- Those who suffered from infections and other wounds as well as trauma
- Those women who were pregnant or planning pregnancy prior to the end of study participation
- Even people suffering from diseases like cancer
- Those who are in current use of medication(s) known to affect weight levels/cause bloating or swelling and for which abstinence during the course of study participation is not safe or medically prudent.
- Subjects with any medical condition known to affect weight levels and/or to cause bloating or swelling.
- Subjects with diagnosis of, and/or taking medication for irritable bowel syndrome.
- Subjects with active infection, wound or other external trauma to the areas to be treated with the laser.
- Subjects with known photosensitivity disorder.
- Subjects having serious mental health illness such as dementia or schizophrenia; psychiatric hospitalization in past two years.
- Subjects with developmental disability or cognitive impairment which might preclude adequate comprehension of the informed consent form and/or ability to record the necessary study measurements.

Sampling

Convenient sampling technique was used. All the obese patients attending Astique clinic were evaluated and those meeting the inclusion and exclusion criteria were included in the study.

Design

Pretest Posttest Experimental Control design

Instrumentation

Inch tape

Procedure for data collection

Prospective participants were explained about the purpose and the nature of the study and informed consent was obtained from patients willing to participate in the study. A detailed assessment of each and every subject was done.400 healthy men and women participated in the study from the Astique clinic in kolkata.

They were randomly assigned into the experimental laser treatment group and to the control placebo treatment group (200 subjects in each group).

They were asked not to change their exercise or diet habits during the trial.

Subjects in the experimental group were treated with 20min of low level laser therapy[10] followed by 30min aerobics twice a week for 4 weeks whereas subjects in the control group received sham treatment for the same followed by 30min aerobics. Standardized waist circumference measurements[11] were taken with a measuring tape before treatment at baseline and after treatment at 4 weeks and after 12 weeks of treatment by 3 different individuals to maintain the reliability of the study.

Data analysis

Data analysis was done using

- Statistica version 6 [Tulsa, Oklahoma: StatSoft Inc., 2001]
- GraphPad Prism version 5 [San Diego, California: GraphPad Software Inc., 2007]

All variables were skewed by Kolmogorov-Smirnov goodness-of-fit test other than the age which is normally distributed and was analysed using Student's unpaired t test .Cumulative waist girth loss was measured after 4 weeks and after 12 weeks post treatment both in the control group and the experimental group and the pre test post test result were compared both within the group and between the groups and

the data were analyzed using Friedman statistic test and Mann whitney U test respectively.

Descriptive statistics of numerical variables – Group 1 [Control i.e. Exercise only; n = 200]

Vari	Valid N	Mean	Median	Minimum	Maximum	Lower Quartile	Upper Quartile	Standard deviation	Standard Error
Age	200	37.82	38.00	30.00	47.00	34.00	41.50	4.683	0.331
AC_B_R1	200	38.28	38.50	35.60	41.20	37.30	39.20	1.706	0.121
AC_B_R2	200	38.20	38.40	35.50	41.10	37.20	39.20	1.715	0.121
AC_B_R3	200	38.23	38.50	35.60	41.10	37.20	39.10	1.676	0.118
AC_1m_R1	200	37.72	38.00	34.90	40.60	36.90	38.60	1.712	0.121
AC_1m_R2	200	37.72	38.10	34.90	40.70	36.80	38.60	1.748	0.124
AC_1m_R3	200	37.75	38.00	34.90	40.70	36.90	38.70	1.712	0.121
AC_3m_R1	200	37.99	38.30	35.10	41.00	37.00	38.90	1.707	0.121
AC_3m_R2	200	37.98	38.30	35.10	41.00	36.95	38.90	1.708	0.121
AC_3m_R3	200	37.99	38.30	35.20	41.00	37.00	38.90	1.703	0.120
AC_B_Mean	200	38.23	38.47	35.57	41.13	37.23	39.17	1.699	0.120
AC_1m_Mean	200	37.73	38.03	34.93	40.67	36.87	38.63	1.723	0.122
AC_3m_Mean	200	37.99	38.27	35.13	40.97	37.00	38.93	1.705	0.121
ChangeIn3m	200	0.24	0.23	0.13	0.50	0.20	0.28	0.065	0.005

AC_B_R1:Abdominal circumference measured by rater1 at baseline
AC_B_R2:Abdominal circumference measured by rater2 at baseline
AC_B_R3:Abdominal circumference measured by rater3 at baseline
AC_1m_R1:Abdominal circumference measured by rater1 at the end of 1month
AC_1m_R2:Abdominal circumference measured by rater2 at the end of 1month
AC_1m_R3:Abdominal circumference measured by rater3 at the end of 1month
AC_3m_R1:Abdominal circumference measured by rater1 at the end of 3month
AC_3m_R2:Abdominal circumference measured by rater2 at the end of 3month
AC_3m_R3:Abdominal circumference measured by rater3 at the end of 3month

Descriptive statistics of numerical variables – Group 2 [Laser + Exercise; n = 100]

Vari	Valid I	Mean	Median	Minimum	Maximum	Lower Quartile	Upper Quartile	Standard deviation	Standard Error
Age	200	37.51	38.00	30.00	46.0	34.00	41.00	4.566	0.323
AC_B_R1	200	48.92	38.85	32.00	109.0	35.30	52.20	23.723	1.678
AC_B_R2	200	38.67	36.40	32.00	55.6	33.50	40.85	6.179	0.437
AC_B_R3	200	38.68	36.40	32.00	55.5	33.55	40.80	6.155	0.435
AC_1m_R1	200	36.49	34.50	30.00	53.5	31.50	38.55	5.864	0.415
AC_1m_R2	200	36.49	34.40	30.00	53.6	31.50	38.60	5.891	0.417
AC_1M_R3	200	36.50	34.40	30.00	53.5	31.55	38.55	5.869	0.415

AC_3m_R1	200	36.76	34.80	30.50	53.6	31.85	38.65	5.880	0.416
AC_3m_R2	200	36.76	34.70	30.40	53.7	31.90	38.75	5.892	0.417
AC_3m_R3	200	36.92	34.70	30.40	61.7	31.90	38.80	6.139	0.434
AC_B_Mean	200	38.67	36.43	32.03	55.6	33.51	40.82	6.163	0.436
AC_1M_Mea	200	36.49	34.43	30.03	53.5	31.50	38.57	5.875	0.415
AC_3m_Mea	200	36.81	34.73	30.47	53.7	31.87	38.80	5.887	0.416
ChangeIn3m	200	1.86	1.80	-8.12	2.8	1.70	1.97	0.798	0.056

Comparison of numerical variables between Groups 1 and 2 – Student's unpaired t test

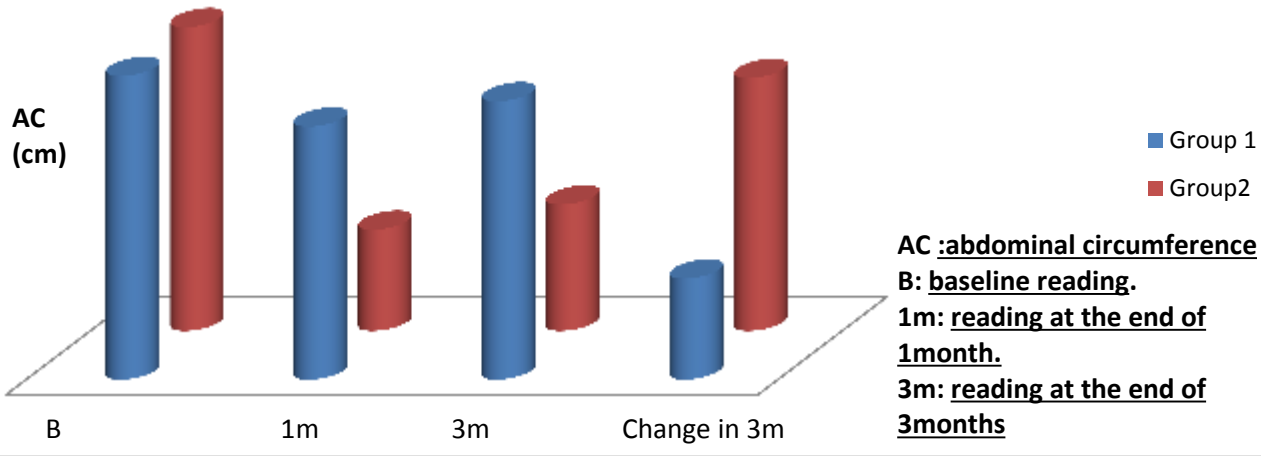
Variable	Mean	Mean	t-value	Df	p	Valid N	. Valid N	Std.Dev.	Std.Dev
	1	2				1	2	1	2
Age	37.82	37.51	0.681159	398	0.496167	200	200	4.683	4.566

The analysis shows that there is no statistically significant difference between group 1 and group 2.

Comparison of numerical variables between groups 1and 2 – Mann-Whitney U test

Rank S	Rank Sum Group 1	Rank Sum Group 2	U	Z	p-level		
AC_B_Mean	**43977.00**	**36223.00**	**16123.00**	**3.3534**	**0.001**		
AC_1M_Mean	**47612.50**	**32587.50**	**12487.50**	**6.4979**	**< 0.001**		
AC_3m_Mean	**47467.50**	**32732.50**	**12632.50**	**6.3725**	**< 0.001**		
ChangeIn3m	**20500.00**	**59700.00**	**400.00**	**-16.9529**	**< 0.001**		

FIG1: COMPARISON BETWEEN THE GROUPS.



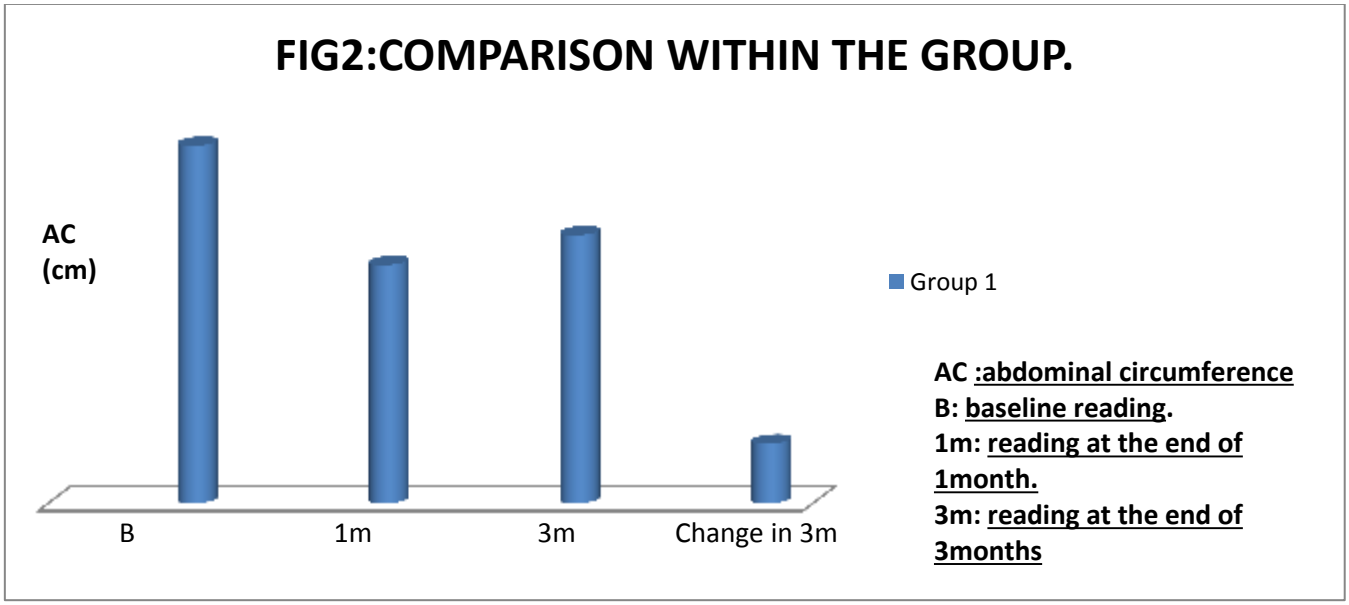
The analysis shows that there is no statistically significant difference between both the groups at baseline but there is at the end of one month and as well as at the end of 3 months with a significant change at the end of 3months.

To assess significance of change within Control (exercise alone) group

Friedman test

Number of time points 3 **Friedman statistic 400.00** **p value < 0.001**

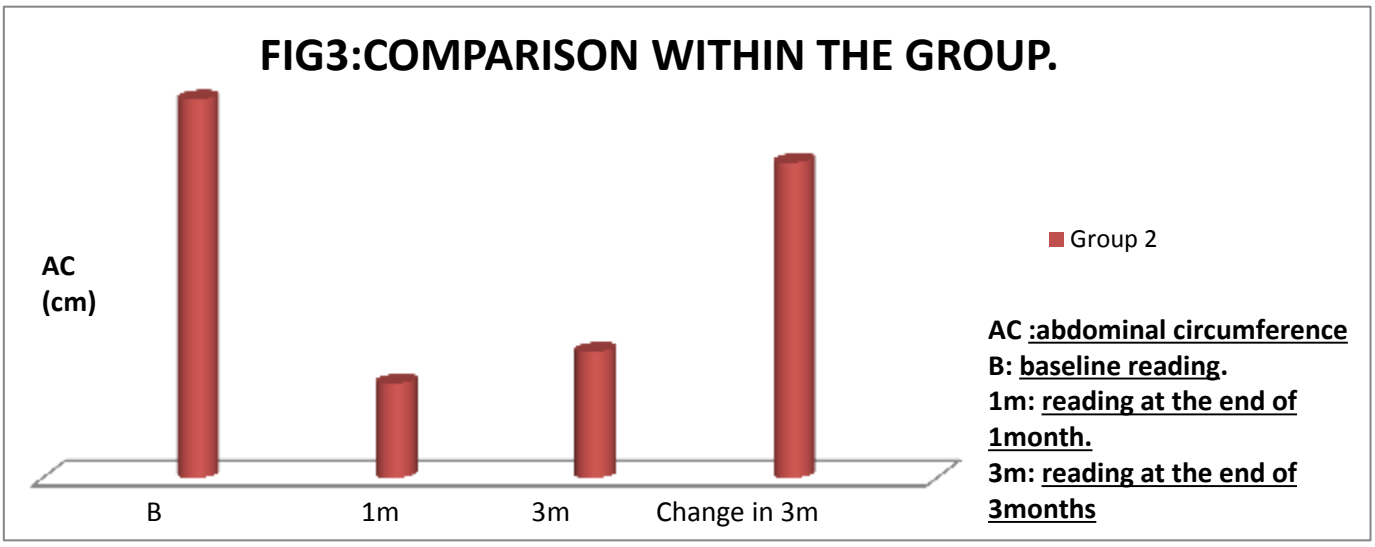
Dunn's Multiple Comparison Test	Difference in rank sum	Significant? P < 0.05?	Summary
AC_B_Mean vs AC_1m_Mean	400.00	Yes	< 0.001
AC_B_Mean vs AC_3m_Mean	200.00	Yes	< 0.001
AC_1M_Mean vs AC_3m_Mean	-200.00	Yes	< 0.001



The analysis shows that there was a statistically significant difference within the group at the end of 1 month as well as at the end of 3 months.

To assess significance of change within Experimental (laser + exercise) group Friedman test

Number of time points 3	**Friedman statistic 395.51**	**p value < 0.001**	
Dunn's Multiple Comparison Test	Difference in rank sum	Significant? P < 0.05?	Summary
AC_B_Mean vs AC_1M_Mean	397.50	Yes	< 0.001
AC_B_Mean vs AC_3m_Mean	198.00	Yes	< 0.001
AC_1M_Mean vs AC_3m_Mean	-199.50	Yes	< 0.001



The analysis shows that there was a statistically significant difference within the group at the end of 1 month as well as at the end of 3 months.

Extent of change	Median	Interquartile range
Control (exercise alone) group	1.80	1.70 to 1.97
Experimental (laser + exercise) group	0.23	0.20 to 0.28

Although there was a significant change both within the groups as well as between the groups but the extent of change which was seen in the experimental group was much higher than the control group.

Discussion

The entire analysis has been conducted in terms of individual readings at baseline, 4 weeks and 12 weeks and finally comparing these values between both the control and experimental groups and within the group. For both the groups all individuals had a waist fat measurement in the range of 35.0 cm-50.0 cm.

Laser therapy[12] is administered in the specific part of the body for instance the abdomen in the study that is the choice of treatment and requires targeting the treatment area. Placing the device on the area of focus through which the laser beam protrudes[13] helps to conduct its role. Benefit of using this therapy is that it is used for shorter period of 15 minutes to 20 minutes duration.

From the study of Honne *et al*[14]. (2012, p.243), increase in ATP production is seen to activate as low-level laser therapy acts on the mitochondria on a particular protein known as cytochrome c oxidase. This activity of the therapy also contributes in reducing the oxidative stress. Low-level laser therapy has been evaluated to contribute in removing the excess cellulite from the waist circumference[15] and generalized fat in the body.

Laser therapy used for treating obesity is conducted by liquefying the fat content from the desired area, which is referred as emulsification[16]. It is seen that adipocyte cells are reduced in their volume by operating low-level laser therapy, which operates by the process of emulsification. The study of Grummer Strawn[17] (2012, p.1348), confirmed that the cells that are emulsified are eliminated from the specific area into the extracellular space. In the process of low-level laser therapy, the device with the laser beam is allowed to make a transitory[18] pore within the cell membrane of the fat cells. Movement of the fatty substances into the extracellular space is conducted across the aperture[19]. Fat cells are of two types, visceral[20] and subcutaneous. Above the skeletal region is the position of the subcutaneous layer, which is placed beneath the skin. As per Jayawardena[21] *et al.* (2012, p.1), this position of the subcutaneous layer helps in proper penetration of laser beam for its performance. On the other hand, fat which is situated beneath the skeletal muscle, is considered as the visceral fat[22], which is difficult to reduce through the process of low-level laser therapy[23].

Benefits of using this therapy are that patients are not subjected to prolonged duration for the treatment[24] as well as they are not the victim of any pain from the therapy. This is beneficial in comparison to surgical process and medications that possess side effects. On the other hand, Fors *et al.* (2012, p.135) asserted that low-level laser therapy[25] can be carried out for every individual with obesity. This is in comparison to the surgical or anti-obesity drug[26] treatments that are applicable to restricted patients. This is because different patients possess different diseases and the medication can interfere with the diseases[27] or the ongoing treatment and negatively affect the health. In addition, Eheman *et al.* (2012, p.2339)[28] pointed out that bariatric surgeries are restricted for normal individuals only with increased weight because it possess greater risk[29] of turning into complicated outcome. Hence LLLT is safe and very effective in spot fat reduction[30].

Future research

Along with this, true results based on the experimental data are profitable for future researchers to make progress in their task based on the research outcome. In addition, future researchers also have the possibility of making comparative analysis based on low-level laser therapy and other interventions for obese people as well as to make comparisons between low-level laser therapy outcome for Indian population and other countries.

Relevance to clinical practice

As per Domon and Aebersold (2010, p.721), this study is useful for taking necessary information on positive and negative influences of low-level laser therapy, while considering the provision of this therapy to obese patients. Besides, in practical aspects of clinical treatment methods, the knowledge gained from this research can help to judge the efficacy of LLLT in improving obesity amongst the larger population in India.

Conclusion

This study has enabled us to develop a good insight into the topic of research as the focus is given on efficacy of low-level laser therapy to effectively reduce abdominal fat compared to other mechanisms.

References cited and Bibliography

1. Aiaaro.in. (2016). *All India Association for Advancing Research in Obesity*. Available at: http://www.aiaaro.in/ [Accessed on 25 May 2016].
2. Chang, S.J., Van Witteloostuijn, A. and Eden, L., (2010). From the editors: Common method variance in international business research. *Journal of International Business Studies*, *41*(2), pp.178-184.
3. Feilzer, M.Y., 2010. Doing mixed methods research pragmatically: Implications for the rediscovery of pragmatism as a research paradigm. *Journal of mixed methods research*, *4*(1), pp.6-16.

4. Gratton, C. and Jones, I., (2010). *Research methods for sports studies.* Abingdon: Taylor & Francis.
5. Grix, J., (2010). *The foundations of research.* Basingstoke: Palgrave Macmillan.
6. Hannes, K., Lockwood, C. and Pearson, A., (2010). A comparative analysis of three online appraisal instruments' ability to assess validity in qualitative research. *Qualitative health research*, pp.12.
7. Lasch, K.E., Marquis, P., Vigneux, M., Abetz, L., Arnould, B., Bayliss, M., Crawford, B. and Rosa, K., 2010. PRO development: rigorous qualitative research as the crucial foundation. *Quality of Life Research*, *19*(8), pp.1087-1096.
8. Lietz, C.A. and Zayas, L.E., (2010). Evaluating qualitative research for social work practitioners. *Advances in Social Work*, *11*(2), pp.188-202.
9. Mahoney, J., (2010). After KKV: The new methodology of qualitative research. *World Politics*, *62*(01), pp.120-147.
10. Mason, M., (2010), Sample size and saturation in PhD studies using qualitative interviews. *In Forum Qualitative Sozialforschung/Forum: Qualitative Social Research*, *11*(3), pp.1-9.
11. Smith, B., Thomsen, W. and Grottick, A. (2006). "The potential use of selective 5HT 2C agonists in treating obesity". Expert Opinion on Investigational Drugs, 15(3), pp.257266. Smith, K. (2010). "Molecular targets for low level light therapy". *Laser therapy*, *19*(3), pp.12-19
12. Smith, M.M. and Minson, C.T., (2012). "Obesity and adipokines: effects on sympathetic overactivity". *The Journal of physiology*, *590*(8), pp.1787-1801
13. Smith, N.R., Kelly, Y.J. and Nazroo, J.Y., (2012). "The effects of acculturation on obesity rates in ethnic minorities in England: evidence from the Health Survey for England". *The European Journal of Public Health*, *22*(4), pp.508-513
14. Staimez, L.R., Weber, M.B., Narayan, K.V. and Oza-Frank, R., (2013). "A systematic review of overweight, obesity, and type 2 diabetes among Asian American subgroups". *Current diabetes reviews*, *9*(4), p.312
15. Stein, J., Stier, C., Raab, H. and Weiner, R., (2014). "Review article: the nutritional and pharmacological consequences of obesity surgery". *Alimentary pharmacology & therapeutics*, *40*(6), pp.582-609
16. Thandassery, R.B., Appasani, S., Yadav, T.D., Dutta, U., Indrajit, A., Singh, K. and Kochhar, R., (2014). "Implementation of the Asia-Pacific guidelines of obesity classification on the APACHE-O scoring system and its role in the prediction of outcomes of acute pancreatitis: a study from India". *Digestive diseases and sciences*, *59*(6), pp.1316-1321
17. Torres, S.J. and Nowson, C.A., (2007). "Relationship between stress, eating behaviour, and obesity". *Nutrition*, *23*(11), pp.887-894
18. Tosaya, C., Blumenfeld, L. and Sliwa, J., Tosaya Carol A and Sliwa John W Jr, (2005). "Ultrasonic apparatus and method for treating obesity or fat-deposits or for delivering cosmetic or other bodily therapy" *U.S. Patent Application*, *11*(262), p.452
19. Turner III, D.W., (2010). Qualitative interview design: A practical guide for novice investigators. *The qualitative report*, *15*(3), p.754.
20. Vasan, S.K., Fall, T., Neville, M.J., Antonisamy, B., Fall, C.H., Geethanjali, F.S., Gu, H.F., Raghupathy, P., Samuel, P., Thomas, N. and Brismar, K., (2012). "Associations of variants in FTO and near MC4R with obesity traits in South Asian Indians". *Obesity*, *20*(11), pp.2268-2277
21. Versini, M., Jeandel, P.Y., Rosenthal, E. and Shoenfeld, Y., (2014). "Obesity in autoimmune diseases: not a passive bystander". *Autoimmunity reviews*, *13*(9), pp.981-1000
22. Vimaleswaran, K., Zhao, J., Wainwright, N., Surtees, P., Wareham, N. and Loos, R. (2010) "Association between serotonin 5-HT-2C receptor gene (HTR2C) polymorphisms and obesity- and mental health-related phenotypes in a large population-based cohort" *International Journal of Obesity Related Metabolic Disorders*, *34*(6), pp.1028-1033.
23. Vimaleswaran, K.S., Berry, D.J., Lu, C., Tikkanen, E., Pilz, S., Hiraki, L.T., Cooper, J.D., Dastani, Z., Li, R., Houston, D.K. and Wood, A.R., (2013). "Causal relationship between obesity and vitamin D status: bi-directional Mendelian randomisation analysis of multiple cohorts". *PLoS Med*, *10*(2), pp. 487-511
24. Volkow, N.D., Wang, G.J., Telang, F., Fowler, J.S., Thanos, P.K., Logan, J., Alexoff, D., Ding, Y.S., Wong, C., Ma, Y. and Pradhan, K., (2008) "Low dopamine striatal D2 receptors are associated with prefrontal metabolism in obese subjects: possible contributing factors". *Neuroimaging*, *42*(4), pp.1537-1543
25. Waltz, C.F., Strickland, O.L. and Lenz, E.R. eds., (2010). *Measurement in nursing and health research.* Berlin: Springer Publishing Company.
26. Wang, J., Feng, B. and Xiong, X., (2013). "Chinese herbal medicine for the treatment of obesity-related hypertension". *Evidence-Based Complementary and Alternative Medicine*, *20*(13), pp. 526-544
27. Wang, S. and Noe, R.A., 2010. Knowledge sharing: A review and directions for future research. *Human Resource Management Review*, *20*(2), pp.115-131.
28. Wang, Y. and Lim, H., (2012). "The global childhood obesity epidemic and the association between socioeconomic status and childhood obesity". *International Review of Psychiatry*, *24*(3), pp.176188
29. Wong, J., Gallagher, M., Gooding, H., Feldman, H., Gordon, C., Ludwig, D. and Ebbeling, C. (2015). "A randomized pilot study of dietary treatments for polycystic ovary syndrome in adolescents". *Paediatric Obesity*, *11*(3), pp.210220.
30. Wright, S. and Aronne, L. (2012) "Causes of obesity". *Abdom Imaging*, *37*(5), pp.730-732.