

EFFECT OF AEROBIC TRAINING ON QUALITY OF LIFE AND MENTAL HEALTH IN OBESE WOMEN

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ABSTRACT

Background: Obesity is increasingly important health problem worldwide including developing countries. Obesity is associated with mental illness and all aspects of individual's quality of life. Aerobic training is mainstay in the management of obesity as it helps in caloric expenditure & weight loss.

Objectives: To assess the effects of aerobic training on quality of life using SF-36 questionnaire and on mental health using Hospital Anxiety and Depression Scale

Study Design: Prospective interventional study

Materials and Methods: 30 women with BMI > 25 kg/m² in the age group of 20-60 years were selected according to convenience sampling method. Then quality of life and mental health evaluation was done using SF-36 questionnaire and Hospital Anxiety and Depression scale respectively. An aerobic training program was given for 8 weeks, 6 sessions per week with each session consisting of warm up & cool down period for 5-10 minutes and aerobic training of 15-45 minutes involving brisk walking, cycling, stair climbing at target heart rate 40%-60% of age predicted maximum heart rate. At the end of 8 weeks reassessment was done.

Results: There was significant statistical difference found in physical functioning, role limitation due to physical health and due to emotional problems, energy levels, social functioning, pain, emotional well-being and general health post 8 weeks of aerobic training using Wilcoxon Signed Rank test p value 0.0001. Also there was statistically significant reduction in weight after aerobic training by using Paired t-test.

Conclusion: We found that aerobic training improved quality of life and mental health in obese women. Also it induced weight loss in obese women.

KEY WORDS: Obesity, aerobic training, quality of life, mental health, SF-36, Hospital Anxiety and depression scale.

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INTRODUCTION

Obesity is a major health concern. Obesity has been implicated as major risk factor for several physical illnesses, functional limitations and poor quality of life [1]. The increased medical problems and mobility restrictions associated

with obesity can have direct impact on psychological well-being [2]. Obesity leads to sedentary life and inability to perform activities of daily living and occupational activities. Also it leads to lack of socialization and low self-esteem. Most of the recent studies point

towards bidirectional relationship between depression and obesity and they have also found association between obesity and anxiety [3]. Obesity is defined as an excessive accumulation of fat in the body resulting in adverse effects on health of the individual [4]. Obesity is an increasingly important health problem worldwide including the developing countries [4]. Overweight and obesity are fifth leading risk for global deaths. In 1997, the WHO formally recognized obesity as a global epidemic. Worldwide obesity has nearly doubled since 1980. At least 2.8 million adults die each year as a result of being overweight or obese.⁵ Obesity has widespread in India in 21st century, with 5% of country's population afflicted by morbid obesity [5]. The National Family Health Survey (NFHS-3) conducted in 2005-2006 indicates that obesity has increased in India significantly especially in women [6-10]. Obesity is not a single disorder but a heterogeneous group of conditions with multiple causes. Body weight is determined by an interaction between genetic, environmental and psychosocial factors acting through, the physiological mediators of energy intake and expenditure [11]. Obesity is associated with a wide range of health problems including circulatory, metabolic, musculoskeletal, respiratory, gastrointestinal etc systems. The net impact of the increased burden of disease associated with obesity is increased mortality. An extensive number of epidemiological studies have established a significant increase in cardiovascular and non-cardiovascular mortality associated with obesity.

WHO defines Quality of life (QOL) as an individual's perception of their position in life in the context of the culture and value systems in their life and in relation to their goals, expectations and concerns [12-15]. Studies have consistently demonstrated that obese individuals have lower quality of life than do average weight individuals [3]. Current findings indicate that a substantial portion of obese individuals in general population experience undesired physical or social consequences of their weight that diminishes their quality of life in one or more areas [16]. Obesity and common mental health disorders account for a significant proportion of global burden of disease [2].

There are bidirectional associations of obesity and mental health problems, with levels of obesity, gender, age, socioeconomic status being key risk factors [2]. In a systematic review and meta-analysis of longitudinal studies: Overweight, obesity, and depression, Luppino FS et al 2010 concluded that 'Obese persons had a 55% increased risk of developing depression over time, whereas depressed persons had a 58% increased risk of becoming obese [17]. Jorm AF et al, 2003 found that obesity has an association with anxiety, depression, and lower well-being in women but not in men [18]. Garipey G et al 2010 showed a moderate level of evidence exists for a positive association between obesity and anxiety disorders [19]. Obesity is associated with variety of chronic diseases most of which are associated with depression [2]. Obese individuals are frequently thought to suffer from depression, low self-esteem and related problems [3]. Women are under greater social pressure than men to be thin. Women report high levels of body image dissatisfaction and so weight has more psychological effects in women than men [2].

Exercise is frequently advocated in the treatment of obesity as a means of increasing energy expenditure and potentially counteracting the negative effects of dietary restriction. Aerobic exercise is advantageous because it may preserve fat free mass, thereby helping to maintain the resting metabolic rate during weight reduction [20]. Aerobic exercise refers to the use of oxygen to adequately meet the energy demands of exercises via aerobic metabolism. Generally aerobic training includes light to moderate intensity activities which can be performed for an extended periods of time [21,22]. Aerobic training is beneficial in improving cardiovascular fitness and can be used as preventive measure in people at risk of developing cardiovascular disease due to obesity [23]. The physical and mental health problems are associated with obesity. Effect of aerobic training is an area of interest for us as mental health in turn helps to enhance physical health and reduce associated health risk. Thus study has been designed to find out the change in quality of life and mental health after aerobic training in obese women.

MATERIALS AND METHODS

Participants: 30 obese women were selected by sample of convenience considering admission of obese women for exercises at physiotherapy department.

Inclusion criteria: women with Body Mass Index more than 25 kg/m² in the age group of 20-60 years

Exclusion criteria: subjects having any acute cardiorespiratory problem, musculoskeletal, neurological problems and subjects participating in any other exercise program. The study was approved by the Institutional Ethical Review Board. All the subjects were informed about the aim, the method of the study and protection of their rights. Informed written consent was taken from all subjects who participated in the study.

Methodology: After recruitment of subjects their basic demographic data, disease, treatment details, weight, height and body mass index were recorded. Then subjects were interviewed for Quality of life evaluation using SF-36 questionnaire and mental health using Hospital Anxiety and Depression Scale.

The Short Form 36 is the most commonly used generic instrument originally developed to measure health outcomes as a part of 2 year observational study of more than 22000 adults [16]. SF-36 assesses 8 domains out of which 6 load on factors that assess either physical health or behavioural health. Of the 36 items, 39% evaluate activity levels. The highest possible score on eight subscales are 100, representing perfect functioning [16]. The SF-36 has proven useful in comparing general and specific populations, estimating the relative burden of different diseases, differentiating the health benefits produced by a wide range of different treatments, and screening individual patients [16]. In obese populations, increasing impairment (particularly on scales assessing physical dimensions) has been reported with increasing weight. Improved functioning has been observed with weight loss (principally on scales assessing physical health) [16].

The Hospital Anxiety and Depression Scale (HADS) have developed by Zigmond and Snaitch in 1983 [40]. The HADS is self-report question-

naire comprised of 14 items with 7 assessing anxiety and 7 assessing depression. The items were scored on 4 point scale from 0-3. The item scores were added giving subscale scores on the anxiety and depression scale from 0-21. A lower score represents better mental health. The HADS has been judged to be well suited for detecting mood disorders among obese and have shown good responsiveness to change in patients operated for morbid obesity [41].

An aerobic training program given to obese women was for duration 8 weeks and frequency-6 sessions/week. Each session consisted of Warm up and cool down in the form of low level of calisthenics and stretching of back and legs for 5-10 minutes each. Aerobic training of 15-45 minutes involving brisk walking, cycling, and stair climbing at Target Heart Rate (THR) 40-60% of age predicted heart rate maximum.

During exercise heart rate was monitored using heart rate monitor. All the subjects were made to exercise to reach up to their target heart rate with graded increase in exercise intensity and duration. At the end of 8 weeks of aerobic training, again assessment of Quality of life and mental health was done.

Statistical Analysis: The data was analysed using Graph pad InStat software version 3.1, at 5% significance. Data normality was assessed using the Kolmogorov-Smirnov test.

The collected data was analysed statistically with Paired T test and Wilcoxon Signed Ranks test.

As the parameter weight was distributed normally, the data was analysed using Paired T test. As the data was ordinal, components of SF-36 questionnaire and Hospital Anxiety and Depression Scale were analysed using Wilcoxon Signed Ranks test.

RESULTS

Demographic data of 30 patients included in the study are as follows:

Parameters	Values
Age (years)	43.76 (±12.32)
Height (meters)	154.66 (±0.0604)
Weight (kg)	75.796 (±9.483)
BMI (kg/m ²)	31.889 (±4.056)

Table 1: Showing the considering the data Wilcoxon Signed Ranks test was used to analyse the median.

Variable	PRE			POST			P-Value	Significance
	Median	S.E.M	95%CI	Median	S.E.M	95%CI		
Physical Functioning	60 (20-95)	3.55	54.829 - 69.353	80 (45-100)	2.427	73.204 - 83.130	<0.0001	Extremely Significant
Role limitation due to Physical Health	35.5 (0 - 100)	6.98	29.054 - 57.612	75 (37.5 - 100)	3.98	64.104 - 80.396		
Role limitation due to Emotional Problems	33.33 (0 - 100)	7.927	30.455 - 62.877	100 (33.3 - 100)	4.149	73.724 - 90.695		
Energy/Fatigue	50 (15 - 80)	3.189	43.146 - 56.188	70 (50 - 90)	2.21	65.480 - 74.520		

As shown in the Table 1, considering the data Wilcoxon Signed Ranks test was used to analyse the median. The difference in physical functioning, role limitation due to physical health, role limitation due to emotional problems and Energy/fatigue before and after aerobic training is extremely significant (p-value < 0.0001)

Table 2: Wilcoxon Signed Ranks test was used to analyse the median.

Variable	PRE			POST			P-Value	Significance
	Median	S.E.M	95%CI	Median	S.E.M	95%CI		
Emotional Well Being	56 (12 - 92)	3.529	51.306 - 65.740	80 (36 - 100)	2.912	70.579 - 82.488	<0.0001	Extremely Significant
Social Functioning	62.5 (0 - 100)	4.734	50.318 - 69.682	75 (50 - 100)	3.139	72.928 - 85.786		
Pain	50 (0 - 100)	5.8	36.039 - 59.795	80 (52.5 - 100)	2.75	72.197 - 83.470		
General Health	41.66 (12.5 - 80)	2.985	37.503 - 49.709	66.5 (50 - 91.66)	2.451	63.469 - 73.492		

As shown in the table 2, Wilcoxon Signed Ranks test was used to analyse the median. The difference in emotional well- being, social functioning, pain and general health before and after aerobic training is extremely significant (p-value < 0.0001).

Table 3: Wilcoxon Signed Ranks test was used to analyse the median.

Variable	PRE			POST			P-Value	Significance
	Median	S.E.M	95%CI	Median	S.E.M	95%CI		
Anxiety Score	9 (2 - 17)	0.7717	7.588 - 10.745	5 (0 - 11)	0.5995	4.441 - 6.893	<0.0001	Extremely Significant
Depression Score	8 (2 - 16)	0.7	6.269 - 9.132	4 (0 - 11)	0.5631	3.115 - 5.418		

As shown in the Table 3, Wilcoxon Signed Ranks test was used to analyse the median. There is an extremely significant difference (p- value < 0.0001) in the anxiety and depression scores before and after aerobic training.

Table 4: Showing the the difference in the weight before and after aerobic training.

As the weight parameter passed the normality test, Paired t-test was used to analyse the mean. The difference in the weight before and after aerobic training is extremely significant (p-value <0.0001) as shown in Table 4.

Weight	PRE	POST
Passed Normality Test	YES	YES
Mean	75.796	73.83
S.E.M	1.731	1.674
95% CI	72.256 - 79.337	70.407 - 77.253
P Value	<0.0001	
Significance	Extremely Significant	

DISCUSSION

Obesity is a complex, multifactorial disease whose etiology involves genetic, metabolic, social, behavioural and cultural factors [42]. Garipey et al 2010 [19] reviewed the literature for a link between obesity and anxiety disorders in the general population, and to present a pooled estimate of association. And they found that overall; a moderate level of evidence exists for a positive association between obesity and anxiety disorders. KM Scott et al 2008 [37], found statistically significant association between obesity and depressive disorders, and between obesity and anxiety disorders.

Several studies have shown that obesity has a significant impact on morbidity and mortality, as well as psychosocial well-being and quality of life. Women seem to be more concerned about obesity than men and are two to three times more likely to seek weight-loss treatment. Also they experience greater dissatisfaction with their weight and shape than men do, and this dissatisfaction increases with BMI. Women also experience more stigma in relation to obesity and are under greater pressure to be slim [2]. John M et al in 2005 studied Physical activity considerations for the treatment and prevention of obesity. Excess body weight is a result of an imbalance between energy intake and energy expenditure. Physical activity is the most variable component of energy expenditure and therefore has been the target of behavioural interventions to modify body weight. Therefore they concluded that physical activity appears to be an important behaviour that may prevent weight gain and significantly contribute to enhancing long-

term weight loss [43]. Aerobic training is beneficial in improving physical activity levels, cardiovascular fitness and caloric expenditure. It increases energy expenditure by activation of lipolysis and affects the reduction of body weight and body fat percentage [23].

This study was designed to evaluate the effects of aerobic training on quality of life and mental health in obese women. The results of this study showed that eight weeks of aerobic training resulted in significant reduction in weight and

significant improvement in quality of life and mental health.

The present study has shown that the mean weight before aerobic training was 75.797 (± 9.483). After aerobic training the weight has changed to 73.83 (± 9.169) showing the weight loss of 1.967, the p value is less than 0.0001 which is considered extremely significant.

Energy balance is the key to maintain the weight. When the energy expenditure is equal to energy intake, body weight is maintained. So to promote weight loss it is necessary to create energy imbalance that elicits an energy deficit. Energy balance is affected by energy expenditure resulting from exercise [43]. The change in weight shown in the present study is attributed to aerobic exercise. Aerobic exercises increase energy expenditure by activation of lipolysis and affect the reduction of body weight and body fat percentage. The American College of Sports Medicine's Guidelines for Exercise Testing and Prescription claim that aerobic exercise is more efficient because it involves a sustained, high rate of energy expenditure [44]. Donnelly J.E et al 1991 stated that Aerobic exercise increases lipid and energy utilization but may indirectly aid weight reduction by increasing lean tissue and metabolic rate [45].

Reduced energy expenditure and impaired fat oxidation are critical factors associated with obesity. Wolf, Donna Lynn et al 2006 concluded that exercise training increases the reliance on fatty acids for energy during physical activity in obese women. Exercise training also improved body composition. These improvements were not affected by the dietary supplement [46]. Willis LH et al 2012 concluded that aerobic training is the optimal mode of exercise for reducing fat mass and body mass, while a program including resistant training is needed for increasing lean mass in middle-aged, overweight/obese individuals [29]. Gwinup G 1987 showed that both walking and cycling are effective methods of reducing body fat [47]. Kempen et al studied the effects of 8 weeks of exercise at 45% of VO_2 max for in obese women and found that fat oxidation was increased in the group combined diet and exercise training compared to diet alone. Increased fat oxidation and improved efficiency of fat oxidation due to

exercise leads to weight loss [48]. Aerobic exercise alone results in clinically significant weight loss for men and women was studied by Joseph E. Donnelly et al 2013. The objective of this study was to evaluate the effect of aerobic exercise, without energy restriction, on weight loss in sedentary overweight and obese men and women. They found that

supervised exercise, with equivalent energy expenditure, results in clinically significant weight loss with no significant difference between men and women [49]. In a systematic review and meta-analysis, Dirk Vissers et al 2013 suggested that an aerobic exercise program, without hypo caloric diet, can show beneficial effects to reduce visceral adipose tissue [50]. Ismail et al 2011 suggest that aerobic exercise is central for exercise programs aimed at reducing visceral adipose tissue, and that aerobic exercise below current recommendations for overweight/obesity management may be sufficient for beneficial visceral adipose tissue modification [51]. Other than visceral fat, aerobic training decreases weight from fat and muscle compartment as showed by Lehri A. et al (2006) [52]. The above studies support finding of this study that 8 weeks of aerobic training results in weight reduction. Exercise can result in health and fitness benefits in the obese independent of weight loss. An increase of fitness can decrease the risk of cardiovascular disease and type 2 diabetes even if no weight loss is observed. The result of the present study has shown that the quality of life of obese women significantly improved after 8 weeks of aerobic training. The components of SF-36 questionnaire which was used to assess quality of life showed significant difference before and after 8 weeks of aerobic training.

The physical functioning has changed from 60(20-95) to 80(45-100) and p value is <0.0001 which is extremely significant. The role limitation due to physical health has changed from 37.5(0-100) to 75(37.5-100) with p value < 0.0001. Role limitation due to emotional problems has changed from 33.33(0-100) to 100(33.33-100) and p value is < 0.0001. Energy/fatigue has changed from 50(15-80) to 70(50-90) with p value < 0.0001. Emotional well-being has changed from 56(12-92) to 80(36-100), p value

< 00001. Social functioning has changed from 62.5(0-100) to 75(50-100), p value < 0.0001. Pain has changed from 50(0-100) to 80(52.5-100) and the p value is < 0.0001. General health has changed from 41.66(12.5-80) to 66.55(50-91.66) with p value < 0.0001. Katschnig H et al in 1997 defined quality of life as a "loosely related body of work on psychological well-being, social and emotional functioning, health status, functional performance, life satisfaction, social support, and standard of living, whereby normative, objective, and subjective indicators of physical, social and emotional functioning are all used" [53]. In a randomized controlled trial by Ikeyama et al 2011 Overweight/obese postmenopausal women were randomly assigned to 12 months of dietary weight loss (n = 118), moderate-to-vigorous aerobic exercise (225 minutes/week, n = 117), combined diet and exercise (n = 117), or control (n = 87). The results showed that twelve-month changes in health related quality of life and psychosocial factors differed by intervention group. Regardless of intervention group, weight loss predicted increased physical functioning, role-physical, vitality, and mental health, while increased aerobic fitness predicted improved physical functioning [27]. Jennifer T et al 1999 showed that weight loss in overweight women was associated with improved physical function and vitality as well as decreased bodily pain. Weight change was more strongly associated with physical rather than mental health [33]. Thus, the improvement in quality of life shown in the present study can be attributed to weight loss. Deborah J Bowen et al 2006 presented results of a randomized trial of moderate-to-vigorous intensity exercise in middle aged, sedentary women and reported changes in and correlates of quality of life and functional status of exercise intervention program for both the short (three months) and longer term (12 months) and documented improvements in quality of life and general functioning that occurred as a result of participating in an exercise intervention in sedentary middle-aged women. This supports the finding of the present study that 8 weeks of aerobic training results in significant improvement in quality of life [26].

The result of the present study has shown that

the anxiety score has changed from 9 (2-17) to 5 (0-11) and depression score has changed from 8 (2-16) to 4 (0-11) with p-value < 0.0001. The difference in scores pre and post aerobic training is extremely significant. In the present study out of 30 subjects, 14 subjects reported both anxiety and depression, 6 subjects reported only anxiety, 3 subjects

reported only depression and 7 subject reported no anxiety and depression. The 7 subjects with no anxiety and depression were also included in the study. This is supported by Fitzgibbon ML et al 2003 stated that obese patients who seek weight reduction report significantly greater psychological distress than did comparably obese individuals who did not seek treatment [54]. Menan A. Rabiél et al 2010 determined that the prevalence of social anxiety symptoms among overweight females seeking treatments for obesity is very high [55]. The World Health Organization defines mental health as 'a state of well-being in which an individual realizes his or her own abilities, can cope with the normal stresses of life, can work productively and is able to make a contribution to his or her community. In this positive sense, mental health is the foundation for individual well-being and the effective functioning of a community' [2]. The most common mental health problems as defined by the National Service Framework for Mental Health are depression and anxiety disorders [2]. Depression is a negative mood state which involves a feeling of sadness while anxiety is a mood state in which feelings of fear predominate and where the fear is out of proportion to any threat [2]. Aerobic training including cycling, walking have been proved to reduce anxiety and depression. These improvements in mood are proposed to be caused by exercise induced increase in blood circulation to the brain and by an influence on the hypothalamic-pituitary-adrenal axis and thus on the physiologic reactivity to stress [56]. Scully D et al 1998 stated that aerobic exercises are effective in producing anti-anxiety and anti-depressant effects [57]. Richardson CR et al 2005 proposed hypotheses to explain beneficial effects of physical activity on mental health include distraction, self-efficacy and social interaction

[58]. James J Annesi 2008 found that there was a feeling of self-efficacy because of participation in the exercise program which was associated with an enhanced psychological profile and better mood. Exercise distracts people from stressful events and thoughts that can produce anxiety and it improves mental health by reducing anxiety,

depression and by improving self-esteem and cognitive function [59]. Also there is release of neurotransmitters like endorphins and enkephalin with exercises which have the calming effect on the body.

The present study has shown significant reductions in anxiety and depression post aerobic training. This change in turn may contribute to individuals' willingness to maintain positive physical activity and nutritional practices which will result in initial weight loss and long term maintenance of weight loss. In this study there is significant improvement in the quality of life and mental health after 8 weeks of aerobic training in obese women. Also there is statistically significant weight loss occurred after aerobic training.

CONCLUSION

From our study we conclude that 8 weeks of aerobic training improved quality of life and mental health in obese women. Aerobic training induced statistically significant reduction in the weight. There was statistically significant difference found in physical functioning, role limitation due to physical health, role limitation due to emotional problems, energy levels, social functioning, pain, emotional well-being and general health.

Conflicts of interest: None

REFERENCES

- [1]. Gadalla TM Association of obesity with mood and anxiety disorders in the adult general population. *Chronic Dis Can* 2009;30(1):29-36.
- [2]. Obesity and Mental health National Obesity Observatory March 2011.
- [3]. Anthony N. Fabricatore, PhD, and Thomas A. Wadden, PhD Psychological functioning of obese individuals *Diabetes Spectrum* 2003;16(4).
- [4]. A Misra, P Chowbey, BM Makkar, NK Vikram, JS Wasir, D Chadha, Shashank R Joshi, S Sadikot, R Gupta, Seema Gulati, YP Munjal Consensus Statement for Diagnosis of Obesity, Abdominal

- Obesity and the Metabolic Syndrome for Asian Indians and Recommendations for Physical Activity, Medical and Surgical Management JAPI 2009;57.
- [5]. Obesity and Overweight World Health Organization, Fact sheet 2013
 - [6]. Dang M. Nguyen, MD and Hashem B.El -Serag, MD, MPH The Epidemiology of Obesity Gastroenterol Clin North Am.2010;39(1):17.
 - [7]. Body Mass Index as a measure of Obesity. National Obesity Observatory.June 2009.
 - [8]. Jack H Wilmore, David L Costillo. Obesity, diabetes and Physical activity. Physiology of sports and exercise,3rd edition pg.675-676.
 - [9]. Louis J. Aronne Classification of obesity and assessment of obesity-related health risks. Obes Res. 2002;10:105S-115S.
 - [10]. WHO Expert Consultation Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies Lancet 2004; 363: 157-63.
 - [11]. Peter G. Kopelman Obesity as a Medical problem Nature 2000;404.
 - [12]. Michael L. Pollock, Jack H. Wilmore. Exercise in Health and Disease.1990;pg. 71.
 - [13]. Health risks of adult obesity. National Obesity Observatory Public Health England 2013.
 - [14]. Xavier Pi-Sunyer The Medical Risks of Obesity Postgrad Med. 2009;121(6):21-33.
 - [15]. WHO Centre for Study of Quality of Life. Department of Psychology, University of Bath, Bath,UK Accepted in revised form 2003.
 - [16]. Wadden TA, Phelan S. Assessment of quality of life in obese individuals. Obesity research. 2002 Nov 1;10(S11):50S-7S.
 - [17]. Luppino FS, de Wit LM, Bouvy PF, Stijnen T, Cuijpers P, Penninx BWJH, Overweight, obesity, and depression: a systematic review and meta-analysis of longitudinal studies. Archives of General Psychiatry 2010;67(3):220-9.
 - [18]. Jorm AF, Korten AE, Christensen H, Jacomb PA, Rodgers B, Parslow RA. Association of obesity with anxiety, depression and emotional well-being: a community survey. Aust N Z J Public Health. 2003; 27(4):434-40.
 - [19]. Garipey G, Nitka D, Schmitz N. The association between obesity and anxiety disorders in the population: a systematic review and meta-analysis. Int J Obes (Lond). 2010 Mar;34(3):407-19.
 - [20]. Susan B Racette , Dale A Schoeller, Robert F Kushner, Karen M Neil, Kim Herling-Iaffaldano. Effects of aerobic exercises and dietary carbohydrate on energy expenditure and body composition during weight reduction in obese women.Am J Clin Nutr 1995; 61: 486-94.
 - [21]. Sharon A.Plowman , Denise J Smith. Exercise Physiology for Health, fitness and Performance. Lippincott Williams & Wilkins.2007; pg .61.
 - [22]. McArdle:F. Katch; V.Katch. Essentials of exercise Physiology. Lippincott Williams & Wilkins 2006 pg. 204.
 - [23]. Sarika Chaudhary, Manpreet Kaur Kang; Jaspal Singh Sandhu. The Effects of Aerobic Versus Resistance Training on Cardiovascular Fitness in Obese Sedentary Females. Asian Journal of Sports Medicine,2010;1(4):177-184.
 - [24]. Jones GL, Sutton A. Quality of life in obese postmenopausal women. Menopause Int. 2008;14(1):26-32.
 - [25]. Valeria H Taylor. Mary Forhan, Simone N. Vigod, RogerS. McIntyre, Katherine M. Morrison, MD (Associate Professor) The Impact of Obesity on Quality of Life. Best Practice & Research Clinical Endocrinology & Metabolism 2013; 27:139-146.
 - [26]. Deborah J Bowen, Megan D Fesinmeyer, Yutaka Yasui, Shelley Tworoger, Cornelia M Ulrich, Melinda L Irwin, Rebecca E Rudolph, Kristin L LaCroix, Robert R Schwartz and Anne McTiernan Randomized trial of exercise in sedentary middle aged women:effects on quality of life. International Journal of Behavioral Nutrition and Physical Activity 2006, 3:34.
 - [27]. Ikuyo Imayama, Catherine M Alfano, Angela Kong, Karen E Foster-Schubert, Carolyn E Bain, Liren Xiao,Catherine Duggan, Ching-Yun Wang, Kristin L Campbell, George L Blackburn and Anne McTiernan. Dietary weight loss and exercise interventional effects on quality of life in overweight/obese postmenopausal women:a randomized-controlled trial. International Journal of Behavioral Nutrition and Physical Activity 2011, 8:118.
 - [28]. James M. Rippe,Janet M. Price, t Stacey A. Hess, Greg Kline.i Kimberly A. DeMers, Susanne Damitz, Imad Kreidieh, Patty Freedsoni. Improved psychological well-being, quality of life, and health practices in moderately overweight women participating in a 12-week structured weight loss program. Obes Res. 1998;6:208-218.
 - [29]. Willis LH, Slentz CA, Bateman LA, Shields AT, Piner LW, Bales CW, Houmard JA, Kraus WE. Effects of aerobic and/or resistance training on body mass and fat mass in overweight or obese adults. J Appl Physiol. 2012; 113(12):1831-7.
 - [30]. James J. Annesi. Relationship of physical activity and weight loss in women with Class II and Class III obesity:Mediation of exercise-induced changes in tension and depression. International Journal of Health and Clinical Psychology. 2010; 10: 435-444.
 - [31]. Sarsan A, Ardiç F, Ozgen M, Topuz O, Sermez Y. The effects of aerobic and resistance exercises in obese women.Clin Rehabil. 2006 Sep;20(9):773-82.
 - [32]. Di Lorenzo TM, Bargman EP, Stucky-Ropp R, Brassington GS, Frensch PA, LaFontaine T. Long-term effects of aerobic exercise on psychological outcomes.Prev Med. 1999 Jan;28(1):75-85.
 - [33]. Jennifer T. Fine; Graham A. Colditz; Eugenie H. Coakley; George Moseley; JoAnn E. Manson; Walter C. Willett; Ichiro Kawachi. A Prospective study of weight change and health related quality of life in women. JAMA 1999; 282: 2136-2142.

- [34]. Kolotkin RL, Meter K, Williams GR. Quality of life and obesity. *Obes Rev*. 2001 Nov;2(4):219-29.
- [35]. Edward H Livingston; Aaron S. Fink. Quality of Life Cost and Future of Bariatric Surgery. *ARCH SURG* 2003; 138:383-388.
- [36]. Zhao G, Ford ES, Dhingra S, Li C, Strine TW, Mokdad AH. Depression and anxiety among US adults: associations with body mass index. *Int J Obes (Lond)*. 2009 Feb;33(2):257-66.
- [37]. KM Scott, R Bruffaerts, GE Simon, J Alonso, M Angermeyer, G de Girolamo, K Demyttenaere, Gasquet, JM Haro, E Karam, RC Kessler, D Levinson, ME Medina Mora, MA Oakley Browne, J Ormel, JP Villa, H Uda and M Von Korff. Obesity and mental disorders in the general population: results from the world mental health surveys. *International Journal of Obesity* 2008;32:192-200.
- [38]. López-Alvarenga JC, Vázquez-Velázquez V, Arcila-Martínez D, Sierra-Ovando AE, González-Barranco J, Salín-Pascual RJ. Accuracy and diagnostic utility of the Hospital Anxiety and Depression Scale (HAD) in a sample of obese Mexican patients. *Rev Invest Clin*. 2002 Sep-Oct;54(5):403-9.
- [39]. Ben Michael Brumpton, Linda Leivseth, Pål Richard Romundstad, Arnulf Langhammer, Yue Chen, Carlos Arturo Camargo Jr and Xiao-Mei Mai. The joint association of anxiety, depression and obesity with incident asthma in adults: the HUNT Study. 2013.
- [40]. Zigmond AS, Snaith RP: The hospital anxiety and depression scale. *Acta Psychiatr Scand* 1983, 67:361-370.
- [41]. John Roger Andersen, Anny Aasprang, Per Bergsholm, Nils Sletteskog, Villy Våge and Gerd Karin Natvig. Anxiety and depression in association with morbid obesity: changes with improved physical health after duodenal switch. *Health and Quality of Life Outcomes* 2010, 8:52.
- [42]. Francesco Corica, Andrea Corsonello, Giovanni Apolone, Maria Lucchetti, Nazario Melchionda, Giulio Marchesini. Construct Validity of the Short Form-36 Health Survey and Its Relationship with BMI in Obese Outpatients. *OBEsITY* 2006; 14(8).
- [43]. John M Jakicic and Amy D Otto Am. Physical activity considerations for the treatment and prevention of obesity. *J Clin Nutr* 2005;82(suppl):226S-9S.
- [44]. Hirsch, J.L. & Batchelor, B. Adipose tissue cellularity and human obesity. *Clinical Endocrinology and Metabolism*. 5: 299, 1976.
- [45]. Donnelly, J.E., Pronk, N.P., Jacobsen, D.J., Pronk, S.J., Jakicic, J.M., Effects of a very-low-calorie diet and physical-training regimens on body composition and resting metabolic rate in obese females. *American Journal of Clinical Nutrition*. 1991;54(1): 56-61.
- [46]. Wolf, Donna Lynn. The Effects of Exercise Training and Dietary Supplementation on Fat Metabolism and Body Composition in Obese Women. 2006.
- [47]. Gwinup G. Weight loss without dietary restriction efficacy of different forms of aerobic exercises. *Am J Sports Med*. 1987;15(3):275-9.
- [48]. Ellen E. Blaak, Wim H. M. Saris. Substrate oxidation, obesity and exercise training. *Best Practice & Research Clinical Endocrinology and Metabolism*. 2002;16:667-668.
- [49]. Joseph E. Donnelly, Jeffery J. Honasa, Bryan K. Smith, Matthew S. Mayoc, Cheryl A. Gibson, Debra K. Sullivan, Jaehoon Lee, Stephen D. Herrmann, Kate Lambourne, and Rik A. Washburn. Aerobic exercise alone results in clinically significant weight loss for men and women: Midwest Exercise Trial-2. *Obesity (Silver Spring)*. 2013; 21(3): E219-E228.
- [50]. Dirk Vissers, Wendy Hens, Jan Taeymans, Jean-Pierre Baeyens, Jacques Poortmans, Luc Van Gaal. The Effect of Exercise on Visceral Adipose Tissue in Overweight Adults: A Systematic Review and Meta-Analysis. *Exercise and Visceral Adipose Tissue*. 2013; 8
- [51]. I. Ismail S. E. Keating, M. K. Baker, N. A. Johnson. A systematic review and meta-analysis of the effect of aerobic vs. resistance exercise training on visceral fat. *Obesity Reviews*. 2011; 13: 68-91.
- [52]. Lehri A. and Mokha, R. Effectiveness of Aerobic and Strength training in causing weight loss and favorably body composition in females. *Journal of Exercise Sciences and Physiology*. 2006; 2: 96-99.
- [53]. Katschnig H. How useful is the concept of quality of life in psychiatry? In: Katschnig H, Freeman H, and Sartorius M, eds. *Quality of Life in Mental Disorders*. New York: Wiley; 1997, pp. 3-15
- [54]. Fitzgibbon ML, Stolley MR, Kirschenbaum DS: Obese people who seek treatment have different characteristics than those who do not seek treatment. *Health Psychol* 1993;12:342-345.
- [55]. Menan A. Rabi, Nahla Fawzy Abo El-Ezz, Mervat Salah-el-Din. Anxiety and Social Anxiety symptoms among overweight females seeking treatment for obesity. *Current Psychiatry*. 2010;17(4):13-20.
- [56]. Guskowska M. Effects of exercise on anxiety, depression and mood. *Psychiatry Pol* 2004;38: 611-620.
- [57]. Scully, D., Kremer, J., Meade, M.M., Graham, R., Dudgeon, K. 1998. Physical exercise and psychological well-being: a critical review. *British Journal of Sports Medicine*. 32; 111-120.
- [58]. Richardson CR, Faulkner G, McDevitt J, Integrating physical activity into mental health services for person with serious mental illness. *Psychiatry Serv*. 2005; 56: 324-331.
- [59]. Callaghan P. Exercise a neglected intervention in mental health care. *Psychiatry Ment Health Nurs*, 2004; 11: 476-483.
- [60]. James J 2008 Relations of mood with BMI changes in severely obese women. *Obesity facts* 2008;1:88-92.