Review Article

EFFECT OF PHYSICAL ACTIVITY ON RESPIRATORY FUNCTION IN OBESE: A SYSTEMIC REVIEW

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ABSTRACT

Obesity is known to be a major risk of whole range of cardio vascular, metabolic and respiratory disorders. Presently Malaysia has a highest obesity population among south East Asia. Lung age increased in morbidly obese women and is associated with increased body mass and BMI. Exercise training and dietary management is now gaining popularity. Most of the studies showed that there was a direct improvement on respiratory parameters in obese people either with aerobic or anaerobic exercise. The benefits of various forms of physical activity and response with long term follow up need to be further assessed.

KEYWORDS: Obesity; Physical activity; Respiratory function.

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INTRODUCTION

Obesity is known to be a major risk of whole range of cardio vascular, metabolic and respiratory disorders. Various studies showed that obesity has various effects on respiratory system by producing obstructive sleep apnoea, obesity hypoventilation syndrome and abdominal compartment syndrome. It has been recognised that the pattern of fat distribution plays an important role in altering parameters and lung function by interfering the respiratory physiology. The World Health Organization (WHO 2013)[1] predicts that, by 2015, around 700 million adults will be obese (at least 10% of the projected global population). In 2005 there was 37.2% of female obese population in Malaysia but in 2010 it reaches to 42.2% of population. According to the health care Malaysia's report of May 2013 two out of three adults are obese. Presently Malaysia has a highest obesity population among south East Asia.

In this review we mainly focus on physical activity such as aerobic or anaerobic exercise that alters the respiratory parameters on obese population. The major respiratory complications of obesity include a heightened demand for ventilation, elevated work of breathing, respiratory muscle inefficiency and diminished respiratory compliance. Obese can profoundly alter pulmonary function and diminish exercise capacity by its adverse effects on respiratory mechanics, resistance with in the pulmonary system, respiratory muscle function , lung volumes, work and energy cost of breathing, and gaseous exchange. In obese people, the presence of adipose tissue around the rib cage and abdomen and in the visceral cavity loads the chest wall and reduces functional residual capacity (FRC) by Salome et al (2010)[2]. Weight loss can reverse many alterations in pulmonary function produced by obesity.

To investigate the effect of obesity on respiratory system, most researches used values of pulmonary function test (PFT). The spirometry tests measured were the forced vital capacity (FVC), forced expiratory volume in one second (FEV1), peak expiratory flow rate (PEFR) and forced mid-expiratory flow (FEF 25-75%) and ratio of FEV1 to FVC was calculated to find the impact of obesity on ventilation. But most of the studies focus on FEV1, minute ventilator volume and ERV. Obese children have more respiratory symptom than their normal weight peers. They have significant restrictive pulmonary defect, evident small airway obstruction and defect in respiratory musculature, weak effort and coordination, with increase airway resistance. Body mass index (BMI) was inversely correlated with most of pulmonary function abnormalities by Faridha et al (2009)[3]. Lung age increased in morbidly obese women and is associated with increased body mass and BMI by Fabina et al (2013)[4].

Impaired pulmonary functions are associated with increased mortality and morbiity. Physical activity known to improve physical fitness and to reduce morbidity and mortality from numerous ailments. Exploration of relation between aerobic exercise and respiratory function will aid in understanding the mechanisms of how aerobics improve quality of life. Moderate weight loss by 12 weeks diet and exercise program significantly improve breating mechanics during exercise for obese men by Tony et al (2011)[5].

The major effects of aerobic exercises are the enhancing of breathing efficiency and to decrease pulmonary resistance and other hand decreases fat percentage by Kippelen et al (2005)[6].

Pulmonary dysfunction occurs in 58.2% obese early adolescents. The most common abnormality was combined type (30%), followed by restrictive (25.5%), and obstructive type (2.7%). There was no correltion between BMI and pulmonary function test parameters by Bambang et al (2010)[7]. The effect of physical activity was shown in increment of FVC and decrease of resting heart rate by Fuster et al (2008)[8]. Obesity has an impact on respiratory functions even in younger age group hence we have to safeguard against the hazards of obesity by taking corrective steps through our health program by Kalpana et al (2011)[9].

The need for several researches in this area is important and currently there are few trials registered in various clinical trials around the world. Therefore, to creates awareness and check interest in exercise training this review was aimed to highlight the on-going trail on exercise training in obese population.

In addition to reduced FEV1 in respiratory disease, a powerful predictor of some chronic disease such as heart disease and of mortality due to cardiovascular disease by Sin et al, (2005)[10]. Total body fat and central adiposity are inversely associated with lung function, but increase FFM reflecting increases in muscle mass is associated with increased lung function and lower odds of low FEV1-FVC in elderly, by Goya et al (2005)[11].

Search strategy

Trails were searched between the years of 2000 to 2013. International Standard Randomised Controlled Trial Number (ISRCTN), World Health Organisation-International Clinical Trail Registry Platform (WHO-ICTRP), PubMed was searched using key word of “physical training for obese”, “physical training improves lung function in obese”, “aerobic improve pulmonary function in obese”.

DISCUSSION

Table 1 and table 2 showing various trails on obese people and ways to improve their pulmonary function. Most of the studies showed that there was a direct improvement on respiratory parameters in obese people either with aerobic or anaerobic exercise. In one particular study by Leao da silva (2012)[22] interdisciplinary intervention for one year duration, there is reduction in leptin that indirectly showed improvement in lung function. Another presentation by Shehab (2007)[14] found that significant reduction in body mass index (BMI) in both aerobic and anaerobic group. But the reduction in aerobic exercise group is higher than reduction in anaerobic group and MVV is also increased in aerobic exercise group than anaerobic group. Exercise training and dietary management is now gaining popularity and is

Table 1: Summary of published studies on physical training in obese.

Number of participants	Intervention (Intensity)	Duration	Result	Reference
Exp group 40 Control group 40	Aerobic training	16 weeks	P < 0.05 significant improvement in MVV.	Chaitra et al (2013)[12]
Exp group- 20 Control group- 20	Aerobic running (65 to 80% THR)	36 weeks, 45 min each sessions	P value <0.05 for FEVC & FIVC.	Zahra et al (2013)[13]
Aerobic group-15, Anaerobic group-15	Aerobic exercise, anaerobic exercise	12 weeks (4 sessions / week for aerobic group) (2 session/ week for anaerobic group)	t value for aerobic exercise group is 12.4 and for anaerobic exercise group is 4.3.	Shehab et al (2007)[14]
30 participants	Treadmill running	24 weeks (3 days/week)	FEV1 (pre-exercise 3.19+0.36, mid exercise 3.19+0.36 and post exercise 3.20+0.36). FVC (pre exercise 3.67+0.43, mid exercise 3.68+0.43, post exercise 3.73+0.43). MVV (pre exercise 127.6+12.1, mid exercise 127.4+12.3, post exercise 128.2+12.04). BMI (pre exercise 28.83+1.7, mid exercise 28.61+1.7, 28.44+1.7).	Ahmed et al (2011)[15]
Exp group-40, Control group- 20	Treadmill training	3 months	FVC,FEV1,MMEFR significant p value <0.05	Shamy et al (2012)[16]
70 obese with asthma	Cycling	Acute Cycling	P=0.05 for FVC, FEV1/FVC. P value=0.026 for MVV and respiratory muscle strength	Mojtaba et al (2011)[17]
9 obese	Diet+ submaximal exercise	12 weeks	P- 0.05 increased significant for FRC and ERV	Tony et al (2011)[5]
16 obese and 16 volunteers	Progressive cycling	12 weeks	Improvement in expiratory flow limitations and operational lung volumes	Mendelson et al (2012)[18]
35 subjects	Aerobic exercise, WI	Not specified	Aerobic exercise group improvement in VO2 but no change in lung volumes but 3% increase in FVC, 18% increase in FRC, 8% increase in RV but no change in FEV1, FEV1/FVC	Womack et al (2000)[19]
Exp group-40, Control group- 20	Aerobic training	16 weeks	Exp group p value=0.007 and control group p value=0.491 for PEFR.	Chaitra et al (2011)[20]
15 adolescent	Indoor and outdoor swimming activity	12 weeks (3 days/week for 30 to 60 min)	Improvement in VO2 peak 17.5%, oxygen pulse -15.8%.	Peter et al (2007)[21]
84 post pubertal adult	Interdisciplinary intervention consisting of physiotherapy, medical, nutritional, exercise, and psychological therapy	1 year duration	Reduction in leptin level(indicates improvement in lung function)	Leao da Silva et al (2012)[22]
9 obese adult	Graded cycle ergometry	12 weeks	Lung volume subdivision at rest were improved where p<0.05 and EELV significane of p<0.05.	Babb et al (2011)[23]
Totally 20 patients among that 10 patients	RMET (30-min isocapnic hyperpnea at 60-80% maximum voluntary ventilation	3-4 times per week during the whole hospitalization period: RMET group)	Vital capacity increased in the RMET group (+0.20 ± 0.26 l, P = 0.039).	Villiot et al (2011)[24]
20 overweight children	Graded cycle exercise test using stationary cycle	8 weeks	Increase in oxygen uptake and ventilator equivalent of carbondioxide.	Kaufman et al (2007)[25]
85 overweight and obese women	Weight control program include physical activity and diet control	16 months	Controlling for VO(2) max and age (P=0.007, P=0.511 and P=0.331).	Minderico et al (2008)[26]
60 female university obese adult	Moderate intensity continuous training.	12 weeks, 5 times per week.	Significant improvements in body composition, left ventricular ejection fraction, heart rate at rest, maximal oxygen uptake and ventilatory threshold.	Sijie et al (2012)[27]
45 obese adult	treadmills, ellipticals, or stationary bikes 60–75% of VO2peak using caloric burning.	3 months, 3 times per week of 60 min duration (include 5 min warm up and 5 min cool down)	Cardiorespiratory fitness p<0.05 by open circuit spirometry.	Lee et al (2011)[28]
10 obese women	Strength exercise and aerobic exercise at the ventilatory threshold.	12 weeks, 3 times per week for 90 min.	Ventilatory efficiency (ΔE/ΔCO(2)) and cardiac efficiency (ΔHR/ΔO(2) improved with significance of p<0.05 respectively.	Castres et al (2011)[29]
3 groups randomly selected. High intensity=14, low intensity=13, non exercise group=12	Endurance exercise program at different intensities. High intensity and low intensity.	20 weeks, 30 min/session.	Significant improvement was seen in HG in majority of cardio respiratory parameters (VO2max, heart rate, EDV, MVV, PEFR, FVC) as compared to the LG (VO2max, heart rate, MVV, PEFR)	Sandip et al (2012)[30]

Table 2: Summary of ongoing trail registered in various database.

Country	Number of participants	Intervention	Duration	Topic/Result	Author & trial No
Norway	30 enrolment. 18 to 70 years.	Interval training 10 min warm up, 4X4 min of high intensity 90 – 95 % of maximum heart rate.	3days per week for 3 months.	On trial- The Effect of Aerobic Interval Training on Obstructive Sleep Apnea, Cardiovascular and Pulmonary Function in Obese Patients	Trine et al ClinicalTrials.gov Identifier: NCT01215617
United Kingdom.		Not disclosed	12 months	A Trial of Rehabilitation in Obesity Hypoventilation Syndrome (OHS) Outcome measures- 1. Weight loss. 2. 6 minute walk test.	Nicholas hurt ClinicalTrials.gov Identifier: NCT01483716.
China	330 participants of 30 to 65 years	Individualized aerobic exercise program.	6 months	Effects of exercise and diet interventions on obesity-related sleep disorders in men: study protocol for a randomized controlled trial. Outcome measures: include anthropometry, body composition, and fitness.	Xiao et al Current Controlled Trials ISRCTN77172005
United Kingdom	60 overweight population	Healthy eating messages, advice on physical activity and use of behaviour change techniques.	12 weeks and 6 months	Piloting a manualised weight management programme (Shape Up-LD) for overweight and obese persons with mild-moderate learning disabilities: study protocol for a pilot randomised controlled trial.	Beeken et al International Standard Randomised Controlled Trial No ISRCTN39605930.
Sweden	64 (9 to 13 years children's)	Life style program include 1 third of the part physical training.	12 months	A controlled study of lifestyle treatment in primary care for children with obesity.	Marild et al ISRCTN44919688.
Netherland	Seventy-five children's (29 overweight, 46 obese) aged 3 to 5 years.	multidisciplinary intervention program	12 months	Results of a multidisciplinary treatment program in 3-year-old to 5-year-old overweight or obese children: a randomized controlled clinical trial.	Bocca et al isrctn.org Identifier: ISRCTN47185691.
Japan	29 overweight /obese children's	Combined aerobic and resisted exercise program	12 weeks	A 12-week after-school physical activity programme improves endothelial cell function in overweight and obese children: a randomised controlled study.	Park et al Current Controlled Trials ISRCTN19037201.
Netherland	2622 participants aged 6 to 12	Three physical education (PE) sessions a week by a professional PE teacher, additional sport and play activities outside school hours and an educational program.	1 year	Effectiveness of a primary school-based intervention to reduce overweight.	Jansen et al ISRCTN84383524
United Kingdom	Recruiting participants (18 years and older)	Exercise and nutrition programme in addition to NIV	Not disclosed Expected 3 months	A Trial of Rehabilitation in Obesity Hypoventilation Syndrome (OHS)	Nicolas hurt ClinicalTrials.gov identifier: NCT01483716
Norway	30 enrolled 18 Years to 75 Years	Interval aerobic exercise program	3 months 3 days /week	The Effect of Aerobic Interval Training on Obstructive Sleep Apnea, Cardiovascular and Pulmonary Function in Obese Patients	Trine et al Clinical trial- NCT01215617

still in early stages of research however most of the study is based on small group and short duration of follow up.

CONCLUSION

The search registered trail in ISRCTN and national clinical trial (NCT) up to October 2013. The various trail registered in various countries such as China, Netherlands, United Kingdom, Sweden and Japan are summarised. The most of the study related to obesity are not concentrated in respiratory parameters, only very few studies concentrated on respiratory parameters such as obstructive sleep apnoea. The benefits of various forms of physical activity and response with long term follow up need to be further assessed. More trail need to

focus on physical activity for obese who suffer from severe morbidity. Collaborative studies with those on going trails will help expand the horizon of physical activity for obese towards respiratory function.

Conflicts of interest: None

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