The impact of obesity on walking and physical performance

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Received 18 March 2014
Accepted 14 April 2014

The Egyptian Society of Internal Medicine
2014, 26:40–44

Background
Obesity-induced limitations of the cardiopulmonary and the metabolic systems, resulting in exertional dyspnea, contribute to the limitations in the functional capacity frequently observed in obese individuals. In addition, the sedentary lifestyle often adopted by these individuals further compounds and contributes to impaired exercise tolerance.

Aim of the study
The current study was conducted to detect the effect of lifestyle modification in the form of weight reduction by diet and aerobic exercise on walking and physical performance.

Patients and methods
Twenty obese participants were included in this study. Their ages ranged from 25 to 43 years. All participants were evaluated before the first session of physical therapy program and at the end of the program after 2 months of exercise and a low-caloric diet of 25 kcal/kg actual weight/day through physical evaluation, which included anthropometric measurements, BMI, inspiratory capacity, and a physical performance test, which includes four tests (15-m rapid walking test, a timed up-and-go test, and stair climbing and stair descending tests).

Results
Analysis of data revealed significant improvement in the parameters assessed as follows: weight decreased from 81.3 ± 8.5 to 68.00 ± 4.50 kg ($P \leq 0.001$); BMI decreased from 29.8 ± 2.0 to 24.1 ± 2.0 kg/m^2 ($P \leq 0.001$); waist circumference decreased from 120.3 ± 14.4 to 112.3 ± 9.6 cm ($P = 0.053$); hip circumference decreased from 121.3 ± 6.1 to 112.6 ± 11.4 cm ($P = 0.009$); inspiratory capacity increased from 14.4 ± 2.7 to 21.0 ± 2.3 s ($P \leq 0.001$); time of 15 m walk decreased from 21.2 ± 1.7 to 15.5 ± 2.1 s; timed up-and-go test decreased from 24.1 ± 2.8 to 15.3 ± 2.3 s; stair climbing time decreased from 45.3 ± 6.5 to 34.2 ± 2.6 s; stair descending time decreased from 36.2 ± 2.3 to 27.2 ± 2.1 s. Hence, the total physical performance increased from 31.9 ± 10.3 to 23.0 ± 8.5 s ($P \leq 0.001$) and consequently improved the quality of life.

Conclusion
Lifestyle modification in the form of a low-caloric diet accompanied by exercise has a positive effect on physical performance and consequently on the quality of life.

Keywords:
aerobic exercise, obesity, physical performance, weight reduction

Egypt J Intern Med 26:40–44

1110-7782

Introduction

Obesity is a chronic medical condition characterized by an excessive accumulation of fat in the human body that causes a generalized increase in body mass. It is measured by the BMI, which is a reflection of weight and height. BMI is calculated as the weight in kilograms divided by the square of the height in meters [BMI = weight (kg)/height (m^2)]. The WHO classified obesity using BMI cutoff values of 25 and 30 kg/m^2. A BMI of 18.5–24.9 kg/m^2 is considered as normal weight, a BMI of 25.0–29.9 kg/m^2 is considered as overweight, and a BMI of 30 kg/m^2 or higher is considered as obesity [1].

More than one billion people around the world are overweight or obese with a BMI of 25 kg/m^2 or more. Increasing rates of obesity are being reported globally, with current data suggesting that the number of individuals in the heaviest BMI groups (40–50 kg/m^2) are increasing at rates two and three times faster than those with a BMI of 30 kg/m^2. Although the clinical complications of severe obesity such as diabetes, vascular disease, and osteoarthritis are well established, less emphasis is traditionally placed on the effects on the respiratory system. Nevertheless, respiratory complications of obesity impact the general health, the quality of life, and longevity [2,3].

Obesity is a consequence of energy imbalance with the caloric intake exceeding energy expenditure. A lack of physical activity is thought to be a major contributor to the obesity epidemic. Some clinical guidelines include an even greater increase in physical activity (300 min/week of moderate-intensity exercise or 150 min/week of vigorous exercise) to achieve more extensive health benefits. Respiratory impairments related to simple obesity have been well described and include reduced lung volumes, decreased chest wall compliance, increased respiratory resistance, and increased work of breathing [4].

Furthermore, the immense value of physical activity in the prevention and treatment of disease has been proven over recent years. Physical activity is essential for improved health and for longevity. Over recent years, exercise on prescription has proven to be a feasible way to increase an individual's or patient's levels of performance. It has been suggested that leisure-time activity will be insufficient to prevent increasing population levels of obesity and chronic diseases, and it may be necessary to focus on decreasing sitting and increasing activity in transport and at work to restore the energy balance that results in a much more stable body weight [5].

The objective of this study was to evaluate the effect of lifestyle modification in the form of low-caloric diet with aerobic exercise on walking abilities and physical performance.

Patients and methods

The current study was carried out on 20 participants; their age ranged from 25 to 43 years. The BMI ranged from 27 to 32 kg/m^2. All participants were subjected to a low-caloric diet consisting of 25 kcal/kg actual weight/day, very low fat, low carbohydrates, protein 1.5 g/kg of actual weight calculated individually for each participants, and plenty of vegetables and fruits.

Informed consent was obtained from all patients for being included in the study. Patients with heart failure, renal failure, and diabetes were excluded from the study. Participants attended three sessions/week for 2 months, and exercised for their remaining sessions daily at home. The exercise training program began with a 15-min session at 60–70% maximal heart rate on a treadmill (luxurious one-way treadmill 901, Chinese), followed by 15 min of resisted exercises.

Methods

All participants were subjected to the following procedures: detailed history taking and complete physical examination, which included anthropometric measurements (weight, height, waist circumference, hip circumference, and BMI), inspiratory capacity, and a physical performance test (PPT), which includes four tests (15-m rapid walking test, a timed up-and-go test, and stair climbing and stair descending tests).

Body weight was measured with a calibrated precision scale with participants wearing a light hospital gown. BMI was derived, and waist circumference and hip circumference were measured in the standing position, using a flexible metal tape. The waist was defined as the minimal abdominal circumference located between the lower edge of the rib cage and the iliac crests. The hip was defined as the maximal circumference around the gluteal muscles below the iliac crests [6].

The timed inspiratory capacity (breath holding at inspiration in the sitting position) was assessed at the beginning and the end of the study after 2 months [7].

Physical function

The PPT was used as an objective measure of physical function. In brief, the PPT included four functional mobility tasks, including a 15-m rapid walking test, a timed up-and-go test where participants were required to rise from a chair, walk 3 m, and return to a seated position on the chair, and stair climbing and stair descending tests [8].

The stair tests consisted of a rapid ascent and descent of 22 stairs. Participants rested between the ascent and the descent for 45 s. Participants underwent four attempts on each task with 40-s rest intervals, and the best time for each test was reported. The PPT score was the sum of the fastest times for each of the four tests [9].

Statistical analysis

Data were statistically described in terms of mean ± SD. The collected data were fed into a computer for statistical analysis, and the statistical significance was determined at a confidence level of 95% (P value ≤ 0.001 as it mentioned in the abstract and this is the right form of the statically used test). All statistical calculations were carried out using computer programs, Microsoft Excel 2007 (Microsoft Corporation, New York, USA) and Mintab version 13.1, Pennsylvania, USA).

Results

The age of our patients ranged between 25 and 43 years. Sex distribution of the study patients was as follows: 14 female patients and six male patients; patients' height ranged from 145 and 179 cm (mean ± SD = 168.80 ± 18.46 m).

There was a significant decrease in body weight from 81.3 ± 8.5 to 68.00 ± 4.50 (P ≤ 0.001). BMI decreased from 29.8 ± 2.0 to 24.1 ± 2.0 (P ≤ 0.001). Waist circumference decreased from 120.3 ± 14.4 to 112.3 ± 9.6 (P = 0.053). Hip circumference decreased from 121.3 ± 6.1 to 112.6 ± 11.4 (P = 0.009). Time of the 15 m walk decreased from 21.2 ± 1.7 to 15.5 ± 2.1 s (P ≤ 0.001). Timed up-and-go test decreased from 24.1 ± 2.8 to 15.3 ± 2.3 s (P ≤ 0.001). Time of stair climbing decreased from 45.3 ± 6.5 to 34.2 ± 2.6 s (P ≤ 0.001).

Time of stair descending decreased from 36.2 ± 2.3 to 27.2 ± 2.1 s ($P \leq 0.001$). The inspiratory capacity increased from 14.4 ± 2.7 to 21.0 ± 2.3 s ($P \leq 0.001$). The total time of physical performance decreased from 126.60 ± 7.92 to 91.70 ± 4.44 s ($P \leq 0.001$; Table 1).

Percent of improvement is calculated from the formula $= \frac{\text{Post} - \text{pre}}{\text{pre}} \times 100$.

Discussion

In recent decades, physical activity levels have been declining and such declines in activity levels could potentially reduce population life expectancy. However, this is difficult to quantify because the degree to which the full range of physical activity in different populations is associated with life expectancy remains unclear. Inactivity as a potential cause and/or result of obesity is of significant interest considering the growing obesity rates. Worldwide, over 400 million adults were reported to be obese in 2005, and by 2015, more than 700 million individuals are expected to have this condition [10,11].

Obesity is the most important major modifiable risk factor associated with obesity sleep apnea. A weight gain of 10% is associated with a 32% increase in disease severity, whereas a 10% weight loss resulted in a disease severity reduction of 26%. Obesity sleep apnea is an independent risk factor for the development of cardiovascular disease, hypertension, and type 2 diabetes [12].

The work of breathing is primarily undertaken on inspiration whereby the chest and lungs expand to accommodate an increased volume of air, whereas expiration is largely passive. Consequently, a training program specifically designed to enhance the performance of inspiratory muscles among overweight and obese individuals might lessen subconscious inhibition of exercise performance, reduce respiratory muscle fatigue, and promote greater performance in response to exercise challenges [13].

Table 1 Comparison of the data pre and post weight loss management

Items	Mean ± SD		*t* value	*P* value
	Pre	Post		
Body weight (kg)	81.3 ± 8.5	68.00 ± 4.50	7.08	0.000**
BMI (kg/m^2)	29.8 ± 2.0	24.1 ± 2.0	8.42	0.000**
Waist circumference (cm)	120.3 ± 14.4	112.3 ± 9.6	2.06	0.053*
Hip circumference (cm)	121.3 ± 6.1	112.6 ± 11.4	2.92	0.009*
Inspiratory capacity (s)	14.4 ± 2.7	21.0 ± 2.3	-8.16	0.000**
15 m walk (s)	21.2 ± 1.7	15.5 ± 2.1	9.16	0.000**
Timed up-and-go test (s)	24.1 ± 2.8	15.3 ± 2.3	10.13	0.000**
Stair climbing (s)	45.3 ± 6.5	34.2 ± 2.6	7.00	0.000**
Stair descending (s)	36.2 ± 2.3	27.2 ± 2.1	9.32	0.000**
Physical performance (s)	126.60 ± 7.92	91.70 ± 4.44	16.26	0.000**

*Significant difference at $P < 0.05$; **Highly significant difference at $P < 0.001$.

Obesity-induced limitations of the cardiopulmonary and the metabolic systems, commonly resulting in exertional dyspnea, contribute to the limitations in the functional capacity frequently observed in obese individuals. In addition, the sedentary lifestyle often adopted by these individuals further compounds and contributes to impaired exercise tolerance [14].

Guidelines of the National Heart, Lung, and Blood Institute (NHLBI) encourage a 10% reduction in weight, although considerable literature indicates reduction in health risk with 3–5% reduction in weight. Physical activity is recommended as a component of weight management for the prevention of weight gain, weight loss, and for maintenance of weight loss [15].

In the current study, a weight reduction of about 16.3% from the original weight improved the inspiratory capacity by about 45.8%. Hence, promoting physical activity and a healthy diet has the potential to substantially reduce the burden of disease and improve the quality of life.

Older adults commonly consume less fruits and vegetables than the recommended serving, and have lower than recommended intakes of a range of nutrients important for the prevention of chronic diseases. It is also estimated that ~45% of adults are not sufficiently active to achieve health benefits, and older adults are less likely than younger adults to participate in 'sufficient' physical activity [16].

The current study also found a significant association between diet and good physical performance. A diet rich in vegetables and fruits, low in fat, low in carbohydrates, protein 1.5 g/kg of the actual weight calculated individually for each participant, and plenty of water, accompanied by aerobic exercise, was found to increase the level of physical performance.

Increased BMI has profound effects on the quality of life. In the general population, an increased BMI was associated with impaired physical function, pain, low vitality, and poor quality of life. However, little is known about the effects of obesity on functional and psychological measures of the quality of life. Even modest obesity can have a significant impact on the quality of life, particularly in women. Generally, obesity

affects the physical components of quality of life more than the psychological components. Obese individuals who remain active appear to have lower morbidity and mortality than normal weight individuals who are sedentary [17,18].

Results of the current study are in agreement with previously mentioned studies: a 16.3% decrease in body weight accompanied by a 27% increase in physical performance.

Health consequences of obesity range from a higher risk of premature death to severe chronic diseases that reduce the quality of life. It is not a moral or a psychological problem or a problem due to lack of strength of will, as erroneously considered up to a short time ago due to misinformation. Today, obesity is known to be a disease, the treatment of which leads to the reduction of mortality and to improvement in the quality of life. Although both diet and exercise interventions reduce total body fat mass, exercise may be more efficient in decreasing abdominal adiposity. Results from observational studies indicate that abdominal adiposity is inversely related to aerobic fitness and physical activity. Studies show that exercise-induced weight loss preferentially reduces abdominal fat [19,20].

Results of the current study are in agreement with Márcia *et al.* and You T, *et al.*, a 6.65% decrease in waist circumference and 7.17% decrease in hip circumference accompanied by a 27% increase in physical performance (Table 2).

It is reported that as little as 20 min of moderate-intensity daily physical activity with an energy expenditure of less than 1500 kcal/week is generally associated with modest reductions in visceral fat (5–10%). Not surprisingly, increasing the physical activity to 60 min/day (energy expenditure of 3500–4500 kcal/week) generally leads to much greater reductions in visceral fat (~30%) [21]. Evidence from rigorously controlled physical activity studies suggests that the reduction in visceral fat approximates 1/10th of the reduction in body weight: for every 10 kg loss in body weight, visceral fat is reduced by about 1.5 kg in men and 1.0 kg in women [21].

Aerobics combined with resistance training not only caused significant weight loss but improved fitness, preserved lean mass, increase high-density lipoprotein cholesterol, and decreased total and abdominal fat (independent of weight loss) [22]; in this study, aerobic exercise plus resistance training decreased body fat and increased lean mass [23].

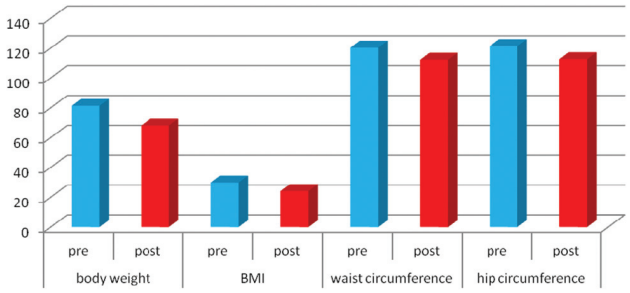
Reviews of the literature reported that enhanced musculoskeletal fitness is associated positively with glucose homeostasis, bone health, functional independence, mobility, psychological well-being, and the overall quality of life and is associated negatively with fall risk, morbidity, and premature mortality. They also reported that interventions that increase musculoskeletal fitness also have a significant positive effect on the health status of the individuals with a low musculoskeletal reserve (e.g. the frail elderly) [24].

Diet and exercise are accompanied by increased physical performance and improved activity of daily living, and these were consistent with the findings reported by previous studies (Figs 1–3).

Table 2: Percent of improvement

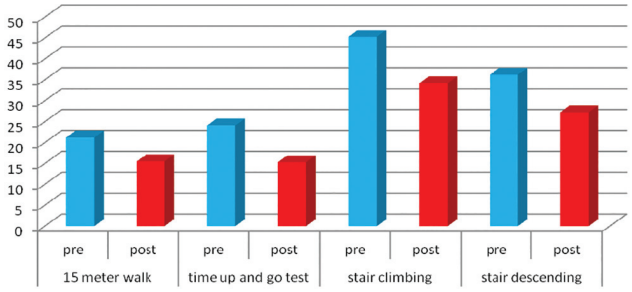
Percent of improvement	Item
16.3	Body weight (kg.)
19.1	BMI (kg./m^2)
6.65	Waist circumference (cm.)
7.17	Hip circumference (cm.)
45.8	Inspiratory capacity (sec.)
26.8	15 meter walk (sec.)
36.5	Time up and go test (sec.)
24.5	Stair climbing (sec.)
24.8	Stair descending (sec.)
27.6	Physical performance (sec.)

Figure 1



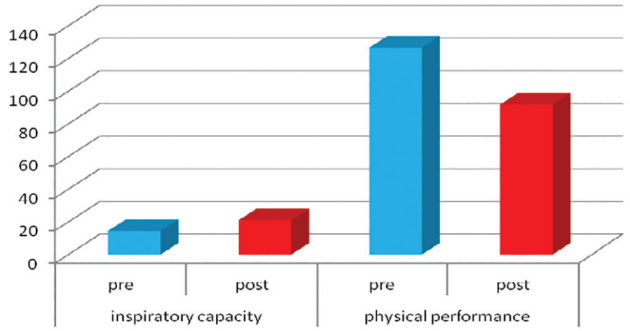
Body weight, BMI, waist circumference, and hip circumference.

Figure 2



15 m walk, timed up-and-go test, stair climbing, and stair descending.

Figure 3



Inspiratory capacity and physical performance test.

Conclusion

The obesity epidemic poses a new challenge to health professionals caring for patients. Obesity has been associated with many health consequences. Promoting physical activity and a healthy diet thus has the potential to substantially reduce the burden of disease and improve the quality of life.

Acknowledgements

Conflicts of interest

There are no conflicts of interest.

References

1 Mohammed AG. The effect of obesity on spirometry tests among healthy non-smoking adults. BMC Pulm Med 2012; 12:10–14.

2 Magali P, Marième D, Geneviève C, Vicky D, Frédéric S, Louis P, *et al.* The effect of obesity on chronic respiratory diseases: pathophysiology and therapeutic strategies. CMAJ 2006; 174:1293–1299.

3 Amanda J, Ronald R. Big breathing: the complex interaction of obesity, hypoventilation, weight loss, and respiratory function. J Appl Physiol 2010; 108:199–205.

4 Moinuddin IK, Collins EG, Kramer HJ, Leehey DJ. Exercise in the management of obesity. J Obes Weight Loss Ther 2012; 2:2–7.

5 Guglielmo M. Behavior, nutrition and lifestyle in a comprehensive health and disease paradigm: skills and knowledge for a predictive, preventive and personalized medicine. EPMA J 2012; 3:8–22.

6 Serap T, Nebahat S, Belma F, Faruk I, Demet T. Influence of knee osteoarthritis on exercise capacity and quality of life in obese adults. Obesity 2007; 15:2071–2076.

7 Gurevich K. Overweight and obesity prevalence and physical activity among Moscow school children. J Health Sci 2012; 2:23–28.

8 Itamar L, Steve S, George J, Andrew S, Cadeyrn J, David L Depressed mood, glycaemic control and functional capacity in overweight/obese men with and without type 2 diabetes. Diabetol Metab Syndr 2012; 4:46–52.

9 Itamar L, Craig G, David L, George J, Steve S. The effect of resistance training on functional capacity and quality of life in individuals with high and low numbers of metabolic risk factors. Diabetes Care 2007; 30:2205–2210.

10 Steven C, Alpa V, Charles E, Amy B, Yikyung P, Hormuzd A, *et al.* Leisure time physical activity of moderate to vigorous intensity and mortality: a large pooled cohort analysis. PLoS Med 2012; 9:e35–e42.

11 Julie N, Marie E, Francois P. Physical activity and obesity: biomechanical and physiological key concepts. J Obes 2011; 6:5–14.

12 Maria R, Anne L, Elizabeth M, Ron G. Sleep apnoea and metabolic dysfunction. Eur Respir Rev 2013; 22:353–364.

13 Edwards A, Maguire G, Graham D, Richardson G. Four weeks of inspiratory muscle training improves self-paced walking performance in overweight and obese adults: a randomised controlled trial. J Obes 2012; 9:1–8.

14 Thommazo L, Soraia P, Viviane C, Aparecida M, Ross A, Audrey B. Metabolic and clinical comparative analysis of treadmill six-minute walking test and cardiopulmonary exercise testing in obese and eutrophic women. Rev Bras Fisioter 2012; 16:469–478.

15 Joseph E, Steven N, John M, Melinda M, Janet W, Bryan K. Appropriate physical activity intervention strategies for weight loss and prevention of weight regain for adults. Med Sci Sports Exerc 2009; 10:1249–1260.

16 Sarah A, David C, Kylie B, Jo S. Understanding determinants of nutrition, physical activity and quality of life among older adults: the Wellbeing, Eating and Exercise for a Long Life (WELL) study. Health Qual Life Outcomes 2012; 10:109–115.

17 Annette O, Cecilia P, Yu A, Ingrid A, Michael S. Obesity is an independent contributor to functional capacity and inflammation in systemic lupus erythematosus. Arthitis Rheum 2005; 52:3651–3659.

18 Denis E, Conor D, Katherine A, Jordan A. Respiratory consequences of mild-to-moderate obesity: impact on exercise performance in health and in chronic obstructive pulmonary disease. Pulm Med 2012; 8:1–12.

19 Márcia A, Reginaldo C, João T, Ajith K. Pulmonary function and quality of life in patients with morbid obesity six months after bariatric surgery. Acta Cir Bras 2010; 25:407–415.

20 You T, Murphy K, Lyles M, Demons J, Lenchik L, Nicklas B. Addition of aerobic exercise to dietary weight loss preferentially reduces abdominal adipocyte size. Int J Obes 2006; 30:1211–1217.

21 Peter M, Robert R. The utility of physical activity in the management of global cardiometabolic risk. Obesity (Silver Spring) 2009; 17:S3-S14.

22 Davidson L, Hudson R, Kilpatrick K. Effects of exercise modality on insulin resistance and functional limitation in older adults: a randomized controlled trial. Arch Intern Med 2009; 169:122–131.

23 Chad M, Jennifer W, Donovan F, Ashli R, Lem T, Bill I, *et al.* Changes in weight loss, body composition and cardiovascular disease risk after altering macronutrient distributions during a regular exercise program in obese women. Nutr J 2010; 9:59–63.

24 Darren E, Sarah C, Adam I, Lindsay N, Shannon S. A systematic review of the evidence for Canada's Physical Activity Guidelines for Adults. Int J Behav Nutr Phys Act 2010; 7:39–259.