Effect of Behavioral Modification in Conjunction with Exercise Induced Weight Loss on Lower Urinary Tract Function in Obese Women

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ABSTRACT

The purpose of this study was to examine the subjective and objective effects of behavior modification with exercise induced weight loss on lower urinary tract function in morbidly obese women. Twenty four subjects underwent a comprehensive evaluation of lower urinary tract function before and after six months of behavior modification with exercise induced weight loss. The results of the current study indicated significant improvement in lower urinary tract function after weight loss. Of twenty four subjects only seven were still complained of incontinence after weight loss. Objective and subjective resolution of stress, urge and mixed incontinence was documented statistically. Significant changes were seen in measures of bladder pressure at first desire, resting urethral pressure, voiding volume, mean flow, number of incontinence episodes, number of episodes of nocturia and the need to use absorptive pads. Also, significant reduction was noted in total body weight, body mass index (BMI), skin fold, fat mass and its percentage between before and after weight loss. As a conclusion, weight reduction by combination of behavioral modification with exercise is desirable for obese women complaining of urinary incontinence and may obviate the need for further incontinence therapy and leads to long term weight control by major gradual changes in life styles.

Key words: *Obesity, behavioral modification, exercise, lower urinary tract function.*

INTRODUCTION

Obesity is a potent risk factor for several diseases. In the scope of urinary system, obesity is a well documented and cited as a factor related for not only development and recurrence of urinary incontinence[2,5,7,11,28] but also for stress incontinence and urgency[5,7,11,26,31]

These complication as a consequence of obesity are also common after pregnancy[12] and even before pregnancy[26,34], some women experience only transient discomfort[31], but others are incontinent for a longer time eventually indefinitely[30,34]. According to Viktrup et al.,[31] and Rasmussen et al.,[26], obese women had significantly higher prevalence of stress incontinence and nocturia compared to normal weight women .

It is well known that urinary bladder is innervated by autonomic nervous system

(sympathetic for inhibition and parasympathetic for activation)[14] while in obese subjects, there is an alteration in the autonomic nervous system activity[23]. Few studies found a relationship between obesity and urinary incontinence, Dwyer et al.,[10] reported that obesity (>20% more than average weight for height and age) significantly more common in women with genuine stress incontinence and detrusor instability than the normal population but they were unable to show any differences between obese and non obese incontinent subjects on urodynamic testing, which included cystometry and uroflowmetry. Whereas, urodynamic testing of Kolbl and Riss[16] demonstrated that subjects with a positive stress test had a significantly higher BMI than subjects with a negative stress test and that increased BMI was associated with a significantly greater resting total urethral pressure but not with a greater resting or stressed urethral closure pressure. Finally, Deited et al.,[9] reported a significant decrease in the prevalence of the symptom of stress incontinence (from 61.2% to 11.6%) in 138 morbidly obese women after weight reduction induced by bariatric surgery. Thus, for morbidly obese incontinent women gastric bypass surgery would seem preferable. However, it must be emphasized that traditional diet and exercise treatment of obesity is often unsuccessful, as permanent reversal of obesity is achieved in fewer than 10% of patients[32].

The factors that balanced appetite, food intake and energy expenditure are multiple and complexly interrelated. Intelligent and focused therapy of obesity will eventually depend importantly on recognizing which of them is disturbed in the individual overweight patient. Blundell[6] reviews the mechanisms that control body weight and calls them collectively the biopsychological ling appetite and divides them between those in the environment and those within the body, or, as he puts it, under the skin . While research done over the past two decades has established that appetite is controlled in a major way by specific neurotransmitters: noradrenergic neurons stimulate eating, while serotoninergic elements terminate eating and maintain satietry[19]. Eating disorders are far more common in women than in men and are associated with substance abuse, obsessive compulsive disorders and depression[29].

Within the past two decades, behavior therapy has been the object of dramatic increase in interest. Many investigators have been focused on the treatment of obesity that has become a popular proving ground for the evaluation of behavioral self control procedures. Physical activity in conjunction with moderate dietary energy restriction and behavior modification has been promoted as an important component of successful weight loss regimen[18,21,29].

In comparing effects of behavioral and pharmacological therapy in obese subjects, patients receiving drugs lost significantly more weight during treatment phase, but patients who received behavioral therapy were more successful in maintaining their weight loss. Thus, for better maintenance of weight loss, it appears that behavioral therapy is superior to short term pharmacotherapy. The benefit of behavior modification may be enhanced when such treatment is combined with other forms of therapy such as diet and exercise[8]. So, techniques of modifying behavior have been successfully incorporated into many weight loss programs in conjunction with exercise. Moreover, weight reduction of 9 to 11 Kg have been reported without restriction of energy intake[13].

In summary, previous studies have demonstrated relationship between obesity and

objectively documented incontinence and there is a gap in literature to examine the relationship between successful weight loss by behavior modification with exercise and incontinence either by subjective or objective measurements.

The aim of the present study was to examine the subjective and objective effects of behavior modification with exercise induced weight loss on lower urinary tract function in morbidly obese women.

SUBJECTS, MATERIALS AND METHODS

Subjects

From a large sample, 24 educated morbidly obese women complaining from urinary incontinence participated in this study from the Out Patient Clinic of the Physical Therapy Department for Obesity at El-Sahel Teaching Hospital. Each woman had to be at least 40 Kg above her ideal body weight as estimated by the 1983 Metropolitan Life Insurance tables for medium frame[5]. Diabetic, hypertensive and cardiac patients were excluded from the study. All women underwent comprehensive urogynaecologic history, physical, gynaecological and neurological examination over saddle area (S_{2-4}). Non of the patients had urinary tract infection, bladder herniation, genitourinary fistula, urethral instability or detrusor atony.

All patients in this study participated in behavior modification with an exercise program for six months.

Procedures

I. Evaluative procedures

Evaluations had been performed for all patients at the time of admission to the study and after six months of participation in behavior modification with exercise program as follows:

(1) Body mass index (BMI)

Each patient was weighted in light street clothing to the nearest kilograms and her height was measured without shoes to the nearest centimeter. BMI= Weight (Kg) per Height (m^2).

(2) Skin fold test

The thickness of the subcutaneous panniculus for each patient was measured over the middle of the extensor surface of the left arm with long skin fold caliper.

(3) Body composition

Body composition was assessed by having the patient lie supine with limbs abducted 35° to 45°. Electrodes were placed at the metacar-palphalangeal joint in the middle of the dorsal side of the right hand and one quarter inch below the transverse (metatarsal) arch on the superior side of the right foot. Detector electrodes were placed on the midline of the posterior side of the right wrist at the level of the pisiform bone and vertically across the medial malleolus of the right ankle with the foot semiflexed. Through it lean body mass (LBM) and fat mass can be detected.

(4) One week urinary diary

Urinary diary was kept for 24 hours each day for every patient. Columns were available to record in one hour blocks the frequency of voluntary voiding episodes and the number of leakage episodes. Subjects were requested to circle their night time sleeping hours in order to separate diurnal from nocturnal micturation frequency, also number of pads used per day calculated.

(5) Urodynamic evaluation

It was conducted after the urinary diary was completed. Urodynamic evaluation included cystometry, urethral pressure profile

and uroflowmetry. A women was considered to have stress incontinence if she complained of the objectionable and involuntary loss of urine coincidental with physical activity. The diagnosis of the condition of genuine stress incontinence was made if the subject had the symptom of stress incontinence and had observable leakage produced by stress without concurrently demonstrable detrusor activity during urethrocystometry. This evaluation was performed for each woman at Naser Institute Hospital.

II. Treatment procedures

[A] Behavioral modification

Treatment focused on methods of acquiring new behaviors that promoted weight loss and long term maintenance of weight loss. As weight loss was maintained, major gradual changes in life styles were required.

Behavioral modification sessions were held three times per week on alternative days at first week of treatment then one session every week until the end of six months of the study.

This program was divided into five sections:

(1) Measurement and description of eating behaviors, in it, self monitoring is usually the first behavior to be prescribed. It involves having the patient make a careful record of body weight, caloric intake, physical activity and any factors that may influence eating e.g. emotional states and social interactions. Then, patient was asked to monitor the behavior, which was asked to change. Each patient had given convenient recording forms and information form, these forms can provide means by which changes in behavior can be reinforced by the therapist or the patient herself.

(2) Modification of the antecedents of eating behavior. One focus of a behavioral analysis is the constellation of variables that precede eating by encouraging the patient to keep all food in the house out of sight, specially high calorie foods and to limit the accessibility of food that must be kept in the house e.g. Candy and nuts dishes are to be eliminated, when visitors arrive, low calorie food are to be served and foods that require preparation (raw vegetables) are to replace those that are prepared (potato chips). Also, concentration on behavior patterns that may become cues to signal eating, as eating when watching television. Therefore, patients are instructed to minimize the numbers of times, places, events associated with eating and to eat only at scheduled times.

(3) Modification of the act of eating itself by bringing the act of eating under the patients control. In it a smaller amount of food will provide adequate enjoyment and slowing the act of eating.

(4) Modification of sedentary behavior by instructing patients to make use of opportunities for small increases in physical activity: using the stairs more often, parking some distance from their destination, getting off the bus one stop early, etc. These behaviors are monitored, reinforced and became an integral part of the program.

(5) Modification of the consequences of eating by reinforcing the behavior via written list of relevant behavior to be followed and also by helding a meeting session with the therapist.

[B] Exercise training

The participants were exercised individually using bicycle ergometer with a constant speed of 60 Km/ hour for all patient for 60 minutes (consisted of 10 minutes warm up, a training period of 40 minutes at 60% of her maximum heart rate and 10 minutes cool down period). The program was applied every other day for six months[15].

III. Data analysis

The data was analyzed to as certain if there was any significant difference between pre and post treatment. Student t test was used to test for significant difference at $P<0.05$.

RESULTS

The results of this study are presented under the following headings:

I. Physical characteristics

The twenty four subjects who completed the study had a mean age of 45±9.8 years (range 42 - 61 years), five were pre menopausal and nineteen were post menopausal.

The mean parity was 2.9±0.9 (range 0 - 5 times) and the mean height was 1.60±0.07 (range 1.49 - 1.66 Cm).

II. Body weight

BMI, skin fold test and body composition (Total weight, % of lean body mass, fat mass and its percentage) showed statistically significant decrease ($P<0.01$) except lean body mass denoted statistically non significant difference ($P<0.34$) between before treatment and after six months of behavioral modification with exercise (Table1).

Table (1): BMI, skin fold test and body composition of all subjects.

Variables		Pre ttt	Post ttt	P value <
BMI (kg/m^2)		47.9 ± 5.8	31.3 ± 6.7	0.001
Skin Fold (mm)		35.73 ± 8.8	21.72 ± 5.9	0.005
Body composition	Total Weight (kg)	126.4 ± 25.6	90.7 ± 21.6	0.001
	LBM ((Kg)	69.3 ± 13.5	69 ± 12.3	0.34
	% LBM	54.8 ± 5.6	76.1 ± 7.3	0.01
	Fat mass (Kg)	57.1 ± 15.2	21.7 ± 12.7	0.001
	% Fat mass	45.1 ± 5.6	23.9 ± 7.3	0.005

LBM lean body mass ttt Treatment

III. Urinary diary

On the one week prospective urinary diary, there were significant decrease ($P<0.001$) in the number of incontinence episodes per week, number of incontinence pads used per day and in episodes of nocturia per week while, there was significant increase in day time voiding frequency ($P<0.05$) between before and after six months of weight reduction (Fig.1).

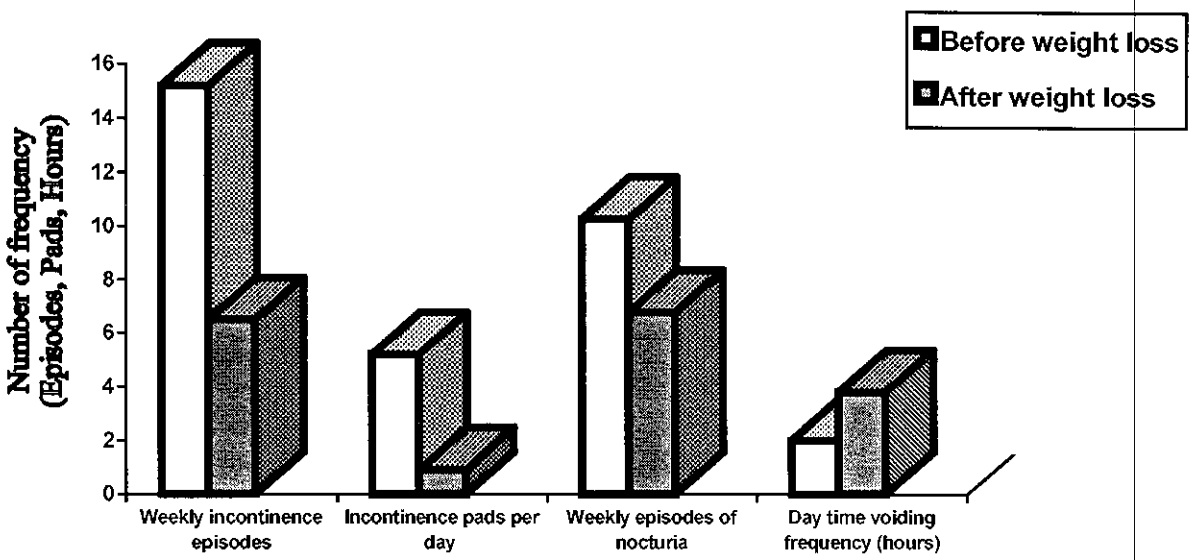


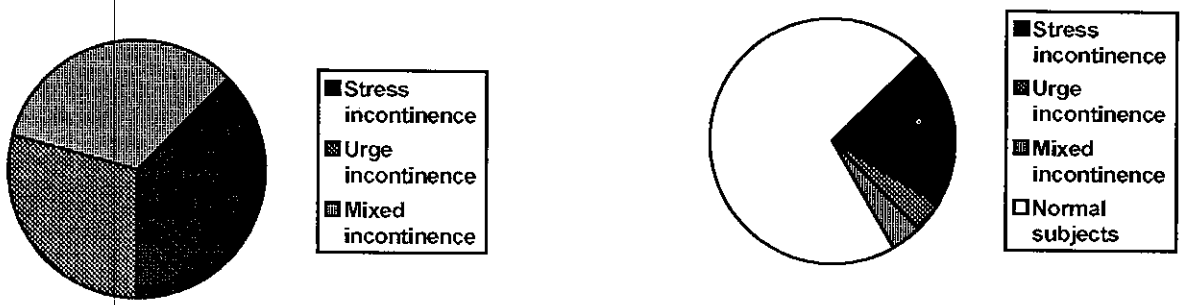
Fig. (1): Effects of behavioral modification with exercise induced weight loss on number of incontinence episodes per week, number of incontinence pads used per day, episodes of nocturia per week and day time voiding frequency in hours.

IV. Urodynamic

(a) Urodynamic diagnosis of each of the 24 subjects revealed that nine subjects (37.5%) had symptoms of stress incontinence, seven (29.1%) had symptoms of urge incontinence and eight (33.3%) had symptoms of mixed incontinence before weight reduction, while after six months of weight reduction only seven (29.1%) cases had complained of symptoms of incontinence which indicated a significant increase ($P<0.03$) in number of normal cases between before and after six months of behavioral modification with exercise.

In the same point, six of nine subjects with symptoms of stress incontinence ($P<0.02$), five of eight subjects with symptoms of mixed incontinence ($P<0.04$) and six of seven subjects with symptoms of urge incontinence ($P<0.004$) noted resolution of the symptoms after six months of weight reduction.

The seven subjects with persistent symptoms, three of them had stress incontinence, three mixed incontinence and one urge incontinence before weight reduction, while, after six months of weight reduction two of three subjects of mixed incontinence noted resolution of urgency incontinence component of their symptoms (Fig.2).



Before treatment *After treatment*

Fig. (2): Percentage of urodynamic diagnosis of subjects involved in this study before and after 6 months of behavioral modification with exercise.

(b) Urodynamic test:

As shown in table (2).

* Cystometry:

A reduction of detrusor pressure at first desire was significant, whereas at maximum desire showed no significant difference, while, cystic volume either at first desire or maximum desire were significantly increase ($P<0.05$) between before and after six months of weight reduction.

** Urethral pressure profile

Resting urethral pressure showed a significant increase ($P<0.001$) whereas, functional urethral length and urethral pressure voluntary control showed non statistically significant difference between before and after six months of behavioral modification accompanied with exercise.

*** Uroflowmetry

Voided volume and mean flow rate showed significant decrease ($P<0.01$), whereas the difference was statistically non significant for peak flow and voiding time between before and after treatment.

Table (2): Mean values of different results by urodynamic test

	Cystometry								Urethral Pressure Profile						Uroflowmetry							
	Cystic vol. at 1st desire		Detrusor Pressure at 1st desire (Cm/H_2o)		Cystic vol. at max. desire (Cm)		Detrusor Pressure at max. desire (Cm/H_2o)		Functional urethral length (Cm)		Resting urethral Pressure (Cm/H_2o)		Urethral Pressure with voluntary control (Cm/H_2o)		Voided vol. (ml)		Peak flow (ml/Sec)		Mean flow (ml/Sec)		Voiding time (Sec)	
	Pre ttt	Post ttt	Pre ttt	Post ttt	Pre ttt	Post ttt	Pre ttt	Post ttt	Pre ttt	Post ttt	Pre ttt	Post Ttt	Pre ttt	Post ttt	Pre ttt	Post ttt	Pre ttt	Post ttt	Pre ttt	Post ttt	Pre ttt	Post ttt
Mean	200	236.36	8.36	6.12	418.18	477.27	12.63	10.27	2.27	2.36	66.36	76.81	122.27	125.9	300.92	235.46	18.36	17.85	9.65	6.36	38.38	36.07
S .D.	54.77	39.31	1.8	2.5	98.16	90.46	2.15	2.43	0.78	0.5	6.74	6.42	16.93	13.38	100.08	79.54	5.12	5.53	3.61	1.94	5.26	4.83
Pvalue <	0.03		0.05		0.02		0.09		0.37		0.001		0.24		0.01		0.34		0.01		0.11	

Vol. Volume max. maximum ttt Treatment

DISCUSSION

This study has demonstrated both statistically and clinically significant improvements in lower urinary tract function after marked weight reduction induced by behavioral modification with exercise in morbidly obese women.This improvement has been seen in both subjective and objective parameters.

Subjectively, seventeen of twenty four women with bothersome incontinence before weight loss noted complete resolution of their incontinence after weight loss.

Objectively, six of nine had resolution of pure stress incontinence, five of eight had resolution of mixed incontinence and six of seven had resolution of urge incontinence on urodynamic diagnosis.

The Findings of this study are in agreement with Foldspang and Mommsen[11], which suggested that obesity contributed both to stress incontinence and urge incontinence.

Non of the previous studies had used the same technique of treatment for such patients. so these results can not be related to prior studies. Whereas, studies by Bump et al.,[4] and Deitel et al.,[9] showed that massive weight loss by gastric bypass and bariatric surgery often led to the resolution of the symptoms of urinary incontinence.

Urodynamic assessment have demonstrated that massive weight loss in morbidly obese women significantly decrease detrusor pressure with a highly significant increase in resting urethral pressure and significant decrease in voiding volume and mean flow rate.

These measurements were not recorded in previous urodynamic evaluation by Dwyer et al.,[10] or by Kolbl and Riss[16].

These results are inconsistent with Wilkie and Stanton[33] study, who demonstrated no differences in bladder pressure and no differences in urethral pressure when comparing obese and normal weight subjects. This discrepancy is explained by differences in study design, in that our comparison of the same subjects before and after loss minimizes many confounding variables that might have influenced these measures in Wilkie and Stanton's[33] small study groups.

The urodynamic results suggest that the mechanism for improved urinary incontinence in the present study, subjects may be related to decrease in detrusor pressure in stress with increasing urethral pressure. Thus, leading to improvement in transmission of this stress to the urethra and decreased axial mobility of the urethra.

The investigators are aware of evidence that decreases total detrusal pressure, such as observed in this study which will improve one's ability to supress detrusor instability (urge incontinence) because in urge incontinence, an imbalance between the signals from the parasympathetic nerve receptors in the bladder and the inhibitory sympathetic reflex to detrusor muscle[25], that may result from obesity[11]. So, alteration in autonomic nervous system activity related to obesity may be normalized with weight reduction by increasing sympathetic and decreasing parasympathetic stimulation to the lower urinary tract which could consequently promote detrusor stability. This change in autonomic nervous system after weight reduction through behavioral modification with exercise could be explained by Alexander et al.,[1] who found that regular aerobic exercise may result in physiological significant alterations in sympathetic function, also Seals et al.,[27] reported that exercise in old age increased activity of sympathetic nervous system which is supported by increasing basal norepinephrine concentration as well as

intraneurally increasing post ganglionic sympathetic activity to muscle.

In the same point of explanation, how could behavioral modification with exercise resolve urinary incontinence? We take the view that in cases with stress incontinence, there is a significant reduction of collagen type III in uterosacral and round ligaments[3]. So, it is possible that this deviation in the concentration of collagen type III could be influenced by physical exercise as mentioned by Price[24] and study of Koyama et al.,[17] who found a significant change of hydroxyproline contents of serum before and after exercise who suggested that collagen metabolism may be accelerated by continuous exercise training.

The reduction in weight after six months of behavioral modification with exercise represented by significant decrease in BMI, skin fold test and body composition in morbidly obese women.

As most studies in this field used only behavioral modification alone or exercise alone and also did not measure the change in weight by objective means as done in this study, but review of literature recommended that combination therapies as diet and exercise could be reinforced by behavioral modification to reduce the easy regain of weight[8,22] and by acquiring new behaviors that will promote weight loss with a long term maintenance of weight loss.

The marked change in skin fold thickness which was found in this study indicates that much of the weight loss represented by loss of body fat which confirmed also by a remarkable decrease in fat mass percentage after six months of behavioral modification with exercise. So, it is possible that exercise might actually have led to increase muscle mass, so that the loss of body fat may have account for a greater proportion of weight lost.

The fact that a striking loss of fat over the arm was produced by a form of exercise that involves primarily the muscles of the legs and also support the result of the study which demonstrated that the site from which fat is lost unrelated to the particular muscles that are exercised[15].

With the findings and qualifications of this study in mind, we concluded that weight reduction by combination of behavioral modification with exercise is desirable for obese women complaining of urinary incontinence.

Three essential components of a weight control program are diet, exercise and behavior modification. Because these elements are interdependent and mutually supportive, a program that incorporates all three is more likely to lead to long term weight control. For weight loss to be maintained, gradual changes in eating habits and exercise levels must occur and psychological factors that impinge on these components must be addressed. A comprehensive, long term weight control program is the only effective treatment for obesity.

Successful weight reduction may obviate the need for further incontinence therapy in at least some obese patients. In addition for obese women with stress incontinence who undergo continence surgery, weight reduction may improve the technical ease and decrease the failure rate of such surgery.

Thus, for some morbidly obese incontinent women behavioral modification with exercise would seem preferable to and of greater overall benefit than continence surgery.

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الملخص العربي

تأثير تغيير السلوك مع التمرينات لإنقاص الوزن على وظيفة مجرى البول السفلي في السيدات البدينات

تهدف هذه الدراسة إلى الاختبار الشخصي والموضوعي لتغيير السلوك مع التمرينات لإنقاص الوزن لدى السيدات البدينات على وظيفة مجرى البول السفلي . ولهذا تم اختيار ٢٤ سيدة بدينه ممن يعانين من اضطرابات في وظيفة مجرى البول السفلي لتقيمهن قبل وبعد ستة أشهر من العلاج وقد أظهرت النتائج تحسن ايجابي ملحوظ في وظيفة مجرى البول السفلي وزالت الأعراض المرضية من ١٧ حالة تماما وأثبت ذلك بطريقة شخصية و موضوعية . وقد وجد تغيير ايجابي في ضغط المثانة، طول القناة البولية، كمية وزمن التبول وكذلك مرات السلس، التبول الليلي والحاجة إلى استخدام فوط ماصة للبول. وأيضا من الملاحظ في هذه الدراسة النقص الإحصائي الإيجابي للوزن وكتلة الدهون وكذلك نسبته، من هنا يتضح أن إنقاص الوزن عن طريق التغيير السلوكي مع التمرينات يفضل في السيدات البدينات اللاتي لديهن شكوى في وظيفة مجرى البول السفلي وكذلك يمكنه إزالة الحاجة إلى علاج أخر للسلس البولي .