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Original Article

"Heavy lifting and urinary incontinence" top read or toss into the bias list?

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Abstract

Introduction: Urinary incontinence (UI) is a multifactorial and prevalent disorder among aged women. Physical activities are believed to have challenging roles in the deterioration of the UI. The aim of this study was to examine the effect of standardized weightlifting on urodynamic parameters in the urinary continent and incontinent individuals.
Methods: Twenty-four UI morbid and 21 control subjects participated in a standardized weightlifting task while undergoing multichannel cystometry tests in two empty and full bladder conditions. Maximum weightlifting force (MWF) and vesical and abdominal pressures (APs) were measured to calculate the detrusor pressure.
Results: Findings showed that the UI participants with full bladder have significant higher abdominal, vesical and detrusor pressures in comparison to the controls; but in empty bladder condition, only the AP of the UI morbid group was significantly greater. The MWF was not significantly changed between the UI and control groups. The MWF was also not correlated with the detrusor pressure among the UI participants and full bladder controls.
Conclusion: Weightlifting till the subject's maximum force can neither produce incontinence in healthy subjects nor deteriorate the UI patients' conditions.

Introduction

Urinary incontinence (UI) is a prevalent disorder among adults, specifically in aged women in menopause.[1,2] It has been reported that the UI has a worldwide average prevalence of 25% to 45%.[3] However, in developing countries, the prevalence is increased to 58%.[4] The global annual costs of the women's UI are more than the expenses of breast, ovals, cervix and uterus cancers combined,[5-7] which highlights the importance of UI among females. Besides the financial issues, the UI causes depression, shame and nervousness in patients and decreases the self-efficiency, effective attendance in the society and the quality of life.[8-10]

Pregnancy and vaginal child delivery are the main risk factors, specifically in youth.[11] Obesity is another risk factor; however, its adverse effects can be controlled by physical activity and exercise.[12] It was reported that weight loss and maintenance of good fitness by moderate exercise reduces the rate of stress UI up to 47%.[5] The heavy exercises, nevertheless, may be a risk factor to the UI.[13] These statements have, therefore, challenged the relationship between the level of physical exercise and the UI. The literature has mainly emphasized on destructive effects of heavy physical activities or strenuous works on the UI and pelvic organ prolapse in females so that lifting a heavy object is prohibited.[13,14] However, few studies have investigated the direct effect of weightlifting on symptoms of the UI in females. Davis et al reported that 31% of the 563 female soldiers had UI during work or exercise.[15] Nygaard et al stated that 28% of the female athletes have UI, 66 % of which had repetitive experiences of it.[16] In a recent study, Wikander et al reported that approximately 41% of weightlifter women had experienced UI at some stage of their lives, 37% of weightlifter women had UI during training, competition or maximum effort lifts, but the rate of UI during the daily life activities is approximately 11% among them.[17] In addition to the above studies that were merely based on questionnaires, some other investigations have quantitatively linked the type and magnitude of loading with some UI-related factors, like intra-abdominal pressure (IAP).[18-21] There were some limitations in these studies. First, there is no consensus on the direct correlation between the IAP and the UI in the literature. Second, these studies have not compared their outcomes with a group of continent subjects to have a fair conclusion. Third, the loading magnitudes were not normalized to the overall muscular strength of the subjects. Therefore, the present study is aimed to

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investigate the effects of standardized weightlifting on a more comprehensive list of UI-related parameters in two incontinent and control continent groups of participants. Moreover, the role of empty and full bladder condition is delineated.

Materials and Methods

Subjects

An announcement was spread in the teaching hospital in order to recruit volunteers to the study. Seventy-five volunteers with the age range of 30 to 65 years were included in this cross-sectional study from July 2017 to January 2018 using convenience sampling. All participants filled a validated ICIQ-UISF in the national language.[22] Then physical examination, vaginal examination and stress test were performed in order to diagnose UI. Subjects with a history of lumbosacral anomalies or injury, diagnosed discopathies, neurogenic or musculoskeletal disorders and history of back or pelvic surgery were excluded, and finally, 46 subjects enrolled in the study from whom, twenty-five person had stress/urge incontinent (entered to the morbid group) and 21 were continent (entered to the control group), which is indicated in Figure 1. The examiners were blinded to the subjects' group. The final sample size for the experiment has been assessed to meet more than 80% statistical power considering the confidence interval of 95%.[23]

Apparatus

A custom-designed apparatus was manufactured to acquire the weightlifting force synchronized to the urodynamic device (Andromeda, Ellipse model, Germany). The weightlifting apparatus consisted of a base fixture attached to the ground, an adjustable hook to be set for different patient heights, a force transducer between the hook and subject's handle to measure the weightlifting force with the sampling frequency of 10 Hz, and electronic equipment for data acquisition using lab view software in a computer.

Protocols

Two distinct test protocols were utilized: i) synchronized urodynamic testing (multichannel cystometry) and standardized weightlifting with an empty bladder; ii) synchronized urodynamic testing (multichannel cystometry) and standardized weightlifting with a full bladder. The standardized weightlifting was defined as the condition in which the subject should stand upright with feet apart equal to the shoulder's width. The handle which is attached to the hook was vertically grasped by the subject's hands to lift and hold the weight while her spine is in an erect position and the legs are straight. The procedure was commenced by asking the subjects to void their bladders. In protocol i, the multichannel cystometry has been performed without the bladder filling phase to measure the abdominal and vesical pressures synchronized to the weightlifting. The weightlifting was performed for 10 seconds in which the force increases gradually to the subject's maximum weightlifting force (MWF) that was measured by the apparatus. In protocol ii, all the stages were performed similar to the first one, but the bladder had already been filled until receiving to its functional capacity. The subjects were catheterized with 6 f catheter, and the bladder is filled by 30 cm/min normal saline flow in an upright position. Both protocols were repeated in three trials with one-minute rest intervals in between.

Besides the abdominal and vesical pressures, the detrusor pressure, i.e., the difference between them was calculated. Also, abdominal leak point pressure was determined during the entire procedure to assess the individual safe limit for weightlifting without leaking.

Statistical analysis

Statistical analysis of data was done using SPSS (version 17). Data were reported as descriptive statistics (frequency and percent) and mean ± SD. An independent *t* test was

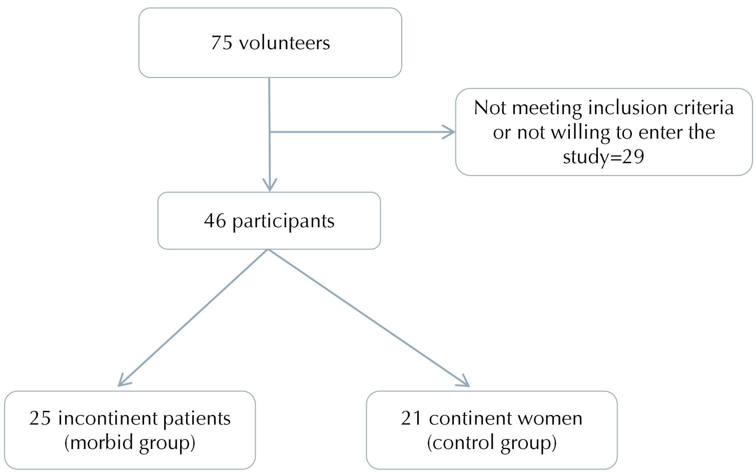

Figure 1. Study flowchart

performed between the control and morbid groups. A paired *t* test was also done to compare the empty and full bladder effects. The Pearson test was used to examine the correlation between the data. The level of significance was considered as 0.05.

Results

Table 1 presents the matched demographic characteristics of the participants. There is no significant difference between two groups of morbid and control in their age, body mass index (BMI) and parity. All participants could accomplish all trials of weightlifting at their MWF, but none of them had any leakage during and after 10-second hold of the lifted weight. Therefore, the abdominal leak point pressure values are not available by definition.

Table 2 shows the comparison between the MWF and multichannel cystometric parameters of two test groups in an empty and full bladder. The effects of applied MWF, vesical and detrusor pressures are not significant between the morbid and control groups while the bladder was empty. However, the abdominal pressure (AP) was significantly increased in the morbid group ($P=0.001$). On the other hand, when the bladder was full, vesical ($P<0.001$), detrusor and ($P=0.004$) abdominal ($P=0.005$) pressures are significantly higher in the morbid group rather than those of the controls. The comparison between two participant groups unveils that the difference between mean values of the exerted MWF is trivial and both are non-significant. Also, in the morbid group, the filled bladder caused a significant reduction in the MWF ($P<0.001$) and a significant increase in vesical pressures ($P<0.001$). Also, filling in the bladder in the control group reduces the MWF ($P=0.001$) as much as the morbid group.

Table 3 shows the Pearson correlation coefficients between the morbid and control groups, and also between the empty and full bladders. In the empty bladder control subjects, there was a strong correlation between the applied MWF and the vesical (r = 0.68), detrusor (r = 0.34) and abdominal (r = 0.62) pressures, meaning that any increase in the MWF has led to increases in the pressure values. Besides, the vesical pressure had a strong positive correlation with the AP (r = 0.96) to show the higher the vesical pressure is, the higher AP would be. In the empty bladder morbid subjects, the MWF was only correlated to the AP (r = 0.39). The vesical pressure was also strongly correlated to the AP (r = 0.63). It has to be noted that the detrusor pressure had been calculated as the difference between the vesical and APs; hence, it is not a directly independent parameter, and the correlation between vesical/APs to the detrusor pressure is not rational and applicable. This is the reason behind the fact that the correlations between the detrusor and vesical/APs are left moot and marked by NA (not applicable) in Table 3.

In the full bladder control subjects, the MWF was correlated to the vesical (r = 0.52) and abdominal (r = 0.45) but not to the detrusor pressures. The vesical pressure was also correlated to the AP (r = 0.90). In the full bladder morbid subjects, the applied MVC was correlated to the vesical (r = 0.32) and abdominal (r = 0.35) but not to the detrusor pressures. The vesical pressure was also strongly correlated to the AP (r = 0.82).

Table 1. Demographic data (mean ± SD) of the participants

	Morbid Group (n = 25)	Control Group (n = 21)	*P* value
Age (yrs)	46.08 ± 8.00	45.05 ± 9.00	0.604
BMI (kg/m²)	29.50 ± 4.12	28.17 ± 2.99	0.139

Discussion

Although several studies have focused on the relationship between the AP and weightlifting,[20,24] the association of the UI and the AP has not been well-established yet. The goal of this study was to evaluate the vesical, detrusor and APs during standardized weightlifting at maximum force, along with synchronized multichannel cystometry. In order to assess the effect of bladder condition, two empty and full bladder conditions were also examined during the tests.

The overriding outcomes of this study indicated that the increase in the AP and vesical pressure might not necessarily lead to an increase in the detrusor pressure.

Table 2. The weightlifting and cystometric parameters (mean ± SD) of morbid and control groups in two empty and full bladder conditions

Parameter	Group	Empty Bladder			Full Bladder			*P* value**
		Mean ± SD	*P* value*	Mean Difference	Mean ± SD	*P* value	Mean Difference	
MWF (N)	Control	405.52 ± 138.07	0.869	3.51	370.16 ± 119.99	0.528	12.28	0.001
	Morbid	402.01 ± 104.97			358.18 ± 108.14			0.000
Vesical pressure (cm H_2O)	Control	24.14 ± 18.33	0.171	-5.03	26.70 ± 18.63	0.000	-18.30	0.234
	Morbid	29.17 ± 24.51			45.00 ± 33.55			0.000
Abdominal pressure (cm H_2O)	Control	21.24 ± 18.12	0.001	-12.25	22.25 ± 20.64	0.005	-11.25	0.489
	Morbid	33.49 ± 23.87			33.50 ± 25.05			0.997
Detrusor pressure (cm H_2O)	Control	5.51 ± 5.56	0.451	-0.80	8.46 ± 9.53	0.004	-7.33	0.003
	Morbid	6.32 ± 6.79			15.80 ± 18.92			0.000

MWF: maximum weightlifting force; SD: standard deviation
* between group *P* value (Morbid vs. Control) indicates significance if $P<0.05$, typed in bold-face.
** within group *P* value (Empty vs. Full bladder) indicates significance if $P<0.05$, typed in bold-face.

Table 3. Pearson correlation coefficients and their *p*-values in parentheses in each of the four test conditions (2 groups × 2 bladder conditions).

Correlation table	Test conditions							
	Control – Empty bladder		Control – Full bladder		Morbid – Empty bladder		Morbid – Full bladder	
	Pearson correlation	*P* value	Pearson correlation	*P* value	Pearson correlation	*P* value	Pearson correlation	*P* value
MWF and vesical pressure	0.685	0.000*	0.128	0.273	0.524	0.000	0.322	0.005
MWF and abdominal pressure	0.628	0.000	0.388	0.001	0.454	0.000	0.351	0.002
MWF and detrusoor pressure	0.345	0.006	-0.016	0.891	0.151	0.242	0.100	0.392
Vesical and abdominal pressure	0.960	0.000	0.630	0.000	0.907	0.000	0.819	0.000

MWF: maximum weightlifting force.
* Significant if $P<0.05$, typed in bold-face.

Since it was stated that the increased detrusor pressure leads to the UI, it could be concluded from the present results that the enhancement of the AP and vesical pressure may not necessarily cause incontinence or urine leakage. To support this finding, it was observed that none of the subjects had leakage of the urine during the test at the MWF level. It implied that the lifting of weights near and below the MWF level might not be a reason for incontinence. The correlation coefficients calculated between the MWF and the detrusor pressures also confirmed that these parameters were correlated only in the control group with empty bladders. The fullness of the bladder or being urinary incontinent have vanished the relationship between the MWF and the detrusor pressure. It is, nevertheless, worth mentioning that the control group participants lifted significantly lower magnitudes of weights (~35 N lesser) once their bladders had been filled. The same result was achieved for the UI group whose MWF values were ~44 N lower than their MWF with an empty bladder. Therefore, any recommendation regarding conferring the permission for weightlifting should consider the bladder condition. Previous clinical investigations also confirmed this fact. Gedymin et al who examined 167 female polish workers with repetitive stance lifting stated that the age, years of employment, number of childbirth and high weightlifting cause UI, uterus and vaginal prolapse; however, there was no significant relationship between UI-related health problems and the magnitudes of weights carried during a day.[25]

Several factors influenced the AP during lifting, some of them studied by Hsu et al in 206 women 6-10 weeks after the vaginal delivery. They were asked to lift a fixed 12.5 kg weight in three lifting types of straight legs, bent and in between. The maximum AP during lifting was correlated to post-delivery time, subject's weight, height and BMI, but independent from the lifting type.[18] The lifting type that was similar to this study (i.e. straight legs vs. standardized), resulted in increase of the AP. In another study, Gerten et al showed that the squat lifting in 41 women causes the maximum AP measured via a rectal catheter.[20] Coleman et al also examined the role of walking speed and type of carrying a 13.6 kg weight on the AP in 46 healthy women. They concluded that faster walks increase the AP. More, carrying the weight in front, side, or awkward position enhanced the AP in comparison with the backpack carrying.[21] The controversy existed among the different studies has not allowed developing a certain practice to lift or carry the weights regarding the prohibition of the excessive increase in the AP.

To the best of the authors' knowledge, this is the first study on the role of weightlifting to the MWF level with synchronized multichannel cystometry with an empty and full bladder in both control and UI morbid groups. According to the literature, lifting increased the vesical and APs, but the main outcome of the present study was no leakage detection during the MWF level lifting, neither in the control nor in the morbid group. Regardless of the bladder condition, even though the MWF of both groups varied similarly, the AP was significantly increased in the UI group rather than the controls. This hypothesized that another intrinsic factor might play a role in the rise of the AP in the morbid group. The no-leakage observation for the UI participants suggests that this factor may be a compensatory mechanism revealed in contractions of the abdominal muscles to prevent urinary leakage. Due to the possible synergies of the abdominal and pelvic floor muscles in the prevention of the UI,[26] an electromyography measurement of these muscles can further investigate this hypothesis.

The detrusor pressure, as an indicator for the UI, between control and morbid groups was only significantly different in full bladder condition. The UI-involved participants had greater detrusor pressure meaning a higher risk of leakage, as it was predicted.

Higher abdominal, vesical and detrusor pressures in the incontinent group were observed only in full bladder status in comparison with the controls, and only the AP of the UI morbid group was significantly greater, but it did not necessarily lead to incontinence, showing that the evidence beyond "lifting equals leaking" is not correct in all situations.

Limitations

This study has been faced with some limitations. First, the magnitude of the lifted weights was only set to the maximal forces that each participant could tolerate. It had better test various submaximal levels of the weightlifting. Second, the bladder condition in the present study was

Study Highlights

What is current knowledge?
- Lifting heavy subjects lead to urinary incontinence.

What is new here?
- Lifting heavy subjects' MWF may not necessarily lead to the UI.

only set to empty and full. Given the similarity with the first limitation, different bladder volumes could be considered for each participant after individual cystometry. Third, load-bearing was only designed for the hold condition. Different types of loading like pulling, pushing, etc. could be considered in various maneuvers or postures rather than the standardized one like a squat, unilateral, backpack, etc. load-bearing. Finally, this study has investigated A limited number of participants. In addition to more accredited results, examining a larger population could confer the opportunity of sub-categorizing regarding other influencing factors, e.g. parity, degree of prolapse and UI severity, etc.

Conclusion

The standardized weightlifting increased the abdominal and bladder pressures; nevertheless, lifting to the subjects' MWF may not necessarily lead to the UI. Recommendations for weightlifting should be individualized by considering the bladder condition.

Conflict of Interest

The authors declare that they have no conflict of interest.

Ethical Approval

This study was registered and approved by the local ethical committee (IR.TBZMED.REC.1395.1051). Each subject received verbal and written explanations and signed the consent form.

Authors' contribution

MB: Data collection, data analysis, manuscript writing. MRA: Study design, apparatus manufacturing, data analysis. SH: Study design, manuscript edition. MMA: Data collection

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