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Comparison of Abdominal Pressure and Cardiac Parameters Between Normal Powerlifters and Obese Individuals

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Abstract

Obesity is a chronic medical condition characterized by excessive body fat accumulation. It is a primary global health concern associated with various adverse health outcomes. Lack of physical activity is one of the primary reasons for obesity. This study compares the abdominal pressure changes and cardiac parameters between obese individuals with and without powerlifting exercises. This study included 50 individuals divided into 25 in each group. The first group was only obese individuals who weren't doing any exercises, whereas the second group of individuals were participating in the powerlifting exercises. Selection criteria are male powerlifters, obese individuals with a BMI over 30, age group of 25—40 years, and powerlifters doing powerlifting for a minimum of two years without cardiac anomalies, pain, or pulmonary complications. The intra-abdominal pressure and cardiac parameters were measured using the Chattanooga stabilizer pressure feedback device and pulse oximeter. The collected data were analyzed using SPSS 24.0. There was no significance when comparing the pre-intervention values; all the p-values are insignificant. While comparing the values of the immediate powerlifting intervention (6.926 $p < 0.462$, 4.599 $p < 0.0001$, 10.437 $p < 0.617$) and five minutes post power lifting intervention (6.178 $p < 1.133$, 6.871 $p < 1.161$, 9.975 $p < 4.96$), there is a marked significance. This study concludes that when comparing intra-abdominal pressure and cardiac parameters between obese individuals who engage in powerlifting exercises and those who do not, a significant reduction in intra-abdominal pressure is noted in powerlifters. In contrast, obese individuals who do not engage in powerlifting exercises do not experience a reduction in intra-abdominal pressure, and their cardiac parameters remain unchanged.

Keywords: Powerlifters; Obesity; Intra-abdominal pressure; heart rate; respiratory rate; Pulse oximetry; Chattanooga pressure biofeedback

Introduction

Obesity has become a potential global health threat, with its prevalence steadily increasing since the start of the 21st century [1]. By 2016, over 2 billion adults, comprising 44 per cent of the global adult population, were overweight or obese, with more than 70 per cent residing in low- to middle-income countries. Obesity is characterized by the excessive accumulation of body fat, and the way fat is distributed in the body plays a crucial role in determining metabolic risk [2]. This health issue is often overlooked despite its significant contribution to developing diabetes and cardiovascular diseases [3]. The number of overweight adults exceeds 1.9 billion, while 650 million are classified as obese [1].

The consequences of being overweight or obese are dire, resulting in approximately 2.8 million deaths. This problem has become a significant public health concern in developed and developing nations. In India, more than 135 million individuals are affected by obesity [4]. Asian Indians, in particular, are more prone to abdominal obesity and visceral fat accumulation, making them more susceptible to associated health risks [5]. Obesity can result in severe health repercussions, including cardiovascular diseases (such as heart disease and stroke), type 2 diabetes, musculoskeletal disorders like osteoarthritis, and certain cancers (endometrial, breast, and colon). These conditions are responsible for premature deaths and significant disability among affected individuals [6].

Exercise is often integrated into various lifestyle interventions, emphasizing the importance of regular physical activity throughout the day [7]. General physical activity within one's daily routine encompasses goal setting, problem-solving, participating in leisure-time physical activities, and incorporating activity into commuting [7]. Considering exercise as a crucial indicator for individuals with obesity: Incorporating exercise and physical activity habits as an additional vital sign could provide valuable insights. This involves gathering information from patients about their current exercise routine, including details about the intensity, type, and duration of the exercises they engage in every week [8].

There is a marked increase in intra-abdominal pressure during the static and dynamic weight-lifting techniques [9]. However, these Intra-abdominal pressures have also been suggested to increase lumbar stability by forming a "rigid cylinder" through the abdominal muscles [10]. However, there are many controversial facts that stability was promoted by intra-abdominal pressure or the trunk muscles. Moreover, few studies focus on the amount of intra-abdominal pressure exerted in obese individuals.

Studies on intra-abdominal pressure show that acute elevation is linked to other morbidities, including increases in central venous pressure, pulmonary capillary wedge pressure, systemic vascular resistance, peak airway pressure, intrapleural pressure, and renal vein pressure [11], and decreases in venous return, cardiac output, visceral blood flow, renal blood flow, glomerular filtration rate, and abdominal wall compliance [12]. A connection between intra-abdominal pressure and visceral fat may exist, given the strong correlation between intra-abdominal pressure and sagittal abdominal diameter. The raised intra-abdominal pressure's role in the aetiology of the onset of metabolic problems. The intra-abdominal pressure must, therefore, be controlled to help avert numerous problems [12].

Typically, obese individuals are prescribed aerobic exercises such as treadmill running, recumbent biking, or using an elliptical machine, while anaerobic exercises are not commonly recommended [13]. This is because weight training can potentially increase intraabdominal pressure, which may not be well-tolerated by obese individuals. Therefore, this study aims to determine the intra-abdominal pressure and cardiac parameters of obese individuals during powerlifting exercises and compare them with those who do not perform powerlifting exercises.

Materials & Methods

The baseline characteristics were calculated: age, gender, height, weight, BMI, etc. This study was a cross-sectional design which involved 50 obese individuals. Twenty-five obese individuals don't do any exercises in their lifetime, and 25 obese individuals do powerlift exercises for one year. The institutional ethical committee at Garden City University, Bangalore, Karnataka, approved this study. Once the approval was received, the participants were recruited. The total duration of the study was six weeks. The participants included were males aged 25—40 years who are more than 30 (Grade I obesity) in BMI and Individuals who did Powerlifting exercises for a minimum of two years without any cardiac anomalies, pain, or pulmonary complications. Before the recruitment, a senior physiotherapist and fitness expert assessed all the participants thoroughly. The powerlifters follow basic training, which includes bench press, squatting and deadlift as a superset. Before the beginning of the study, the participant's abdominal pressure was monitored using pressure biofeedback equipment, and heart rate and respiratory rate were obtained using a pulse oximeter. The pre-data was taken at the time of the study, the second data was collected immediately following powerlifting techniques, and the third data was collected after 5 minutes of powerlifting techniques. All participants were given clear instructions, and written consent was obtained from every participant. All the collected data were analyzed using SPSS 24.0.

Results & Discussion

The unpaired t-test was deemed an appropriate statistical method for analyzing group changes in this study. The data was analyzed using SPSS 24.0, a widely used statistical analysis software suitable for this study. The significance level (α) was set at 0.05, a commonly used threshold for statistical significance.

Table 1 provides information on the demographic characteristics of the study participants, including age and duration of treatment.

Variables	***Mean***	***S. D***
Age group	30.68	7.29
BMI	30.76	0.657
Peak Heart rate	83.91	4.639
Peak Pulse rate	76.12	2.163
Peak Respiratory rate	20.96	1.784

Table 1: Demographic analysis.

Tables 2, 3 and 4 present the student t-test results to compare the values on the pre-intervention time, immediate power lifting time and five minutes after powerlifting exercises. The data collected are the intra-abdominal pressure, Heart rate and respiratory rate. The effect sizes for the significant variables indicate that the differences between the means and the reference value (μ0) were substantial.

Outcomes	***Group I (Mean ± SD)***	***Group II (Mean ± SD)***	***Student t test values***	***Effect Size***	***P value***
Intra-abdominal pressure	12 ± 1.323	12.04 ± 1.338	0.106	0.03	0.916*
Heart Rate	83.68 ± 3.750	84.12 ± 5.457	0.332	0.09	0.741*
Respiratory Rate	21.01 ± 1.581	20.92 ± 1.998	0.157	0.04	0.8759*

*Since p-value > α, H0 cannot be rejected.

Table 2: Analysis between the groups of variables before the Power lift exercises.

Outcomes	***Group I (Mean ± SD)***	***Group II (Mean ± SD)***	***Student t test values***	***Effect Size***	***P value***
Intra-abdominal pressure	12.12 ± 1.201	15.32 ± 1.973	6.926	1.96	0.0462*
Heart Rate	84.01 ± 4.734	89.08 ± 2.827	4.599	1.31	0.000*
Respiratory Rate	20.96 ± 1.567	27.01 ± 2.432	10.437	2.95	0.617*

*Since p-value < α, H0 can be rejected.

Table 3: Analysis between the groups of variables immediately after the Power lift exercises.

Outcomes	*Group I (Mean ± SD)*	*Group II (Mean ± SD)*	*Student t test values*	*Effect Size*	*P value*
Intra-abdominal pressure	12.12 ± 1.201	10.01 ± 1.225	6.1785	1.75	1.33*
Heart Rate	83.56 ± 5.165	75.84 ± 2.211	6.871	1.94	1.161*
Respiratory Rate	21.36 ± 1.868	16.76 ± 1.422	9.795	2.77	4.961*

*Since p-value < α, H0 can be rejected.

Table 4: Analysis between the groups of variables five minutes after the Power lift exercises.

This table suggests that during the powerlifting exercises, there is a marked rise in Intra-abdominal pressure, heart rate, and respiratory rate. But when the exercises ceased, the values returned to normal, almost equal to the average adult values. This shows that exercises help reduce intra-abdominal pressure and heart and respiratory rates.

Discussion

The study compared intra-abdominal pressure and cardiac parameters in obese individuals with and without powerlifting exercises. The physiological effects of intra-abdominal pressure have garnered significant attention [14]. Numerous studies have demonstrated a strong association between increased body mass index (BMI) and elevated intra-abdominal pressure. Obese individuals experience a 25% to 36% rise in intra-abdominal pressure compared to non-obese individuals [15]. Studies have further revealed elevated intra-abdominal pressures in morbidly obese subjects, supporting data from previous research [16].

Interestingly, multiple linear regression analyses have shown that intra-abdominal pressure is more closely linked to sagittal abdominal diameter than BMI or weight. Sagittal abdominal diameter is considered one of the most reliable anthropometric indicators of abdominal visceral adipose tissue [17]. The study suggests that visceral fat accumulation may contribute to increased intra-abdominal pressure. It was always helpful to measure visceral adipose tissue volume more precisely using computerized tomography, magnetic resonance imaging, or dual-energy X-ray absorptiometry [18, 19].

There is a stronger correlation between intra-abdominal pressure and directly measured visceral abdominal tissue, thereby implying a potential role of intra-abdominal pressure in developing metabolic complications associated with visceral fat accumulation [20]. However, it is essential to distinguish between the effects of elevated intra-abdominal pressure and the independent, confounding effects of harmful visceral fat accumulation [21]. Additional research is needed to clarify this distinction.

Powerlifting exercises aim to increase an individual's strength by engaging multiple muscle groups, promoting bone mineral enhancement, stretching connective tissues, and improving muscle strength [22]. It is hypothesized that strenuous exercises can elevate intra-abdominal pressure, transmitting this pressure to the pelvic floor muscles, connective structures, tissues, and nerves, possibly leading to injury [23]. The activation of the transverse abdominal muscle and body lifting postures that involve contact between the thighs and an abdominal wall has been shown to correlate positively with the generation of intra-abdominal pressure [22]. Weir et al. 2006, has observed changes in intra-abdominal pressure in healthy adults during various activities and found that weightlifting was also positively associated with increased intra-abdominal pressure [24].

Studies have identified a significant rise in intra-abdominal pressure during resistance exercises, although supporting the trunk benefits healthy populations [25]. During exercise, different muscles are engaged, leading to increased blood flow to the muscles and higher cardiac output. Cardiac output increases substantially due to the elevated heart rates achieved during exercise. Heart rate increases in proportion to workload until reaching near-maximal levels. As blood circulation to the exercising muscles intensifies, heart and pulse rates also increase [26]. The efficient delivery of oxygen to the working skeletal and cardiac muscles during exercise is crucial for maintaining ATP production through aerobic mechanisms [27].

Immediately after the cessation of exercise, heart rate and intra-abdominal pressure, which had risen during the activity, decreased rapidly [28]. The decline in heart rate immediately after exercise is attributed to the reactivation of the parasympathetic nervous system [28]. It has been observed that vagal reactivation is the primary determinant of the initial decrease in heart rate during the first 30 seconds of recovery, and this mechanism is independent of age and exercise intensity [29].

Based on statistical analyses and previous studies, it has been determined that powerlifting increases intra-abdominal pressure and cardiac parameters. However, these pressures return to near-normal levels soon after exercise ceases. While obese individuals typically exhibit elevated intra-abdominal pressure, exercising helps maintain these pressures within a more normal range.

In this study, it was inferred that understanding the physiological consequences of intra-abdominal pressure is crucial. Obesity is strongly associated with increased intra-abdominal pressure, and visceral fat accumulation may contribute to this rise. Powerlifting exercises can elevate intra-abdominal pressure but reduce obesity in individuals who regularly engage in such activities.

It is essential to admit some limitations of this study: a) It is a single-measurement study, and conducting multiple measurements and comparisons may yield different results. b) The study did not evaluate intra-rater and inter-rater reliability. c) All powerlifting obese individuals included in the study were trained and not amateurs, suggesting they may have had prior knowledge of proper lifting mechanics. Further research is needed to explore the relationship between intra-abdominal pressure, visceral fat accumulation, and metabolic complications, as well as to address the limitations of this study.

Conclusion

The study concluded that powerlifters, compared to obese individuals who did not engage in powerlifting exercises, experienced a significant reduction in intra-abdominal pressure and cardiac parameters. In contrast, obese individuals don't have a reduction in their intra-abdominal pressure and the cardiac parameters are not changed.

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Conflict of interest

None declared by the authors.

Author Contributions

Dr Anne Thomas, Mr. Rajan and Dr Vanitha conceived and planned the experiment. Dr. Arun and Mr. Rajan carried out the experiment. All authors contributed to the interpretation of the results, provided critical feedback, and helped shape the manuscript. All authors reviewed the results and approved the final version of the manuscript.

References

1. Schneider P., et al. "Health and economic impacts of overweight/obesity". Health and Economic Consequences of an Impending Global Challenge (2020): 69.
2. Chaudhary M and Sharma P. "Abdominal obesity in India: analysis of the National Family Health Survey-5 (2019–2021) data". The Lancet Regional Health-Southeast Asia (2023).
3. Mendis S. "Global status report on noncommunicable diseases 2014". World health organization (2014).
4. Das M and Bose K. "Presence of high rates of overweight and obesity among adult Marwaris of Howrah, West Bengal, India". Collegium antropologicum 30.1 (2006): 81-6.
5. Joshi SR. "Metabolic syndrome-emerging clusters of the Indian phenotype". Journal-Association of Physicians of India 51 (2003):

445-6.

6. Halfon N, Larson K and Slusser W. “Associations between obesity and comorbid mental health, developmental, and physical health conditions in a nationally representative sample of US children aged 10 to 17”. Academic pediatrics 13.1 (2013): 6-13.
7. Bechara RG and Kelly AM. “Exercise improves object recognition memory and induces BDNF expression and cell proliferation in cognitively enriched rats”. Behavioural brain research 245 (2013): 96-100.
8. Swift DL., et al. “The role of exercise and physical activity in weight loss and maintenance”. Progress in cardiovascular diseases 56.4 (2014): 441-7.
9. Hagins M., et al. “The effects of breath control on intra-abdominal pressure during lifting tasks”. Spine 29.4 (2004): 464-9.
10. Tayashiki K., et al. “Causal effect of intra-abdominal pressure on maximal voluntary isometric hip extension torque”. European Journal of Applied Physiology 118 (2018): 93-9.
11. Lambert DM, Marceau S and Forse RA. “Intra-abdominal pressure in the morbidly obese”. Obesity surgery 15.9 (2005): 1225-32.
12. Pupelis G., et al. “Clinical significance of increased intraabdominal pressure in severe acute pancreatitis”. Acta Chirurgica Belgica 102.2 (2002): 71-4.
13. Haskell WL., et al. “ACSM/AHA Recommendations”. Circulation 116.9 (2007): 1081-93.
14. Papavramidis TS., et al. “Abdominal compartment syndrome–Intra-abdominal hypertension: Defining, diagnosing, and managing”. Journal of Emergencies, Trauma and Shock 4.2 (2011): 279-91.
15. Sanchez NC., et al. “What is normal intra-abdominal pressure?”. The American Surgeon 67.3 (2001): 243-8.
16. Smit M., et al. “How central obesity influences intra-abdominal pressure: a prospective, observational study in cardiothoracic surgical patients”. Annals of intensive care 6 (2016): 99.
17. Chan DC., et al. “Waist circumference, waist-to-hip ratio and body mass index as predictors of adipose tissue compartments in men”. Qjm 96.6 (2003): 441-7.
18. Jin Y., et al. “Segmentation and evaluation of adipose tissue from whole body MRI scans”. InMedical Image Computing and Computer-Assisted Intervention-MICCAI 2003: 6th International Conference, Montréal, Canada, November 15-18, 2003. Proceedings 6 (2003): 635-642.
19. Shuster A., et al. “The clinical importance of visceral adiposity: a critical review of methods for visceral adipose tissue analysis”. The British journal of radiology 85.1009 (2012): 1-10.
20. Armaly Z and Abassi Z. “Deleterious effects of increased intra-abdominal pressure on kidney function”. Advances in Nephrology (2014).
21. Liu T., et al. “Numerical investigation of intra-abdominal pressure effects on spinal loads and load-sharing in forward flexion”. Frontiers in Bioengineering and Biotechnology 7 (2019): 428.
22. Austin D and Mann B. “Powerlifting: The complete guide to technique, training, and competition”. Human Kinetics (2021).
23. Gerten KA., et al. “Intraabdominal pressure changes associated with lifting: implications for postoperative activity restrictions”. American journal of obstetrics and gynecology 198.3 (2008): 306.e1-5.
24. Weir LF., et al. “Postoperative activity restrictions: any evidence?”. Obstetrics & Gynecology 107.2 Part 1 (2006): 305-9.
25. Ravishankar N and Hunter J. “Measurement of intra-abdominal pressure in intensive care units in the United Kingdom: a national postal questionnaire study”. British journal of anaesthesia 94.6 (2005): 763-6.
26. Blazek D., et al. “Systematic review of intra-abdominal and intrathoracic pressures initiated by the Valsalva manoeuvre during high-intensity resistance exercises”. Biology of Sport 36.4 (2019): 373-86.
27. Hellsten Y and Nyberg M. “Cardiovascular adaptations to exercise training”. Comprehensive Physiology 6.1 (2011): 1-32.
28. Lauer MS and Froelicher V. “Abnormal heart-rate recovery after exercise”. The Lancet 360.9340 (2002): 1176-7.
29. Vaseghi M and Shivkumar K. “The role of the autonomic nervous system in sudden cardiac death”. Progress in cardiovascular diseases 50.6 (2008): 404-19.

Volume 5 Issue 5 November 2023