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The Effectiveness of William Flexion Exercises in Improving the Lumbar Stability in Obese Adults: A Quasi-Experimental Study

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ABSTRACT

BACKGROUND

The word obesity is used to describe the higher fat accumulation in the body. Mechanical low back pain is most common in obese and overweight people. The irregular fat distribution and irregular forces acting upon the lumbar spine affect the stability and coordination of balance. Obesity was measured by BMI tool and stability with OLST.

OBJECTIVE

This study aimed to determine the effectiveness of William Flexion Exercises in improving lumbar stability in obese adults.

METHODOLOGY

A quasi-experimental study was conducted on a sample of 17 males and females' obese adults in Lahore. Their BMI was calculated and those who had BMI was equal to or greater than 30kg/m^2 and meet the inclusion criteria were included in this study. OLST was performed to check the stability of the lumbar spine before and after William Flexion Exercises. The one-sample test was used to analyze pretest and post-test effects.

Statistical data were analyzed by using SPSS version 20.

RESULTS

The results of this study were satisfactory and showed a significant difference between before and after RST and before and after RHT. The p-value p = 0.000 means that the null hypothesis was rejected.

CONCLUSION

The results of this study were satisfactory and showed a significant difference the lumbar stability before and after intervention application. This proved that Williams Flexion Exercises strengthen the low back muscle and helped in improving lumbar stability.

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KEYWORDS

William flexion exercises; Stability; Obese adults; OLST; RST; RHT; Intervention

INTRODUCTION

The word obesity is used to describe the higher fat accumulation in the body. Obesity became a serious health issue lately as it is considered a multifactorial disease like other serious diseases e.g., asthma, heart diseases, epilepsy, etc. since 1980 the ratio of obesity is doubled, and one-third population of the world is overweight or obese. Males and females of all ages are equally affected, there is no influence of gender distribution on obesity. Older adults are more obese than young people. This sequence of obesity is the same in all countries of the world, despite their different cultures and geographic areas [1].

WHO has declared obesity a global epidemic. The ratio of obesity is doubled over the past decades. The 25.0% adult population of Pakistan is either overweight or obese. The trend of obesity in rural areas is less than in urban areas. It is more common in females than in males. It became a serious health issue among the young generation and has many hazardous effects. Body Mass Index is considered a standard tool to measure obesity. It is calculated as weight in kg divided by height in meter square. WHO has set the cut-off values for a healthy weight for BMI is 25.0 kg/m^2 - 29.99 kg/m^2. More than 30 kg/m^2 is considered overweight or obese. It is a cheap, simple, and valid tool to measure body weight [2].

Mechanical low back pain is most common in obese and overweight people. The irregular fat distribution and irregular forces acting upon the lumbar spine affect the stability and coordination of balance. The activities of daily living also compromised to a great level. Those who have a sedentary lifestyle with obesity are more prone to have back and balance issues. As the strong musculature increases stability, decreases pain and the risk of falling.

Obesity causes several musculoskeletal disorders i.e., lordosis, either tightness and weakness of muscles, increased pelvic tilting either anteriorly or posteriorly, atrophy of muscles, poor strength of muscles, etc. which disturb the mechanics of the lumbar spine and decreases the stability of the spine. During the walk, there is hyperextension of the lumbar spine. The stiffness and weakness of lumbar spine muscles cause instability in obese adults.

Obesity disturbs the anatomy of the whole body. The acting forces of the gravity on the body also disturbed and could not hold the balance in the sagittal plane and fail to maintain normal posture because of the minimum amount of energy. This may cause weakening of the muscular structure of the lumbar spine, exaggerate anterior lumbar curve, and might develop lumbar lordosis [3].

The lumbar spine muscles along with abdominal muscles form the core of the body. These muscles activate and work together to support the lumbar spine and provide stability. The stability system includes deep and superficial muscles of this region i.e., transverse abdominals, multifidus, erector spinae and rectus abdominals. These muscles are prone to fatigue and injuries. Even in athletes, these muscles are sometimes neglected to strengthen which may disturb normal functioning and spinal loading. This may increase the chances of LBP, muscle strain, sprain and instability. During walking or running the shear load on the lumbar spine increases anteriorly due to weak musculature and increases the risk of fall. While the irregular distribution of compressive load on the lumbar vertebrae, which is increased on the upper segment and reduced on the lower segment of L-spine vertebrae [4].

Lumbar instability is one of the reasons for LBP and soft tissue injuries which can be settled with exercises. William flexion exercises also known as lumbar flexion exercises are used to treat LBP, to strengthen weak musculature which increases lumbar stability, balance, and coordination. William flexion exercises include single/double knee to chest, bridging exercises, pelvic tilt down, pelvic tilt tail tuck and bridging will help to strengthen weak core muscles, straighten the increased curve of the low back in obese and relieve low back pain [5].

Single leg standing test OLST will be used to measure the stability of the lumbar spine in obese adults before and after the application of the intervention. OLST is a reliable and valid tool to measure kinematic changes by its two components which are relative holding time RHT and relative standstill time RST. Subjects were asked to keep the OLST position for 30 seconds with 3 repetitions to calculate the mean average value [6].

OLST test is used to check the improvement in lumbar stability. The RST time will be recorded before and after exercises. Total 3 times this test was applied to calculate the mean value, if the mean value is less than 30 seconds it means that the lumbar spine was unstable and has weak muscles. Then the 4 weeks exercise plan will be followed to check the difference between before and after stability. Lumbar stability will be improving if the RST and RHT increase up to 30 seconds. A one-sample test will be used to analyze the before and after-effects of the study.

Many studies supported Williams Flexion Exercises helped decrease low back pain but is no such studies in the past proved the effects of William flexion exercises in improving L-spine stability of obese adults by recording relative standstill time and relative holding time of the OLST. This study will show the effects of Williams flexion exercises on obesity and lumbar stability.

LITERATERATURE REVIEW

An experimental study was performed by Chaiyong et al. in 2015. This study aimed to determine the effects of yoga exercises on OLST and FRT for static and dynamic balance in obese people with poor balance. There were two groups, the control group and the intervention group. Each group had 16 members and the intervention group performed yoga exercises for 45 minutes in a day and 3 days per week. The tools that were used in this study were One Standing Test and Functional Reach Test. These tests were performed with both eyes closed and eyes opened. The results of this study showed that the static balance of the yoga group increased significantly but on the other hand there was no significant change in the control group. This concludes that yoga exercises helped improve the static balance of obese people with poor balance [7].

Stefani A. Nelvin et al. [8] conducted an experimental study in 2021. He aimed to determine the effects of lumbar flexion exercises in relieving LBP in farmers. In this quasi-experimental study, 23 participants were recruited randomly from a rice farm in Lembor Selatan District with LBP. All the farmers were asked to do William flexion exercises, abdominal strengthening exercises for 30 minutes - 40 minutes. The Oswestry questionnaire tool was used to measure LBP in farmers and the data difference between pre- and post-intervention status was measured with the Wilcoxon sign ranking test. The results were satisfactory as the level of low back pain before application of intervention was 64.26 but after intervention application, pain reduced to 47.96 and the difference was 16.3. This shows that low back pain can be reduced by William Flexion Exercise [8].

An experimental study was performed in 2010 by Sung et al. [6] to determine the stability of the lumbar spine in adults who had LBP and without LBP by comparing kinematic changes during the single leg holding test. The control group members were slightly younger than with LPB. They performed the single leg standing test for 25

seconds, while the researchers measured RST and RHT to check the stability of both axes of the lumbar spine and core spine. In this study, the comparison of both axes was measured by two-way repeated measurement analyses. To compare the difference between the two groups independent t-test was used. In the results, the RHT of participants without LBP and any visual block was longer than those who had LBP pain. While RST time for both participants was $F = 7.17$ and $P = 0.01$. The RHT and RST in members with LBP reduced while visual feedback was also blocked, and the relation of visual feedback and trunk rotation tells us that there is poor coordination of muscle control. Hence core muscle training was required to prevent postural instabilities [6].

Sam-Ho-Park et al. in 2021 conducted a research study on the effects of intense neuromuscular stability exercises on pain, motor activity, abdominal contractions, psychological and social factors affecting an obese person's health. It was a double blinded randomized control study contain 46 members, 23 in the control group exercised on a stable surface and 23 in the experimental group did a highly intensive exercise on an unstable surface. Its results showed that there was a huge difference in both group's BMI, quadruple visual analog scale, Fear-Avoidance Beliefs Questionnaire, Korean Oswestry Disability Index and balance ability in pre and post comparison of intervention. The transverse abdominals thickness differs greatly after intervention application. The contraction rate of the abdominals was $P < 0.05$. Therefore, these highly intensive exercises were proved beneficial for pain management, motor activity, psychomotor activity, transverse abdominal muscle thickness and contraction rate of the experimental group in patients with LBP and lumbar instability [9].

In 2019, Fatemeh Ehsani et al. [10] conducted a randomized controlled triple-blinded study on the effects of balance board standing exercise in the thickness of lateral abdominals, and the outcomes of stabilization exercises (SE) and general exercises (GE) on the patients with chronic LBP. In this, 40 females with CLBP were recruited in the control group and experimental group. To measure the difference before and after intervention in total thickness of lateral abdominals, ultrasound images were used. On the other hand, pain intensity and disability were measured by the visual analog scale and the Ronald-Morris disability scale. The standing balance exercises showed an increase in abdominals thickness is $P = 0.02$ while with the use of SE there was a significant decrease in pain intensity and disability in the experimental group i.e. $P < 0.002$. On the other side, the GE group showed a less significant increase in lateral abdominals thickness ($P > 0.05$) and reduced pain intensity and disability ($p = 0.03$). In conclusion, vigorous activity i.e., standing balance exercise could increase the thickness of lateral abdominal muscles in subjects with chronic low back pain [10].

A quasi-experimental study was performed by Minseock et al. in 2017. The main aim of this experiment was to evaluate the significance of therapeutic exercises in elder women with nonspecific back pain. 38 women participated and were divided into two different groups i.e., hollowing lumbar stabilization exercises and bracing lumbar stabilization exercises for 3 times a week and the total time was 12 weeks. These all the women performed side plank, bridging, 4 kneeling, prone plank and prone extension exercises considering hollow and brace techniques. The pre and post difference of trunks stability (K-ODI), low back disability (K-RMDQ) and static balance (single leg standing test) were recorded as per the method. So, HLSE and BLSE showed a significant difference i.e., trunk flexion ($F = 10.11$, $P = .001$) while BLSE ($t = 5.56$, $P = .001$) and HLSE ($t = -2.50$, $P = .24$). However, the patient with NSLBP should be advised to do HLSE and BLSE for trunk stability and muscle strength in community settings [11].

Iqra Nayyab et al. [12] researched from august 2018 to January 2019 held at a rehabilitation center. The aim was

to evaluate the significance of therapeutic exercises on core spinal muscles. There was a total of 30 post-C-section operated women 15 in each group, the control group performed exercises at home without supervision and the experimental group exercised under supervision. In this, pain rating scale, Oswestry Disability Index, inclinometer and core stability assessment tools were used. The difference between pre- and post-treatment of intergroup and intragroup were recorded. The results showed that exercises were performed at home or rehabilitation centers were effective. But core muscles exercises that were performed at the rehabilitation center proved to be more effective in terms to manage disability and pain and increase core muscle activity [12].

Kwack et al. [13] studied the development of lordosis and disturbance of inter-vertebral disc angle due to obesity. 170 patients were allowed to participate in this study. The lumbar lordotic angle LLA, intervertebral disc angle IDA and relationship between spinopelvic parameters, pelvic incidence and sacral horizontal curve were measured from the lateral view of lumbar and sacral spine in radiographic images. BMI tool was used to measure obesity. Independent t-test, ANOVA and Pearson test were used to analyze the results. The results showed that obesity was greatly related to LLA than with individual IDA. On the other hand, LLA and IDA were correlated. Thus, lordosis could occur due to abdominal obesity. Consequently, obesity increased pressure on the lumbar spine, changed mechanics due to weak core muscles causing lumbar pain and the development of lordosis [13].

A study based on systemic review was performed by Ahreum Han et al. in 2018. The purpose of this study was to determine the effect of intervention exercises on motor abilities and balance coordination in obese children. It was extensive research that contains data from different research sites i.e. CINAHL, Scopus, MEDLINE, SPORTSDicsus, EMBASE and web science. A total of 3944 research articles were appeared of which 17 articles included in this study. From these 17 studies, a total of 38 different tasks was focused on in which 33 showed positive effects of interventions on obese children's motor skill improvement and locomotor skill enhancement while the rest 5 shows no significant results. Thus, the specialized physical activities improved motor skills and motor coordination in obese children and helped to prevent obesity [14].

Demet Merder Coskun in 2017 analyzed a community-based observational cross-sectional study. The objective of this study was to find the association between physical examination, obesity, and function of the musculoskeletal system. 318 total participants, 125 with normal weight and 193 obese children of age 5 years to 16 years were allocated to this study. To examine physically; gait balance and muscle strength were included while the measurement tools used were BMI, ROM and PODIC. As a result, pes planus diseased was the most common musculoskeletal disease and single leg standing time was shorter (0.002) than time up and go test time (0.004). In obese children, PODIC happiness scale values were $p < 0.05$ and ROM values were also decrease ($P < 0.05$). Hence, in obese there were more chances of musculoskeletal disorders and decrease ROM, balance in-coordination, functional and emotional skills were also depressed. One can be able to prevent obesity by doing physical interventions [15].

In 2017, Prasetiowati et al. [16] explore the impact of obesity on balance and lower extremity muscle strength and their relationship. There was a total of 63 children which were divided into 3 groups' normal, overweight, and obese children of age 8 years to10 years. To measure all the components one leg standing test and dynamometer were used. COP during the single leg standing test was increased in the obese group than the other two. The strength of the lower limb of obese in comparison to the other two groups was low.

The postural balance of obese declined while knee extensors strength was more than the overweight and normal-weight group [16].

Paravel Khanal et al. [17] performed a study in 2021. The purpose of this study was to set up one leg standing test threshold for the muscles that had low muscle mass and evaluate the ability of this threshold to check out muscle impairment. 291 women took part in either of the legs standing tests and hold for 30sec. a questionnaire was filled out by participants to measure physical activity and MCVKE/FFM was used to record muscle quality. The outcome of the OLST threshold was 55 seconds for low muscle mass, sensitivity = 0.63, specificity 0.60. Consequently, OLTS was easy to use to measure muscle mass and recognize the ones who were at risk of sarcopenia [17].

OBJECTIVE

To determine the effectiveness of William flexion exercises in improving lumbar stability in obese adults.

HYPOTHESIS

Null Hypothesis

There is no difference in lumbar stability between before and after application of the intervention.

Alternate Hypothesis

There is a significant difference in lumbar stability between before and after application of the intervention.

RATIONALE

This study will help us to determine the effects of Williams Flexion Exercises on lumbar stability in obese adults. To execute a successful study, participant's consent will be taken if they will agree and are motivated for a 4-weeks exercise follow-up plan then they will be recruited. Moreover, after the execution of this study, the exercise intervention will strengthen the weak core muscles, improve balance and stability. This study will spread awareness among obese people to live a healthy life and improve their quality of life.

OPERATIONAL DEFINITION

Characteristics of WFE

Frequency	5 days/week
Intensity	Moderate-high
Time	10sec/3 rep/each exercise
Type	Hamstring stretch, knee-chest uni/bilateral, quadruped arm/leg raise and bridging exercise (strengthening)

OLST

One leg standing test is also known as the single leg standing test is used to measure the stability of the lumbar spine by its two components Relative Holding time RHT and relative Stand Still Time RST. RST records the swaying backward or forward time during the test and RHT will record the holding time of the leg in the air. The subject will stand on the dominant leg for 30 seconds while the other leg is flexed without any visual block. RST and RHT will tell if the lumbar spine is stable or unstable. It is frequently used in clinics and research because it is highly reliable, valid, simple, and cost-free. Its reliability and validity are 0.84-0.94 and 0.657-0.998 [6].

BMI

The prevalence of obesity in Pakistan is 25.0% among adults. Body Mass Index BMI is a standard tool to measure obesity and according to WHO more than 30kg/m^2 is considered overweight or obese. To calculate BMI, weight in kilograms divided by height in meters square is taken. It is categorical and it interprets as underweight, healthy weight, overweight and obese [2]. It is a simple and reliable screening tool for body weight. Sensitivity and specificity are 76.3% and 100% [18].

MATERIAL AND METHODS

Study Design

It was a quasi-experimental study. The reason being quasi-experimental study design; it was quantitative in which only one group’s pretest and post-tests effects of the

intervention were evaluated. In this study pre and post effects of WFE had been evaluated in obese adults by recording their RST and RHT during OLST. The one sample test was used to identify the significant difference between pre and post effects of intervention in improving lumbar stability.

Setting

This study was executed in a physiotherapy clinic in Lahore, Pakistan.

Study population

In this study, obese adults including males and females of age 20 years - 40 years took part.

Duration of Study

6 months

Study Parameters	
Incidence, population	30%
Incidence, study group	70%
Alpha	0.05
Beta	0.05
Power	0.95

Sample size

In this research 17 men and women were included.

The sample size was calculated by using the following formula and parameters.

$$N = \frac{p_0 q_0 \left\{ z_{1-\alpha/2} + z_{1-\beta} \sqrt{\frac{p_1 q_1}{p_0 q_0}} \right\}^2}{(p_1 - p_0)^2}$$

$$q_0 = 1 - p_0$$

$$q_1 = 1 - p_1$$

$$N = \frac{0.3 * 0.7 \left\{ 1.96 + 1.64 \sqrt{\frac{0.7*0.3}{0.3*0.7}} \right\}^2}{(0.7 - 0.3)^2}$$

$$N = 17$$

p_0 = proportion (incidence) of population
p_1 = proportion (incidence) of study group
N = sample size for study group
α = probability of type I error (usually 0.05)
β = probability of type II error (usually 0.2)
z = critical Z value for a given α or β

The proportion of the obese population was 30%. By using the formula mentioned above, the total sample size was 17.

Sampling Technique

In this study convenient sampling technique was used.

Inclusion Criteria

- Subjects whose BMI was more than 30 kg/m^2.
- Men and women between aged 20 years - 40 years.
- Subjects whose OLST time was less than 30 seconds.

Exclusion Criteria

- Any pre-existing balance-related disorder e.g., positional vertigo.
- Any pre-existing spinal disorder e.g., scoliosis, kyphosis, lordosis, etc.
- Genetic disorder e.g., muscular dystrophy.
- Any systemic disease e.g. cancer.
- Any neural symptoms e.g., numbness, radiculopathy in lower limbs.

Data Collection Procedure

To collect data, 17 obese males and females took part in this study willingly to determine the effectiveness of William flexion exercises in the improvement of lumbar

stability. Before the practical application of the intervention, participants were informed about the whole procedure and their consent was taken. The subjects who do not meet the inclusion criteria were excluded from the study. The tools were used to perform these studies were BMI and OLST. The BMI of all the participants was calculated and was more than 30 kh/m^2. The OLST was performed before exercise, in this test RST and RHT were measured for 30 seconds. Then all the participants followed William's Flexion Exercises for 4 weeks. The frequency of exercise was 5 days/week. The stability was checked after 4^{th} weeks. To check the difference between lumbar stability after exercises OLST was performed once again.

Ethical Consideration

This study did not harm anyone in any manner and did not violate medical ethics. This study had not any bad impact on society. Before the application of intervention, consent was taken from the participants and ensured that their data will be kept confidential. Those people who did not willing to participate in this study wholeheartedly were not forced to take part.

Statistical Analysis

Data analysis was done by SPSS version 25. In the analysis, the frequencies and percentages of categorical variables were calculated. The mean and standard deviation of quantitative variables was calculated.

Endnote version 8X was used to add references to all the related previous studies.

RESULTS

Demographic profile

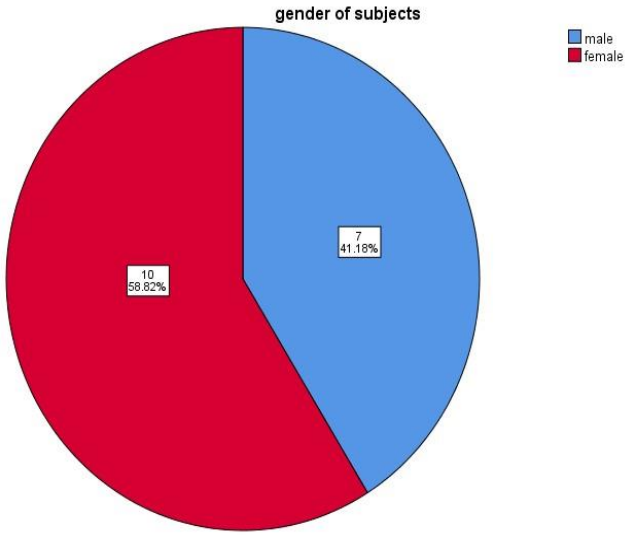
Table 1 shows that there were 41.2% [7] male and 58.8% [10] female obese adults.

Females had a greater ratio than males who participated in this study.

	Frequency	Percent
Male	7	41.2
Female	10	58.8
Total	17	100.0

Table 1: Frequency of gender of obese adults.

Pie Chart



Descriptive Statistics

Mean age and BMI of subjects

	N	Range	Minimum m	Maximum m	Mean	Std. Deviation
Age of the subjects	17	17.00	22.00	39.00	30.4706	4.96384
BMI of subjects	17	14.00	30.00	44.00	34.2059	3.73605

Table 2: It shows the mean age and BMI of subjects. Mean age was found 30.4706 with SD ± 4.96384 and mean BMI was found 34.2059 with SD ± 3.73605. the age limitation for this study was 2040 yrs. Here the minimum age of the participant is 22-yr and the maximum age is 39 yrs. The standard value of BMI for obese adults was considered as 30 kg/m^2. Here the minimum BMI value was 30.00 and the maximum was 44.00.

T-Test

One-sample statistics.

	N	Mean	Std. Deviation	Std. Error Mean
Before exercise RST	17	14.8882	3.23088	.78360
After exercise RST	17	32.0118	1.60969	.39041

Table 3: Shows that all the participants perform exercises and here is their before and after relative still standing time mean. The mean RST before exercises was 14.89 with SD ± 2.23 and the mean of RST after exercise was found 32.01 with SD ± 1.61. Std. Error means indicated that for before RST was .78306 and for after exercise RST value was 0.39041.

One-Sample Test	Test Value = 0				95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
before exercise RST	19	16	0	14.88824	13.2271	16.5494
after exercise RST	81.996	16	0	32.01176	31.1841	32.8394

Table 4: Showing one-sample test for RST. There is a difference between the mean before and after exercises which shows that the lumbar stability was improved after the application of WFE. According to the Wilcoxon rank test if p = 0.000, the null hypothesis would have rejected.

The P-value, p = 0.000 indicates the significant difference between pretest and posttest effects of intervention in improving lumbar stability of obese adults. It means that the alternative hypothesis was accepted.

T-Test

One-sample statistics

	N	Mean	Std. Deviation	Std. Error Mean
Before exercise RHT	17	24.3176	1.83584	0.44526
After exercise RHT	17	39.7412	4.81106	1.16685

Table 5: Shows that all the 17 participants performed RHT before and after exercise and their Mean values were different. The Mean relative holding time RHT before exercise was 24.32 with SD ± 1.84. The mean of RHT after the intervention was found 39.74 with SD ± 4.81.

One-Sample Test	Test Value = 0			95% Confidence Interval of the Difference		
	t	df	Sig. (2 tailed)	Mean Difference	Lower	Upper
Before exercise RHT	54.615	16	.000	24.31765	23.3737	25.2615
After exercise RHT	34.058	16	.000	39.74118	37.2676	42.2148

Table 6: Shows the one-sample test of RHT before and after exercise. The mean of RHT before and after the application was found different. This means that the null hypothesis had been rejected. It would have been accepted if there is no difference between before and after exercise.

The P-value p = 0.000 shows that there was a significant difference between before and after intervention in improving lumbar stability. thus, the alternative hypothesis was accepted.

DISCUSSION

Obesity has health hazards but unfortunately, people do not consider obesity as a serious issue in developing countries like Pakistan. They underestimate the risk factors of obesity. Obese people are at risk of getting serious systemic diseases [19] The weak muscular structure of the lumbar spine causes imbalance and exaggeration of the anterior lumbar curve. This increases the chances of lordosis and poor lumbar stability in obese adults.

A similar study, by Kwak et al in 2020 said that lumbar vertebrae act as a shock absorber.

The correct alignment of vertebrae is very important for forces to act properly and effortlessly. Lumbar lordosis might develop if the structural stability and stability of each vertebral segment have been imbalanced. Low back pain was also seen as common in obese adults who had poor stability [13]. Similarly, another study narrated that balance is impaired in obese people. Stability

of static and dynamic balance was assessed during walking and there were increased chances of fall and musculoskeletal injuries found in older obese [20]. There is a lack of interest, motivation, and awareness towards living an active lifestyle and doing physical therapy exercises in daily routine life.

The purpose of this study was to determine the difference in the improvement of lumbar stability of obese adults between before and after the application of William flexion exercise. All the participants were obese and the tool that was used to measure obesity as body mass index. A previous study has also used this same tool to measure obesity and narrated that people with a BMI is equal to or greater than 30 kg/m^2 considered as obesity [2].

After completion of inclusion criteria, the participants followed the exercise plan for 4 weeks under the supervision of a physiotherapist. Their lumbar stability was assessed before the beginning of 4 weeks' exercise plan and at the end of the fourth week. Following previous research, the RST and RHT time of one leg standing test was evaluated [6]. This research showed a significant result in increasing OLST time after the completion of the exercise plan.

The results of this study were in line with previous research which narrates that if the p-value is less than 0.05 then it's mean that there is a significant difference between pretest and posttest effects of the intervention. The null hypothesis was rejected, and the alternative hypothesis accepted [8]. Thus, this study showed a significant difference in lumbar stability after the application of William Flexion Exercises.

There was another corroborating research found in 2017 by Lee-A Rum et al in which he explained the effects of William flexion exercises on the lumbar spine by improving the low back pain of overweight adults. These exercises decrease low back pain by strengthening low back muscles and there was also a significant decrease in excessive fat-ratio after 12 weeks [21]. Similarly, my study also followed William Flexion Exercises plan to strengthening the weak muscles of the low back and to see its effects in improving the lumbar stability of obese adults.

In 2015 the same study was conducted on improving lumbar stability but with a different exercise plan by Jorrakate. That old study was aimed to check the static balance of obese adults with the OLST tool before and after 8 yoga exercises for 4 weeks [7]. The aims, measurement tools and total time for execution of the exercise plan of this study are similar to the previous study but the intervention plan was different. The results of this study are in line with the previous study despite different interventions and showed a significant difference between pre- and post-lumbar stability and the p-value found $p = 0.000$, which means the alternative hypothesis was accepted. Stability is important to distribute forces on the spine and pelvis equally.

This same thing was found in past literature, the weak muscles of the core do not perform their activities properly so the muscles opposite to these weak muscles engaged in over activity. This improper function also disturbs the stability of the core spine. Hip and core stability exercises improved muscle strength, stability and function [22].

Similarly, another research proved that one leg standing test was used to evaluate static balance in healthy old-aged females. The test was performed with both the right and left legs. The total time to test the stability of the lumbar spine 30 seconds. those who maintain this position for 30 seconds were stable and those who were not able to hold this position were unstable. The results showed that those who had poor static balance had more fat accumulation on the core spine in comparison to others [23].

A recent study was performed to identify the effects of William flexion exercises on older adults. The results showed similar benefits of these exercises for older people in improving low back pain and muscle strengthening as it has on young adults [24]. Similarly, another literature proved that William Flexion Exercises has a positive effect in improving lumbar spine function, stability, and low back pain [25].

CONCLUSION

The results showed that William Flexion Exercises strengthen the low back muscles, improves the static balance and the stability index of OLST was also increased. The functional ability also improved. Thus, William flexion exercises increase lumbar stability and may also decrease the chances of fall due to improved balance.

LIMITATIONS

- Limited time.
- Small study population.
- A specific population (adults) was chosen.

RECOMMENDATIONS

In the future, it could be done on a large population of every age including children, teenagers, adults and old aged, etc. and in a large community not only in one city. The other effects of William flexion exercises can also be seen as in this study only one variable lumbar stability was studied. It can also be compared with underweight people.

DECLARATION

It is declared that no funding taken for this study. There was no ethical issue.

Participants identity secured throughout the study.

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