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ARTICLE

Effects of multi-gravitational suspension-based therapy on posture, physical fitness, quality of life, depression, and sleep quality in women without regular exercise habits

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ABSTRACT

Background: Multi-gravitational suspension-based therapy (M-Gravity) is a comprehensive discipline based on the principles of non-gravity, which serves to increase the quality of life and holistic health of the individual with the rehabilitation content of non-pressure inversion therapy and suspension systems.

Aims: To examine the effects of M-Gravity exercise on posture, physical fitness, quality of life, depression, and sleep quality in women without regular exercise habits.

Methods: This study included 20 women without regular exercise habits, who participated in M-Gravity exercise and 20 women who did not participate in any exercise program. Posture was measured by the New York posture rating chart, flexibility of the hamstring and pectoral muscles were assessed with flexibility tests, and endurance of the core muscles was measured with plank test. Depression levels were measured by Beck Depression Inventory, sleep quality was measured by Pittsburgh Sleep Quality Index, and Nottingham Health Profile was used to measure the perceived health levels of the subjects. Measurement of the core stability was performed with the Stabilizer Pressure Biofeedback. Two evaluations were made at baseline and after 4 weeks of exercise program.

Results: Although statistically significant results were achieved for all parameters in the M-Gravity group, no differences were observed in the control group between baseline and post-test scores ($p < 0.05$).

Conclusions: We came to the idea that eight sessions of M-Gravity program may have positive effects on posture, physical fitness and quality of life in women who do not have regular exercise habits.

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KEYWORDS
Women; exercise; posture; physical fitness; quality of life

Introduction

Multi-gravitational suspension-based therapy (M-Gravity) is a comprehensive discipline based on the principles of non-gravity, which serves to increase the quality of life and holistic health of the individual with the rehabilitation content of non-pressure inversion therapy. It is a hybrid exercise that comes from Pilates, kinesis, Gyrotonic, acrobatics, dance, barre method, fitness, and yoga. This discipline is called Aerial Yoga, especially with those who practice Yoga asanas (Melek 2021). The M-Gravity involves using a hammock to make movements easier for participants to strengthen and stretch muscles and mobilise fascial movements (Kriventsova et al. 2017).

Gravity can worsen problems with circulation, organ prolapse, and general body functions over time. Inversion is an effective method that prevents the negative effects of gravity on the body. Reversal can also be presented as a proactive method to maintain overall health. Standing upside down can stretch and relax muscles, reduce stress and pressure, and help ligaments move healthily (Margarita et al. 2019). M-Gravity exercises also contain upside-down positions in movements. Upside down postures relieves the pressure on the spinal discs and allows them to receive the necessary fluid, thus creating space for the nerves in the spinal cord. It is claimed that M-Gravity may relief chronic low back and neck pain. It may rejuvenate the endocrine, lymph, digestive and circulatory systems. It may release happiness hormones such as serotonin, endorphins, endophilin, endocannabinoids, and dopamine (Kriventsova et al. 2017; Margarita et al. 2019; Melek 2021).

There are many studies in the literature on the effects of various exercises performed on sedentary women on posture, muscle strength and endurance, but there is no study about the effects of such an exercise program made with hammock, which includes inversion, stretching and strengthening like M-Gravity exercise program. For this reason, the aim of our study is to examine the effects of M-Gravity

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exercise on posture, physical fitness, quality of life, depression, and sleep quality in women without regular exercise habits.

Materials and methods

Study design

This study was designed as a non-randomized controlled trial. One group performed the exercise with the M-Gravity, 2 sessions per week, for 4 weeks, at the Outpatient Clinic of Department of Physical Therapy, Baskent University. One session lasted for about 60 min. In the other group, no exercise was performed, and the measurements were repeated at the end of 4 weeks.

Ethical considerations

Ethical considerations of the study was approved by Baskent University Medical and Health Sciences Research Board and Ethics Committee (KA21/349). All participants gave written informed consent after receiving a complete written description of the study. The study was carried out in accordance with the Declaration of Helsinki. The study was registered to ClinicalTrial.Gov website with the registration number of NCT 05317650.

Participants

In our study, 20 volunteer women, without regular exercise habits, participated in exercise with M-Gravity and 20 volunteer women, without regular exercise habits participated in control group. Total of 40 women between the ages of 20 and 60 years were included. A total of two measurements were taken, at baseline and after 4 weeks. Basic demographic and clinical characteristics were collected at baseline. BMI is calculated by dividing the body mass by the square of the length in metres. Ideal weight is obtained by multiplying the desired BMI by the square of the height (Margarita et al. 2019)

Exclusion criteria: individuals with a physical, cardiac, or neurological disease that may interfere with our practices and assessments; pregnancy and post-natal individuals; individuals with scoliosis of 20 degrees or more; glaucoma; recent surgery (3–6 months waiting period according to surgery); hypertension (exercise in the upside-down position can cause an increase in blood pressure and a hypertensive crisis); impaired cerebral circulation; botox treatment in the last 6 h; spinal fractures; severe osteoporosis; sequestered disc herniation; spinal tumours; inflammatory conditions of the spine; head injuries; previous myocardial infarction; vertigo.

Assessments

Posture

The posture of the subjects participating in the study was evaluated with the New York posture-rating chart. In this evaluation system, postural changes that may occur in 13 different spots of the body were monitored and scored. Accordingly, five (5) points were given if the person's posture was correct, three (3) points if moderately impaired, and one (1) point if severely impaired. The total score obtained as a result of the test is maximum of 65 and minimum of 13. Standard evaluation criteria developed for this test were defined as 'very good' if the total score is $>=45$, 'good' if the score is 40–44, 'moderate' if the score is 30–39, 'fair' if the score is 20–29, and 'poor' if the score is $<=19$ (Magee 1987).

Hamstring flexibility

Goniometric measurement of active knee extension is done where the individual is asked to actively extend the knee while lying on his back and maintaining the hip in 90° flexion. The maximum knee extension angle that the person can achieve will be measured with a goniometer (Mayorga-Vega et al. 2014).

Pectoralis major flexibility

While the patient is lying in the supine position, the shoulder is placed in external rotation with, 135 degrees' abduction, and the elbow extended. It is expected that the arm will fall to the ground freely, if it does not, there is shortness, and the distance between the lateral epicondyle of the humerus and the table is measured with a tape and recorded in cm (Reiman and Manske 2009).

Endurance

Plank endurance test was used to assess the endurance of core muscles. The holding time in the elbow plank position was recorded in seconds. Plank position: Standing straight on your elbows, parallel to the floor (Beck et al. 1961).

Quality of life

The 'Nottingham Health Profile (NHP)' questionnaire was used to measure the perceived health levels of the cases. NHP, is a simple and short questionnaire consisting of two parts that individuals can answer themselves. This questionnaire reflects a broad description of physical, social, and mental well-being and takes approximately 10 min to complete. The answers to the questions are given as 'yes' and 'no' according to the current situation perception. The total score is between 0 and 600, and the perception of high quality of life related to health is inversely proportional to the score obtained (Doll et al. 1993).

Muscular strength

The strength measurements of the deep lumbar muscles were measured with a stabilizer. The measurement of the contraction force of the deep lumbar muscles is performed with the 'Stabilizer Pressure Biofeedback' (Chattanooga Stabilizer). Before the test, each subject is taught how to contract the transversus abdominus with the corset method

in the supine and quadrupedal position. Subjects were placed face down on an inflated pillow attached to a manometer (Stabilizer, Chattanooga). Subjects were instructed to lie down with the knees straight, spine straight and relaxed, and head comfortably placed, placing the pillow on the lower part of the abdominal region. After the pressure of the manometer was adjusted to 70 mmHg, the subjects were asked to contract the transversus abdominus slowly with the abdominal corset technique and maintain this contraction for 5 s, without holding their breath. After 4 repetitions, the subject was rested for 30 s. It was in 3 repetitions; the measurements were recorded, and the average was taken (Ziller 1974).

Sleep quality

The Pittsburgh Sleep Quality Index (PSQI) contains a total of 24 questions. This questionnaire has 19 self-assessment questions, and five are answered by a spouse or a roommate. When calculating the index score, questions answered by the individual's spouse or roommate are not included in the calculation. Self-evaluation questions include various items related to sleep quality. These are for detecting sleep duration, sleep latency (latency), and the frequency and severity of specific sleep-related problems. The 19 scored items and seven component scores are classified. Some of the components consist of a single item, while others are obtained by grouping several items. Each item is evaluated with a score between 0 and 3. A high total score indicates poor quality. The index is a sleep disorder and does not indicate sleep patterns or prevalence. However, a five or above of the overall PSQI score shows poor quality of sleep (Fitzpatrick et al. 1992).

Psychological status

Psychological status was evaluated with Beck Depression Inventory (BDI). BDI was prepared by Beck to measure depression, stress and suicidal tendencies of patients and consists of 21 questions. The questions were about; mood, pessimism, sense of failure, lack of satisfaction, guilt feelings, sense of punishment, self-dislike, self-accusation, suicidal wishes, crying, irritability, social withdrawal, indecisiveness, distortion of body image, work inhibition, sleep disturbance, fatigability, loss of appetite, weight loss, somatic preoccupation, and loss of libido. Each question in the BDI contains four grades of self-assessment sentences, going from least to most. Sentences are scored from '0' to '3' according to the degree of depression. The total BDI score is classified as minimal, mild, moderate, and severe depression. The inventory generally takes 5–10 min to complete (Hisli 1989).

Intervention

Multi-gravitational suspension-based therapy discipline (M-Gravity)

Within the scope of exercise with M-Gravity, pectoral stretching, hamstring stretching, core strength, iliopsoas stretching, various balance movements, positions for body awareness were studied. The exercise with the M-Gravity was done 2 sessions a week, for 4 weeks, with 60 min sessions. One session includes entrance greeting and adjusting the length of the hammock (5 min), mountain series (5 min), strap series in back belt (2 min), cat-cow series (5 min − 3 rounds), circle series on a turn- in the wrist or hand belt (3 min), down facing triangle series (5 min), swing series and core (3 min), floor hammade head down position (The time to prepare, the movement from start to finish is 5–8 min in total, only upside down is 1–3 min), silkworm series (10 min), jokey sit breath 3–6 rounds and 1–2 min), Meditation (2–3 min), (Rest-Relax-Savasana) (5–7 min) and finish greeting (Figure 1) (Melek 2021).

Statistical analysis

The power analysis indicated that 40 participants for each group were needed with 80% power and a 5% type 1 error. The sample size was determined using G*Power software (v. 3.0.10; Heinrich-Heine-Universität Düsseldorf, Düsseldorf,

Figure 1. M-Gravity exercise samples.

Germany). At least twenty subjects were required to achieve the statistical power of 80%, at a 5% probability threshold.

Frequency analysis was used to define the nominal and ordinal data in the study. Measurement data were defined with mean, standard deviation, minimum-maximum and median values. Mann Whitney *U* test was used for difference analysis of paired groups. Chi-Square Similarity Test and Fischer's Exact Test were used in the difference analysis of ordinal and nominal data between the groups. Wilcoxon Signed Rank Test was used for the differences between the mean values of the same groups before and after the exercises. All analyzes were performed in SPSS 17.0 for Windows program, with a 95% confidence interval and 0.05 significance level.

Results

The mean age of the M-Gravity exercise group was 35.35 ± 7.73 years, and the mean age of the women in the control group was 41.35 ± 12.76 years. There was no significant difference between the ages of the groups ($p = 0.078$) (Table 1).

Considering the differences between baseline and post-test results in M-Gravity Group, all assessment parameters were found significantly different (all $p < 0.05$) (Table 2). When we look at the differences between baseline and post-test results in Control Group, no significant difference was found in all parameters (all $p > 0.05$) (Table 3).

Considering the difference between M-Gravity and Control Groups; New York Posture Rating Chart results ($p = 0.008$), plank endurance time ($p \leq 0.001$), hamstring flexibility in right ($p \leq 0.001$) and left ($p = 0.002$), pectoralis major flexibility in right ($p \leq 0.001$) and left ($p = 0.002$), Stabilizer results ($p \leq 0.001$) and NHP results ($p = 0.002$) were found significantly different. No significant difference was found in BDI results ($p = 0.265$) and PSQI results ($p = 0.086$) between groups (Table 4).

Table 1. Age, height, weight, and BMI values of the groups.

Group	M-Gravity group ($n = 20$)	Control group ($n = 20$)	p Value[a]
Age			0.221
Mean ± SD	35.35 ± 7.73	41.35 ± 12.76	
Median (min–max)	36.00 (21–54)	39.50(24–59)	
Height (cm)			0.904
Mean ± SD	164.40 ± 5.98	162.95 ± 9.63	
Median (min–max)	166.50 (153–176)	165.00 (150–178)	
Weight			0.046*
Mean ± SD	60.88 ± 12.96	68.85 ± 16.50	
Median (min–max)	58.00 (49–107)	65.00 (50–120)	
BMI			0.007*
Mean ± SD	21.46 ± 6.10	26.07 ± 6.45	
Median (min-max)	21.03 (2.87–37.94)	23.61 (17.54–44.11)	

[a]Mann Whitney *U* test; SD: standard deviation; BMI: body mass index; min: minimum; max: maximum; *$p < 0.05$.

Discussion

This study has aimed to examine the effects of M-Gravity exercises on posture, physical fitness, quality of life, depression, and sleep quality in women without regular exercise habits. We found that M-Gravity program may have positive effects on posture, physical fitness and quality of life in women who do not have regular exercise habits.

Many studies in the literature indicate that the negative effects of a sedentary life are more especially in women, and body image perception is among the reasons for this difference (Delisle Nyström et al. 2019). Various fitness programs that aim to burn fat, promote exercise or regulate nutrition are provided for sedentary women. Mauvais-Jarvis et al.

Table 2. Difference between baseline and post-test results in M-Gravity exercise group.

Mean ± SD median (min–max)	M-Gravity ($n = 20$) baseline	M-Gravity ($n = 20$) post-test	p Value*	Effect size
New York Posture Assessment	34.30 ± 8.72 32.50 (17.0–47.00)	46.50 ± 7.96 50.00 (33.00–56.00)	≤0.001*	0.387
Plank endurance time (sec.)	35.35 ± 12.80 37.00 (14.00–60.00)	54.90 ± 19.85 50.00 (30.00–120.00)	≤0.001*	0.347
Hamstring flexibility right (°)	131.05 ± 15.98 127.50 (110.00–170.00)	152.85 ± 11.87 155.00 (125.00–80.00)	≤0.001*	0.530
Hamstring flexibility left (°)	130.25 ± 15.93 125.00 (100.00–170.00)	150.30 ± 14.15 150.00 (125.00–80.00)	≤0.001*	0.458
Pectoral flexibility right (cm)	4.85 ± 1.76 4.75 (2.00–9.00)	3.30 ± 0.86 3.00 (2.00–5.00)	≤0.001*	0.086
Pectoral flexibility left (cm)	5.00 ± 1.75 5.00 (2.00–8.00)	3.45 ± 1.10 3.00 (2.00–6.00)	≤0.001*	0.065
BDI	9.65 ± 9.49 6.50 (0.00–37.00)	5.90 ± 6.75 5.00 (0.00–29.00)	0.001*	0.365
NHP	116.48 ± 154.88 62.86 (0.00–550.00)	72.24 ± 121.43 15.00 (0.00–500.00)	0.001*	0.384
Stabilizer pressure biofeedback	4.55 ± 1.47 5.00 (2.00–7.00)	6.55 ± 1.36 6.50 (4.00–10.00)	≤0.001*	0.129
PSQI	6.30 ± 3.40 5.00 (2.00–16.00)	4.70 ± 3.50 4.00 (1.00–14.00)	0.003*	0.359

*Wilcoxon Signed Rank Test; BDI: Beck Depression Inventory; NHP: Nottingham Health Profile; SD: standard deviation; BMI: body mass index; min: minimum; max: maximum; PSQI: The Pittsburgh Sleep Quality Index; *$p < 0.05$.

Table 3. Difference between baseline and post-test results in control group.

Mean ± SD median (min-max)	Control group ($n = 20$) baseline	Control group ($n = 20$) post-test	p Value*	Effect size
New York Posture Assessment	38.45 ± 9.94 39.00 (17.00–57.00)	38.15 ± 10.20 36.00 (18.00–57.00)	0.688	0.033
Plank endurance time (sec.)	30.95 ± 12.59 30.00 (14.00–60.00)	32.00 ± 12.97 30.00 (14.00–65.00)	0.061	0.332
Hamstring flexibility right (°)	133.75 ± 13.94 130.00 (120.00–70.00)	135.05 ± 13.82 130.00 (120.00–170.00)	0.221	0.210
Hamstring flexibility left (°)	134.50 ± 12.75 132.50 (120.00–65.00)	135.55 ± 13.03 132.50 (120.00–170.00)	0.272	0.274
Pectoral flexibility right (cm)	4.60 ± 1.23 4.50 (2.00–7.00)	4.70 ± 1.17 5.00 (2.00–7.00)	0.317	0.261
Pectoral flexibility left (cm)	4.60 ± 1.23 4.50 (2.00–7.00)	4.71 ± 1.33 5.00 (2.00–8.00)	0.258	0.265
BDI	13.10 ± 13.03 11.00 (0.00–37.00)	13.25 ± 13.05 12.00 (0.00–37.00)	0.667	0.092
NHP	175.63 ± 140.54 158.57 (0.00–550.00)	178.24 ± 139.43 158.57 (0.00–550.00)	0.129	0.407
Stabilizer pressure biofeedback	3.11 ± 1.48 3.00 (2.00–9.00)	3.36 ± 1.50 3.00 (2.00–9.00)	0.023	0.314
PSQI	7.35 ± 3.80 8.00 (0.00–12.00)	7.15 ± 4.38 8.50 (0.00–12.00)	0.406	0.261

*Wilcoxon Signed Rank Test; BDI: Beck Depression Inventory; NHP: Nottingham Health Profile; SD: standard deviation; BMI: body mass index; min: minimum; max: maximum; PSQI: The Pittsburgh Sleep Quality Index; *$p < 0.05$.

Table 4. Difference between groups in terms of assessment parameters.

Mean ± SD Median (min-maks)	M-Gravity ($n = 20$)	Control ($n = 20$)	p Value*
New York Posture Assessment	46.50 ± 7.96 50.00 (33.00–56.00)	38.15 ± 10.20 36.00 (18.00–57.00)	0.008*
Plank endurance time (sec.)	54.90 ± 19.85 50.00 (30.00–120.00)	32.00 ± 12.97 30.00 (14.00–65.00)	≤0.001*
Hamstring flexibility right (°)	152.85 ± 11.87 155.00 (125.00–180.00)	135.05 ± 13.82 130.00 (120.00–170.00)	≤0.001*
Hamstring Flexibility left (°)	150.30 ± 14.15 150.00 (125.00–180.00)	135.55 ± 13.03 132.50 (120.00–170.00)	0.002*
Pectoral flexibility right (cm)	3.30 ± 0.86 3.00 (2.00–5.00)	4.70 ± 1.17 5.00 (2.00–7.00)	≤0.001*
Pectoral flexibility left (cm)	3.45 ± 1.10 3.00 (2.00–6.00)	4.71 ± 1.33 5.00 (2.00–8.00)	0.002*
BDI	5.90 ± 6.75 5.00 (0.00–29.00)	13.25 ± 13.05 12.00 (0.00–37.00)	0.265
NHP	72.24 ± 121.43 15.00 (0.00–500.00)	178.24 ± 139.43 158.57 (0.00–550.00)	0.002*
Stabilizer pressure biofeedback	6.55 ± 1.36 6.50(4.00–10.00)	3.36 ± 1.50 3.00(2.00–9.00)	≤0.001*
PSQI	4.70 ± 3.50 4.00(1.00–14.00)	7.15 ± 4.38 8.50(0.00–12.00)	0.086

BDI: Beck Depression Inventory; NHP: Nottingham Health Profile; SD: standard deviation; BMI: body mass index; min: minimum; max: maximum; PSQI: The Pittsburgh Sleep Quality Index; *$p < 0.05$.

claimed that body image perception is more important for women than for men, and therefore, the sedentary life has more negative and destructive effects on women (Mauvais-Jarvis et al. 2020). In our research, we focused on women without regular exercise participance, prompting them to lead an increasingly sedentary life, and who are also highly conscious about their body image. Body image concerns and physical fitness levels affect the quality of life and depression levels more in women leading a sedentary life, and therefore these individuals need more support (Stein and Sridhar 2017). We found that M-Gravity exercise program may have a positive effect against the negative effects of daily life.

The women selected for our sample were individuals aged between 20 and 59 years. However, the mean age was found to be 35.35 ± 7.73 years in the M-Gravity group and 41.35 ± 12.76 years in the control group. The mean age was mostly close to the young-middle age group. This age range is one of the periods when individuals are more conscious about their body image, and it can also be seen as one of the segments where the need for physical activity is highest and the benefits of physical activity alternative programs will be highest. In addition, the middle age group or generation is also suitable for the weighted average age of the population in our country. Therefore, it can be stated that the generalizability of the findings obtained in the study according to age groups is compatible with the population in the country (Sen et al. 2020).

Various studies on posture assessment have been conducted in studies involving yoga exercises. They reported that posture and body image perception are higher in women who practice yoga (Shah et al. 2021). In another study, they reported that postural values changed significantly and there was a positive change after 12 weeks and 75 min of yoga sessions (Puciato and Rozpara 2021). As M-Gravity exercise mostly include physical activities similar to yoga, in our study posture was a significant parameter that changed in M-Gravity group, but did not differ in control group. So it may be stated that 8 weeks of M-Gravity exercise done with hammock may have positive effects on posture of women without regular exercise habits.

Physical fitness contains parameters such as endurance, strength, flexibility and body mass index. It has been reported in studies in the literature that endurance, which is also described as being able to do long-term work or using one's strength is increased with exercises (Neumark-Sztainer et al. 2018). In our study, M-Gravity exercise which contains exercises to increase core endurance made a significant difference in M-Gravity group. M-Gravity exercise program seemed to increase endurance of core muscles about 20 sec, which is a very good result in clinical experience. Control group did not have a change in core endurance, which makes us think that M-Gravity exercise program is a useful way to improve core endurance. Parallel to this finding, all parameters assessed in this study have increase in M-Gravity group and did not differ in Control group. Flexibility is also a feature that exercise programs focus on and aim to develop. Flexibility is important in yoga exercises, as in other physical exercises. It is reported that yoga exercises improve hamstring flexibility, reduce pain, and increase the quality of life (Saper et al. 2014). Another study reported that yoga exercises also improved flexibility, which is related to strength tolerance, thus explaining the difference between men and women (Shamsi et al. 2020). In our study, hamstring and pectoralis major muscles are assessed for flexibility and we found that both of them were improved in terms of flexibility for both sides. Muscular strength, which is measured for core stabilization with an objective technique and also a very important physical fitness parameter, is significantly increased in M-Gravity exercise program group too.

Parallel to many studies related to the fact that exercise increases the quality of life in individuals who do not have an exercise habit, in our study, it was seen that M-Gravity exercises increase the quality of life in women. All changes in physical fitness parameters point to ease in daily life activities of individuals, maintaining a job without fatigue for a longer period of time, and physical health. For this reason, we think that the M-Gravity exercise program we apply is a useful exercise program to achieve physical health in women who do not have regular exercise habits.

Limitations of the study: One of the limitations of our study may be that no application was made to the control group, but then these individuals were also included in an exercise program.

Our study is the first study on M-Gravity exercise program. We plan to examine the effects on different populations in future studies. Although our study is the first study on the exercise program, we hope that it will shed light on future studies.

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