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Impact Of Dash Diet Combined With Under-Water Training On Quality Of Life, Functional Capacity, And Pain Management In Obese Women With Fibromyalgia

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ABSTRACT

Background and purpose: *The purpose of this investigation was to examine the efficacy of combining the DASH diet with underwater training in improving quality of life, enhancing functional capacity, and reducing pain in obese women with fibromyalgia.*

Methods: *"A total of 100 obese women with fibromyalgia participated in this study, which aimed to investigate the effects of combining the DASH diet with aquatic exercises on quality of life, functional capacity, and pain management. Trial participants were recruited from Green Apple clinic in El-Mahalla, utilizing the American College of Rheumatology (ARC) classification criteria to identify eligible individuals.*

The inclusion criteria for participants are as follows: an age range of 30-45 years, a body mass index (BMI) range of 28-40 kg/m², and either primipara or multipara status. All participants were healthy women without any serious underlying diseases.

Exclusion criteria include: *history of epileptic fits, cardiac conditions, pacemaker use, heavy smoking, renal, liver, or endocrine disorders, pulmonary or lung diseases, skin diseases, and infectious conditions.*

Participants were divided into two equal groups: Group A (the control group) and Group B (the study group). Group A consisted of 50 obese women with fibromyalgia who performed aquatic exercises on an underwater treadmill, 3 times a week for 8 weeks. Group B consisted of 50 obese women with fibromyalgia who were following the DASH diet, which emphasizes reduced sodium intake, increased consumption of fortified foods, and a wholesome diet emphasizing fresh fruits, crunchy veggies, nutritious whole grains, lean protein sources, and nourishing healthy fats. Participants in Group B also performed aquatic exercises on an underwater treadmill, 3 times a week for 8 weeks.

Outcome measures included: BMI, assessed using a weight and height scale; pain, assessed using the Visual Analogue Scale (VAS); inflammatory condition, assessed using C-reactive protein (CRP) levels; and functional capacity and quality of life, assessed using the Oswestry Disability Index (ODI). These outcomes were measured at baseline and post-intervention for both groups."

The study was approved by Research Ethical committee of the faculty of Physical Therapy Cairo University with approval number P.T.REC/012/005764 on 6-3-2025.

Results: *The results revealed no significant differences in BMI, VAS, CRP, and ODI scores between the two groups at baseline. However, post-treatment analysis showed a significant decrease in mean BMI, VAS, HsCRP, and ODI scores in both groups, with a more pronounced decrease observed in Group B.*

The findings of this study suggest that the combination of the DASH diet and underwater exercising led to significant improvements in quality of life, functional capacity, and pain management in obese women with fibromyalgia (FMS). These findings highlight the value of comprehensive approaches in managing symptoms among fibromyalgia patients.

Keywords: *Oswestry Disability Index (ODI)-Fibromyalgia-HsCRP, inflammation, FMS, C-reactive protein*

1. INTRODUCTION

Fibromyalgia is a multifaceted disorder marked by persistent widespread pain, frequently coupled with

fatigue, sleep issues, cognitive difficulties, and various other symptoms. Additional symptoms may include headaches, abdominal pain or cramps, depression, insomnia, and heightened sensitivity to stimuli.

The precise etiology of fibromyalgia is still unclear, but it is believed to stem from a complex interplay of genetic and environmental influences. Potential environmental triggers include psychological stress, trauma, and certain infections.

The condition is often referred to as a "central sensitization syndrome" because the pain appears to stem from altered processing within the central nervous system, rather than from peripheral tissue damage (1)

The hallmark symptoms of fibromyalgia include chronic widespread pain, persistent fatigue, and disrupted sleep patterns. Additional symptoms may encompass:

- Heightened sensitivity to touch (allodynia)
- Cognitive difficulties
- Musculoskeletal stiffness
- Sensitivity to environmental factors
- Hypervigilance
- Sexual dysfunction
- Visual disturbances

Some individuals with fibromyalgia may also experience post-exceptional malaise, characterized by a worsening of symptoms 24 hours or more after engaging in physical activity (2).

The management of fibromyalgia is symptomatic and multidisciplinary, focusing on alleviating symptoms and improving quality of life. According to the European Alliance of Associations for Rheumatology, aerobic and strengthening exercises are strongly recommended.

Other therapies, such as mindfulness, psychotherapy, acupuncture, hydrotherapy, and meditative exercises (e.g., qigong, yoga, and tai chi), are weakly recommended but may provide benefits.

The use of medication in fibromyalgia treatment is a topic of debate. Research indicates that antidepressants can lead to improvements in quality of life for individuals with fibromyalgia. Other potentially helpful medications include:

- Serotonin-norepinephrine reuptake inhibitors
- No steroidal anti-inflammatory drugs
- Muscle relaxants

Additionally, supplements such as coenzyme Q10 and vitamin D may help reduce pain and improve quality of life.

Notably, fibromyalgia is a chronic condition that does not result in mortality or tissue damage, despite its persistent nature (3).

Water therapy is a non-pharmacological intervention that may be beneficial for managing fibromyalgia syndrome (FMS) symptoms. Studies indicate that aquatic therapy may be beneficial in alleviating pain, reducing fatigue, and enhancing quality of life for individuals with fibromyalgia syndrome (FMS). The therapeutic effects of water therapy are attributed to the physiological changes that occur during in-water exercise.

However, further studies are needed to elucidate the underlying mechanisms of action and to determine whether the long-term effects of water therapy are superior to other forms of intervention, such as land-based exercises (4) and (5).

Embracing an anti-inflammatory diet can be beneficial for individuals experiencing chronic pain. Rather than a rigid eating plan, an anti-inflammatory diet provides guidelines that empower people to make informed food choices, helping to mitigate inflammation and alleviate chronic pain symptoms (6).

A plant-based diet may also provide benefits for alleviating fibromyalgia symptoms. This is attributed to the high antioxidant content in many plant-based foods, which aid in eliminating free radicals. Free radicals are naturally occurring waste products that can accumulate in the body and exacerbate oxidative

stress (7). Elevated levels of free radicals in the body can trigger oxidative stress, which in turn can lead to chronic inflammation (8). Exacerbating oxidative stress and inflammation, high levels of free radicals can increase the risk of chronic inflammation. Given the potential link between fibromyalgia and inflammation, following a diet that promotes a healthy weight may be beneficial in managing symptoms. (9). The DASH diet not only helps regulate blood sugar levels but also offers comprehensive health benefits, particularly for obese individuals with fibromyalgia. (10).

2. METHODS:

Subjects

The study investigated the Effects of the DASH Diet Combined with Aquatic Exercises on Quality of Life, Functional Capacity, and Pain Management in Obese Women with Fibromyalgia.

Participants were recruited from Green Apple Clinic in El-Mahalla. The study included 100 participants who met the inclusion criteria.

Participants were included in the study if they had a diagnosis of fibromyalgia according to the American College of Rheumatology criteria (ACR) 2010 criteria and met the following inclusion criteria: (aged 30-45 years, with a body mass index (BMI) of 28-40 kg/m^2). Although the participants had fibromyalgia, they were otherwise healthy, meaning they did not have any other underlying medical conditions that could affect the study outcomes.

The diagnosis of fibromyalgia was based on ARC 2010 criteria, which include widespread pain lasting for at least 3 months and the presence of other symptoms such as fatigue, sleep disturbances, and cognitive difficulties.

Participants were randomly assigned to either an intervention group that received aquatic treadmill exercise combined with the DASH diet or a control group that received aquatic treadmill exercise only, using a computer-based random number generator.

Exclusion criteria included serious diseases, such as epileptic fits, cardiac conditions, renal or liver disorders, pulmonary diseases, skin diseases, and infectious conditions.

Participants were divided into two equal groups:

- Group A (Control group): 50 obese women with fibromyalgia performed aquatic exercises on an underwater treadmill, 3 times/week for 8 weeks.
- Group B (Study group): 50 obese women with fibromyalgia followed the DASH diet, combined with aquatic exercises on an underwater treadmill, 3 times/week for 8 weeks.

The DASH diet was implemented as follows: participants were provided with a detailed dietary plan that emphasized whole grains, fruits, vegetables, lean protein, and low-fat dairy products. The diet was tailored to meet the individual caloric needs of each participant, with a focus on reducing sodium intake to less than 2,300 mg per day. Participants received weekly counseling sessions with a registered dietitian to ensure adherence to the diet and address any questions or concerns. Participants' dietary intake was tracked through self-reported 24-hour recalls and food diaries.

Target heart rate was determined using the Karvina formula, and heart rate was monitored during exercise sessions using a heart rate monitor.

Outcome measures included:

- BMI, assessed using a weight and height scale
- Pain intensity was qualified using a 100-mm Visual Analog Scale (VAS), with higher scores indicating greater pain.
- Inflammatory condition, assessed using C-reactive protein (CRP) levels
- Functional capacity and quality of life, assessed using the Oswestry Disability Index (ODI)

The study was approved by Research Ethical committee of the faculty of Physical Therapy Cairo University with approval number P.T.REC/012/005764 on 6-3-2025. By ethical guidelines, written informed consent was secured from all participants before study commencement.

Procedures

A full explanation of the protocol of the study was given to all women, and a consent form was signed by every woman participating in our investigation.

A) Evaluation Procedures:

1-Weight-Height scale: was used to measure the weight and height for A& B groups pre- and post-treatment program.

2- VAS (Visual analogue scale) was used to measure the intensity of pain for A& B groups pre- and post-treatment program.

3- ODI (Oswestry Disability Index or Oswestry scale) was used to measure the functional capacity and quality of life for A& B groups pre- and post-treatment program.

4-Blood analysis: HsCRP (highly sensitive C-reactive protein) was used to measure the involvement of the inflammatory process for A& B groups pre- and post-treatment program.

B) Treatment Procedures:

1- Aquatic exercises in the form of an under-water treadmill that was used to perform aquatic walking on a treadmill 3 times/week for 8 weeks for both groups. Each session will take about 30 minutes as follows: 5 minutes of warming up exercises by walking on the treadmill at low speed, 20 minutes walking at moderate intensity (the exercise bout was preceded by a 5-minute warm-up and followed by a 5-minute cool-down, both involving low-speed treadmill walking. Participants worked out at an intensity equivalent to 70% of their maximum heart rate. Warm water (30 °C). Target heart rate was determined using the Karvonen formula, and heart rate was monitored during exercise sessions using a heart rate monitor.

3- DASH diet: a dietary plan focused on reducing blood pressure, inflammatory process, and promoting overall health was used for group B. The DASH diet was implemented as follows: participants were provided with a detailed dietary plan that emphasized whole grains, fruits, vegetables, lean protein, and low-fat dairy products. The diet was tailored to meet the individual caloric needs of each participant, with a focus on reducing sodium intake to less than 2,300 mg per day. Participants received weekly counseling sessions with a registered dietitian to ensure adherence to the diet and address any questions or concerns. Food consumption was monitored via 24-hour recalls and participant-maintained food diaries.

Decreasing sodium consumption and adding nutrient-rich, fortified foods high in potassium, calcium, and magnesium to one's diet. The diet emphasizes low-fat food sources with a lot of vegetables, fruits, and moderate amounts of whole grains, fish, poultry, and nuts, meals/ day with 2 snacks in-between, with 5to 6 hours between main meals.

Statistical analysis:

Results presented as mean ± standard deviation. Data distribution was ascertained utilizing the Shapiro-Wilk test.

Comparative Analysis:

- Independent sample t-tests (unpaired t-tests) were employed to compare variables between the control and study groups.
- Paired t-tests were used to compare pre- and post-treatment variables within the same group.

Data Analysis Software:

Data were processed with SPSS software, Version 24, for Windows.

Significance Level:

A p-value ≤ 0.05 is considered statistically significant.

Minimal clinically important differences (MCIDs): The MCIDs for the outcome measures were: 1-2 units for BMI, 2-3 points for VAS, 10-15 points for ODI, and 1-2 mg/dl for CRP.

No missing data were encountered in the dataset; all participants had complete data for all outcome measures. Effect sizes (Cohen's d) were calculated to determine the magnitude of the treatment effects.

95% confidence intervals were reported for all outcome measures.

Analysis of Variance:

T-tests were used to determine the impact of the DASH diet combined with underwater exercise on quality of life, functional capacity, and pain management in obese women with fibromyalgia. The level of significance is fixed at 5% ($P < 0.05$).

3. RESULTS (Findings):

I-Physical (general) of patient's characteristics:

1- Age, height, weight, and BMI:

A) Before treatment: No statistically significant differences between mean values of age, height, weight, and BMI of group A and group B were found (Table 1).

Table (1): Age, Height, Weight, and BMI of the two studied groups before treatment.

	Group A (n= 50)	Group B (n=50)	t-value	P-value
Age (yrs)	36.04±4.70	35.09±4.64	0.06419	0.9490 (NS)
Height (cm)	161.48±5.14	161.34±5.06	0.1372	0.8912 (NS)
Weight (Kg)	94.76±11.77	92.88± 11.78	0.05097	0.9594 (NS)
BMI (Kg/m²)	35.77±4.18	36.39±4.16	0.000	>0.9999 (NS)

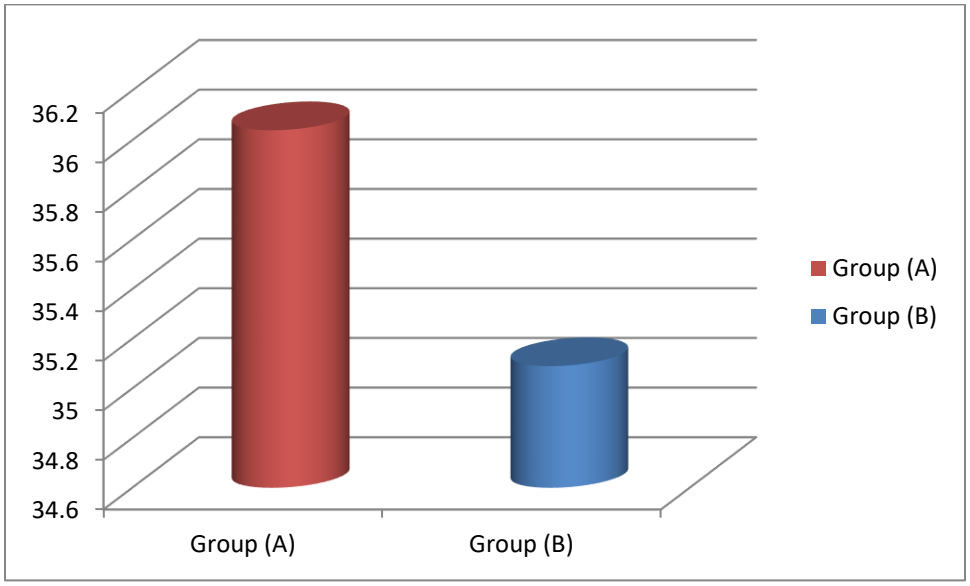

Fig. (1): Mean values of age in both groups (yrs).

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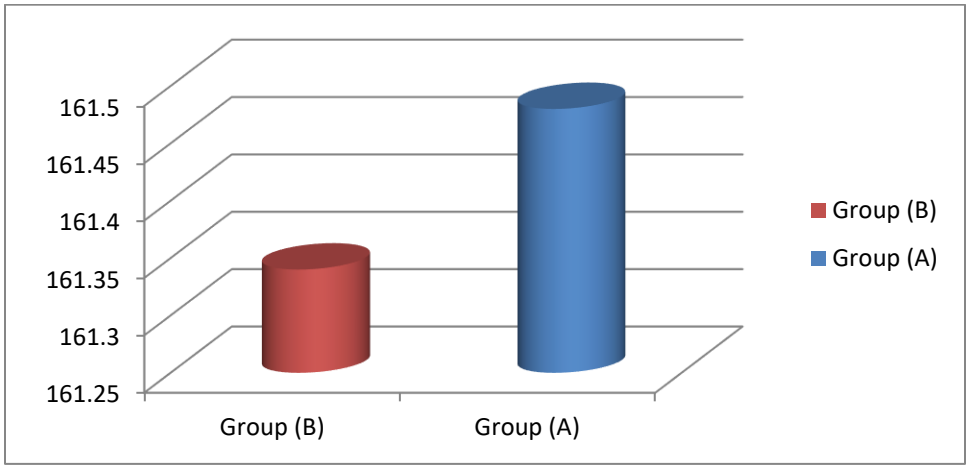

Fig. (2): Mean values of height in both groups (cm).

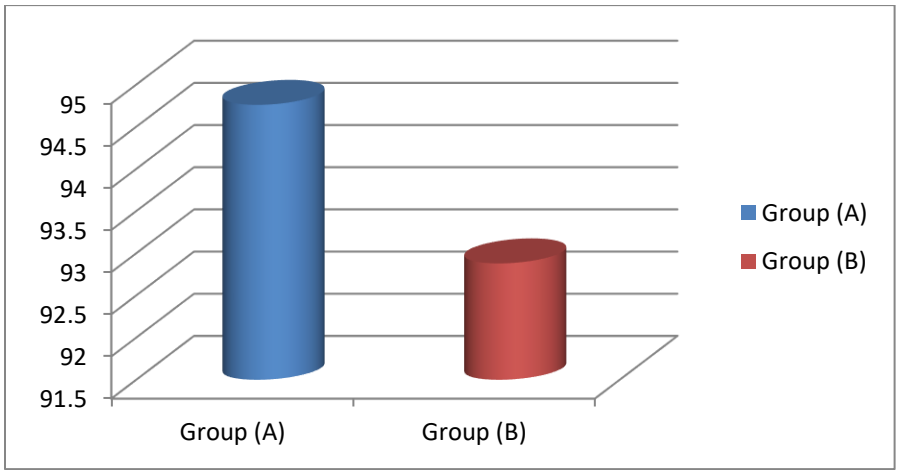

Fig. (3): Mean values of weight in both groups (Kg).

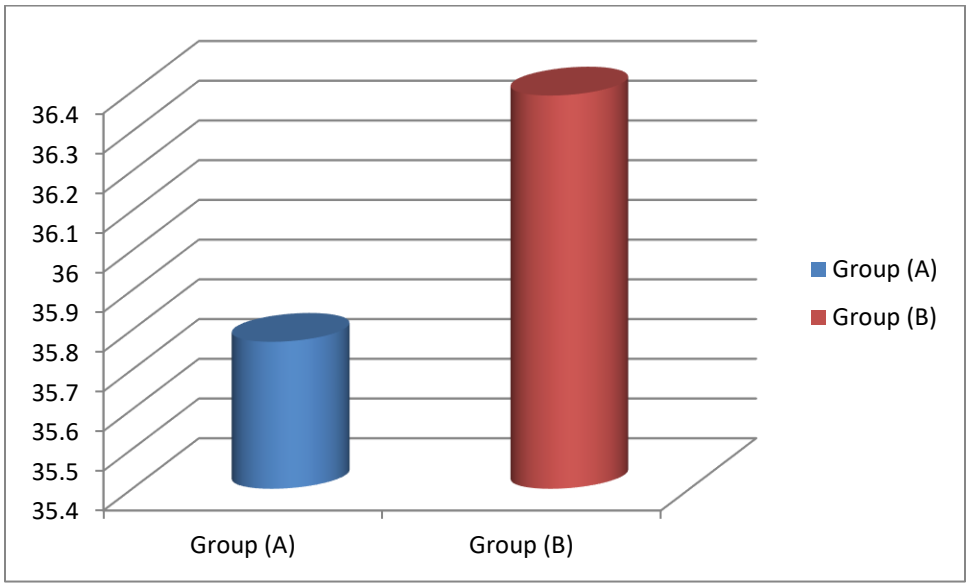

Fig. (4): Mean values of BMI in both groups (Kg/m^2).

B) After treatment: statistically significant differences between mean values of weight and BMI of group A and group B were found after treatment, with a greater reduction in weight and BMI of group B, Table 2.

Table (2): Weight and BMI of the two studied groups after treatment.

	Group A (n= 50)	Group B (n=50)	t-value	P-value
Weight (Kg)	89.168± 11.45	79.43± 11.24	4.299	<0.0001 (S)
BMI (Kg/m²)	34.2± 3.92	30.564±4.23	3.472	0.0008 (S)

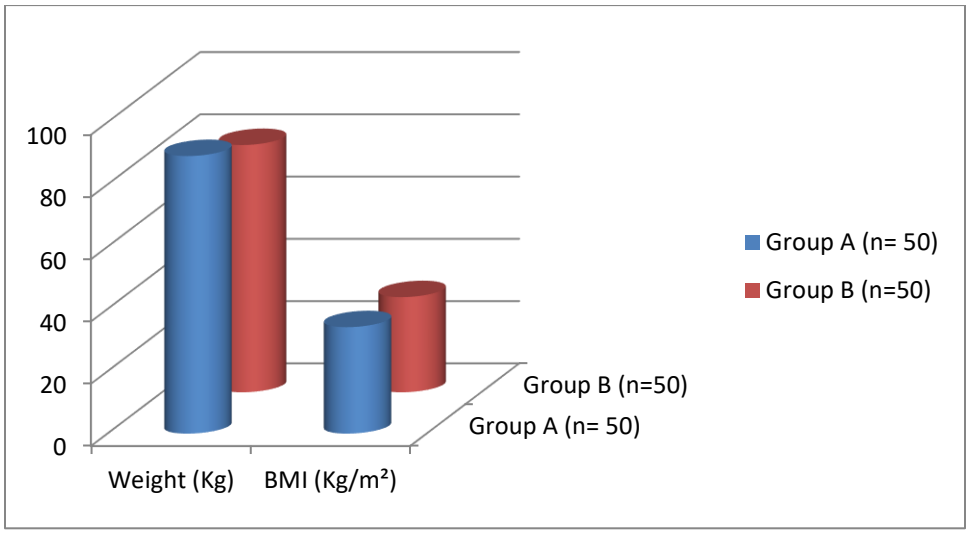

Fig. (5): Mean values of weight (Kg) and BMI (Kg/m²) in both groups after treatment.

II-VAS

A-Within groups:

Group (A):

A statistically significant decrease in the mean value of VAS measured after treatment (7.06± 1.33) when compared with its corresponding value (8.3± 1.07)before treatment, with a t-value of 11.00

Group (B):

A statistically significant decrease in the mean value of VAS measured after treatment (3.5 ± 1.37) when compared with its corresponding value (8.18 ± 1.004)before treatment, with a t-value of 26.08

Table (3) Comparison between mean values of VAS measured before and after treatment in the two studied groups

	A (n=50)	B (n=50)
Before treatment	8.3± 1.07	8.18 ± 1.004
After treatment	7.06± 1.33	3.5 ± 1.37
Mean difference	-1.240	-4.680
% change	1.24	4.68
T value	11.00	26.08
P value	<0.0001	<0.0001 (0.0003)

S: significant.

B-Between groups:

No significant difference between both groups (A) (8.3 ±1.073807) and its corresponding value in group (B) (8.18 ± 1.00387) before treatment in VAS was found.

In both groups, there was a decrease in VAS mean value. VAS mean for (A) (7.06 ± 1.33) was more than its corresponding value in (B) (3.5 ± 1.37) after treatment, with no significant difference, Table 4.

Table (4) Comparison between VAS mean value measured pre- and post-treatment.

	A (n=50)	B (n=50)	T	P
Before treatment	8.3 ±1.073807	8.18 ± 1.00387	0.5772	0.5651
After treatment	7.06 ± 1.33	3.5 ± 1.37	13.16	0.8254

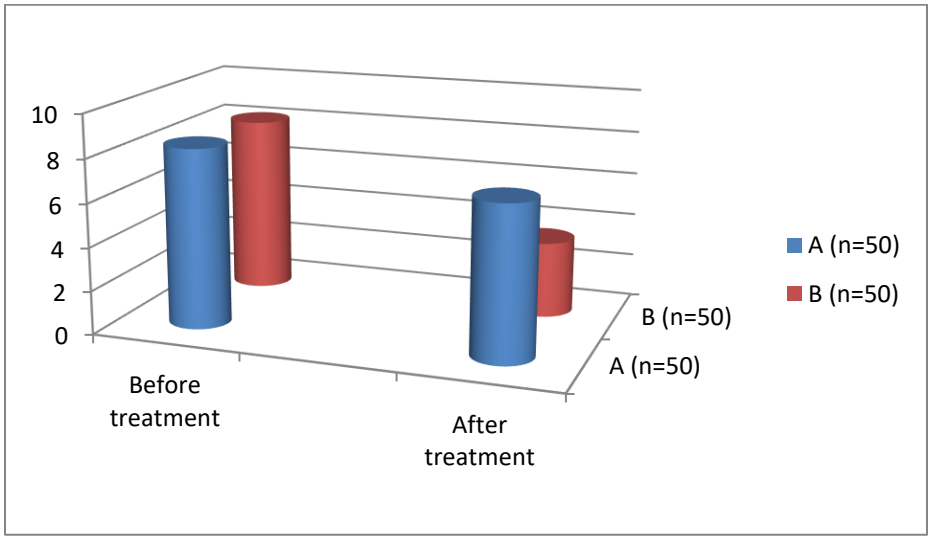

Fig. (6) Comparison between VAS mean values measured before and after treatment.

III-ODI (oswestry disability index scale)

A-Within groups:

Group (A):

A statistically significant decrease in the mean value of ODI measured after treatment (42% ± 0.109531) when compared with its corresponding value (45% ± 0.10977) before treatment, with a t-value of -2.480

Group (B):

A statistically significant decrease in the mean value of ODI measured after treatment (30% ± 0.09245) when compared with its corresponding value (45% ± 0.10977) before treatment, with a t-value of 14.91

Table (5) Comparison between mean values of ODI measured before and after treatment in the two studied groups

	A (n=50)	B (n=50)
Before treatment	45% ± 0.10977	45% ± 0.10977
After treatment	42% ± 0.109531	30% ± 0.09245
Mean difference	-2.480	-14.38
% change	3%	15%
T value	5.708	14.91
P value	<0.0001	<0.0001

S: significant.

B-Between groups:

No significant difference between both groups (A) (45% ± 0.10977) and its corresponding value in group (B) (45% ± 0.10977) before treatment in ODI was found.
In both groups, there was a decrease in ODI mean value. ODI mean for (A) (42% ± 0.109531) was more than its corresponding value in (B) (30% ± 0.09245) after treatment with no significant difference, but with more reduction of ODI for group (B) Table (6).

Table (6) Comparison between ODI mean value measured pre- and post-treatment.

	A (n=50)	B (n=50)	T	P
Before treatment	45% ± 0.10977	45% ± 0.10977	0.000	>0.9999 NS
After treatment	42% ± 0.109531	30% ± 0.09245	5.871	0.2388

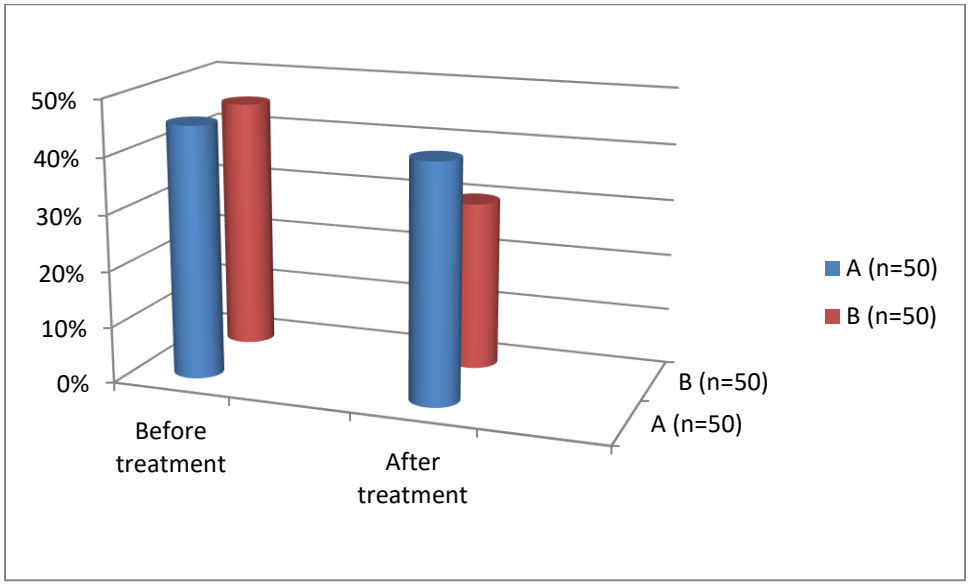

Fig. (7) Comparison between mean values of ODI measured before and after treatment in the two studied groups.

III-hsCRP

A-Within groups:

Group (A):

A statistically significant decrease in the mean value of hsCRP measured after treatment (6.17± 2.087597) when compared with its corresponding value (6.64± 2.117661) before treatment, with a t-value of 7.744.

Group (B):

A statistically significant decrease in the mean value of hsCRP measured after treatment (3.208±1.494867) when compared with its corresponding value (6.62±2.01) before treatment, with a t-value of 18.10

Table (7) Comparison between mean values of hsCRP measured before and after treatment in the two studied groups

	A (n=50)	B (n=50)
Before treatment	6.64± 2.117661	6.62±2.01
After treatment	6.17± 2.087597	3.208±1.494867

Mean difference	-0.4700	-3.432
% change	0.47	3.412
T value	7.744	18.10
P value	<0.0001 S	<0.0001 S

S: significant.

B-Between groups:

No significant difference between both groups (A) (6.64±2.117661) and its corresponding value in group (B) (6.62±2.01) before treatment in hsCRP was found.

In both groups, there was a decrease in ODI mean value. hsCRP mean for (A) (6.17± 2.087597) was more than its corresponding value in (B) (3.208±1.494867) after treatment with no significant difference, but with more reduction of hsCRP for group (B) Table (8).

Table (8) Comparison between the hsCRP mean value measured pre- and post-treatment.

	A (n=50)	B (n=50)	T	P
Before treatment	6.64± 2.117661	6.62±2.01	0.000	>0.9999NS
After treatment	6.17± 2.087597	3.208±1.494867	8.157	0.0212 S

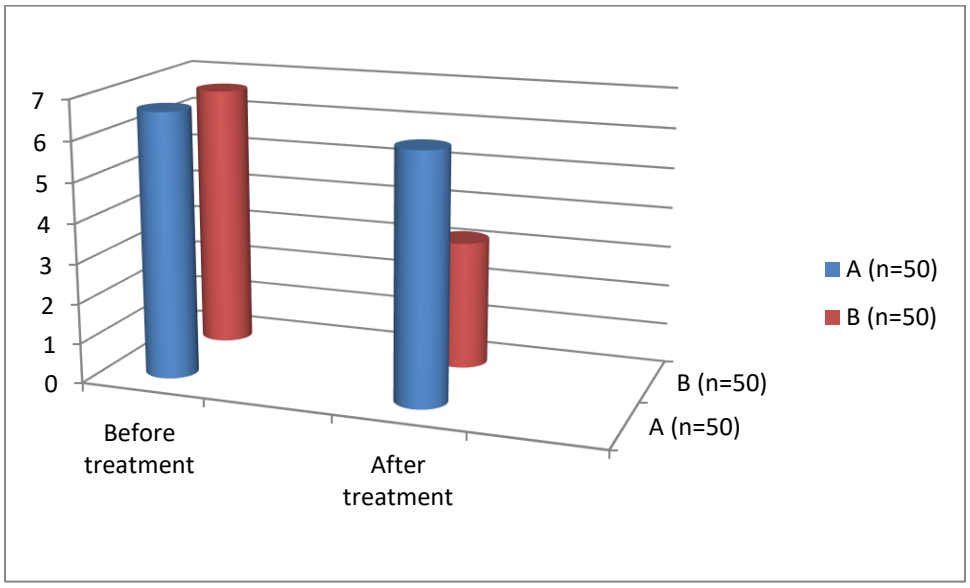

Fig. (8) Comparison between mean values of hsCRP measured before and after treatment in the two studied groups.

4. DISCUSSION:

Fibromyalgia is a complex musculoskeletal disorder characterized by:

1. Core features (always present):
   - Widespread pain
   - Tenderness
2. Characteristic features (present >75% of the time):
   - Fatigue
   - Non-refreshed sleep
   - Morning stiffness

3. Common features (present >25% of the time):
   - Paraesthesia
   - Irritable bowel syndrome
   - Functional disability

Prevalence:
- 2.1% of family practice clinic patients
- 5% of general medical patients
- 10-20% of rheumatic disease clinic patients

Diagnostic criteria:
Evolving criteria enable accurate identification of patients for clinical and research purposes. (10).
Fibromyalgia is classed as a disorder of pain processing due to abnormalities in how pain signals are processed in the central nervous system (11).
ICD-11 Classification:
Fibromyalgia is categorized under "Chronic widespread pain" (MG30.01).
Heterogeneity in Fibromyalgia:
People with fibromyalgia exhibit variations in:
1. Severity: Differences in pain intensity and impact.
2. Adjustment: Variability in coping mechanisms and adaptation.
3. Symptom profile: Diversity in symptoms experienced (e.g., pain, fatigue, sleep issues).
4. Psychological profile: Differences in mental health aspects (e.g., anxiety, depression).
5. Response to treatment: Variability in effectiveness of treatments.

This diversity highlights the complexity of fibromyalgia and the need for personalized approaches to management and treatment. (12).
The primary symptoms of fibromyalgia include:
1. Chronic widespread pain: Persistent pain affecting multiple areas of the body.
2. Fatigue: On-going exhaustion and lack of energy.
3. Sleep disturbance: Difficulty sleeping or waking up feeling refreshed

These core symptoms are central to understanding and diagnosing fibromyalgia. Other symptoms may include heightened pain in response to tactile pressure (allodynia), cognitive problems, musculoskeletal stiffness, environmental sensitivity, hypervigilance, sexual dysfunction, and visual symptoms (13). Some people with fibromyalgia experience post-exertional malaise, in which symptoms flare up a day or longer after physical exercise (14).
One hundred obese women participated in this study to investigate the effect of the DASH diet combined with aquatic exercises on quality of life, functional capacity, and pain management in obese women with fibromyalgia. They were selected randomly according to American College of Rheumatology criteria from Green Apple Clinic in El-Mahalla, to participate in this study, their ages were ranged from 30-45 years old and the body mass index for them was ranged from 28-40 kg/m^2, some women were primipara and others were multipara. All women were healthy women without any serious disease. All epileptic fits, cardiac affection, and using a maker, heavy smokers, renal, liver, or endocrine disorder, pulmonary or lung diseases. Any skin disease or any infectious condition was excluded from the study. Women were divided into two equal groups. A (Control group) consisted of fifty obese women with fibromyalgia who performed aquatic exercises in the form of an under-water treadmill 3 times/week for 8 weeks. Group B (Study group) consisted of fifty obese women with fibromyalgia who followed the DASH diet (a reduction in sodium intake and incorporating a variety of fortified foods with nutrients, such as potassium, calcium, and magnesium, into their diet. The diet emphasized low-fat food sources with a lot of vegetables, fruits, and moderate amounts of whole grains, fish, poultry, and nuts meals/ day with 2 snacks in between, with 5to 6 hours between main meals) combined with an aquatic exercise program, in the form of under-water treadmill 3 times/week for 8 weeks. A weight and height scale were used to assess BMI. VAS was used to assess pain, CRP was used

to assess the inflammatory condition, and the Oswestry scale was used to assess functional capacity and quality of life, for both groups before and after treatment. The pre-treatment evaluation showed comparable BMI, pain levels, inflammation, and disability scores across the groups, indicating no significant differences. After treatment, BMI, VAS, CRP, and ODI in (A) and (B) showed a decrease in mean when compared to their corresponding values before treatment, with a greater decrease in group B. It can be concluded that the DASH diet combined with underwater exercise has a great effect on Quality of life, Functional capacity, and pain management in obese women with Fibromyalgia.

Our findings are consistent with those of (15), who suggested that water therapy is a viable non-pharmacological option for managing fibromyalgia symptoms, particularly pain and fatigue, and quality of life.

The results of the study agree with (16), who concluded that underwater exercises are very effective in treating fibromyalgia postmenopausal symptoms.

The results of the study agree with (17) and (18), who declared that there is elevated highly sensitive C-reactive protein in fibromyalgia. According to (19) and (20), the DASH diet could be beneficial in treating inflammation, strain, and so on, and decrease hsCRP, which is also concluded from our study.

The study results are supported by (21) and (22), who revealed that the DASH diet could decrease pain in cases like gout, hypertension, and inflammatory conditions such as fibromyalgia.

The study agrees with (23) and (24), who showed that there is a negative impact on quality of life, including decreased functional capacity, which is linked to total disability in females with fibromyalgia.

Our findings are consistent with those of (25), who suggested that non-pharmacological modalities play an important role in the successful managing fibromyalgia.

The study agrees with (26) and (27), who showed that there is a positive impact on leptin level and pain sensitivity in obese females with fibromyalgia with weight reduction.

The study results are supported by (28) and (29), who revealed that aquatic exercise enhance sleep quality in adults with chronic musculoskeletal pain. Most FM has sleep problems which affect their life.

On the other hand, (30) found that fibromyalgia patients reported more sleep problems, imbalance, high general fatigue, underwater exercises included extremity pain and perceived exertion compared with untrained healthy controls. The exercises induced extremity pain in fibromyalgia patients that had not returned to the pre-exercise values 24 hours after the exercises. High exercises induced extremity pain in fibromyalgia patients, after static and dynamic upper limb exercises, and also after bicycling at submaximal to maximal intensity in fibromyalgia patients.

IMPLICATIONS OF PHYSIOTHERAPY PRACTICE:

The findings of this study suggest that incorporating the DASH diet with underwater training exercises could be a beneficial approach for physiotherapists managing obese women with fibromyalgia. This integrated intervention may enhance treatment outcomes by improving quality of life, functional capacity, and pain management. Physiotherapists could consider including dietary counselling as part of a holistic treatment plan for such patients.

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