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Efficacy of Interval Training on Quality of Life in Women with Vitamin D Deficiency

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Abstract

Background: Vitamin D deficiency affects individuals in all age groups worldwide.

Aim of Study: This study aimed to identify the efficacy of interval training combined with vitamin D supplementation on quality of life in women with vitamin deficiency.

Subject and Methods: Forty women with vitamin D deficiency participated in this study. Their age ranged from 40 to 50 years. They were assigned randomly into 2 groups. The first group (A) included 20 patients who participated in an interval training exercise program with vitamin D supplementation. The second group (B) included 20 patients who received vitamin D supplementation only. The interval training exercises were conducted for one hour, three times per week on a total period of 12 weeks. The quality of life was assessed by short form health survey (SF-12).

Results: Before the study, there was no significant difference in the mean values of all variables among the two groups. After study there was a significant improvement in both components of SF-12 in all groups with significant difference between 2 groups (p<0.05).

Conclusion: Combined interval training and vitamin D supplementation are effective for improving quality of life in women with vitamin D deficiency than either of them alone.

Key Words: *Vitamin D – Quality of life – Interval training.*

Introduction

VITAMIN D is fat-soluble steroid hormones ingested in the diet and produced in the skin following exposure to ultraviolet rays in sunlight, and conversion to active forms of vitamin D occurs in the liver and kidneys [1]. Vitamin D is a group of fat-soluble prohormones which were identified after the discovery of the anti-rachitic effect of cod liver oil in the early part of the 20th century [2].

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The primary role of Vitamin D is the regulation of serum calcium levels within a narrow range. Vitamin D plays an essential role in bone formation, maintenance, and remodelling, as well as in muscle function [3].

Vitamin D deficiency was defined as serum 25-OHD level less than 25nmol/L because clinical evidence of skeletal diseases (rickets or osteomalacia) become manifest below this level [4]. According to current recommendations, serum 25(OH) D levels <30ng/ml and <10ng/ml were defined as vitamin D insufficiency and deficiency, respectively [5].

Hypovitaminosis D is a prevalent disorder in developing countries. Clinical manifestations of hypovitaminosis D include musculoskeletal disorders, such as nonspecific muscle pain and poor muscle function [6]. Low level of vitamin D reduce the absorption of calcium, leading to decreased bone mass and onset of bone pain [7].

It has been observed that there are relationships between low vitamin D levels and multiple disease states. Low vitamin D levels are associated with increased overall and cardiovascular mortality, cancer incidence and mortality, and autoimmune diseases such as multiple sclerosis. Although it is well known that the combination of vitamin D and calcium is necessary to maintain bone density as people age, vitamin D deficiency may also be an independent risk factor for falls among the elderly. Unfortunately, little evidence guides clinicians on when to screen for vitamin D deficiency or effective treatment options [8].

Interval training is a type of physical training that involves bursts of high-intensity work interspersed with periods of low-intensity. The high

intensity periods are typically at or close to near-maximum exertion, while the recovery periods may involve either complete rest or activity of lower intensity **[9]**. Interval training is primarily applied utilizing aerobic exercise, such as a running on a treadmill and cycling on an ergometer **[10]**.

Quality of Life (QOL) is the extent to which objective human needs are fulfilled in relation to personal or group perceptions of subjective well-being **[11]**. It was maintained that QOL should include both people's idiosyncratic perception of happiness, in relation to their lives and situations, as well as an explanation of circumstantial personal factors **[12]**.

The concept of quality of life appeared after the Second World War in the USA. Initially, it meant 'a good life' in its consumer sense only i.e. denoted material status, and possession of goods and property such as a house, its furnishings, a car, etc. It was not until the second half of the 20 th century that the category of 'have' was supplemented by that of 'be', which embraced such values as education, personal freedom or satisfaction found in various spheres of life **[13]**.

Laufer **[14]**, described QOL as the value assigned to the duration of life as modified by the impairments, functional states, perceptions and social opportunities that are influenced by disease, injury, treatment or policy.

Subjects and Methods

Subject:

The current study is a randomized controlled comparative study to identify efficacy of interval training combined with vitamin D supplementation on quality of life in women with vitamin D deficiency.

Forty women with vitamin D deficiency participated in this study. The patients were recruited from the outpatient clinic of Orthopedic Department at Nassar hospital in Shoubra El Khaima during 2018.

Their age ranged from 40 to 50 years.

They were assigned randomly into two groups:

Group (A): Included 20 patients who participated in an interval training exercise program with vitamin D supplementation (cholecalciferol 400 IU/day).

Group (B): Included 20 patients who received vitamin D supplementation only (cholecalciferol 400 IU/day).

The interval training was conducted for one hour, three days per week on a total period of 12 weeks.

Inclusion criteria:

- Forty sedentary women with nonspecific muscle pain.
- The patients' ages ranged from 40-50 years.
- All patients have nonspecific muscle pain for more than 2 months.
- They have vitamin D deficiency.
- All patients have BMI from 25 to 34.9kg/m^2.
- All patients were clinically and medically stable when attending the study.

Exclusion criteria:

The patients with one or more of the following criteria were excluded:

- Unstable cardiovascular and chest problems.
- Patients with diseases which affect vitamin D level as a history of rheumatic or metabolic bone diseases and diabetes.
- Patients taking drugs which affect vitamin D level as steroids and anticonvulsants drugs.
- Musculoskeletal disorders which may affect their physical ability to do the exercises.

Tools:

For assessment:

1- Laboratory BioPlex® 2200 System: BioPlex® 2200 System manufactured by (Hitachi, model 704,902, Japan) was used for measuring serum vitamin D level (25OHD) **[15]**.

2- Short form health survey (SF-12): The SF-12 is often used to compare health status between two groups of patients, to indentify predictors of health status, and to determine health status in a specific disease population **[16]**.

For treatment:

1- *Bicycle ergometer:*

Bicycle ergometer (Monark Rehab trainer model 88E) was used to train subjects in group (A). It is a stationary bicycle with an ergometer (electronically braked) to measure the work done by the exerciser. It is equipped with an electronic meter showing pedal revolutions per minute, total pedal revolutions and time function. It provides low-impact, safe, and effective cardiovascular exercise. This low-impact movement does not put much stress on joints.

2- Vitamin D supplementation:

It was taken by subjects in groups (A and B). One capsule containing (cholecalciferol 400 IU) was taken every day **[17]** Kragstrup, 2010).

3- Procedures:

All patients were given a full explanation of the protocol of the study and a consent form was signed with each patient before participating in the study.

a- Assessment:

All the patients were subjected to complete clinical evaluation including careful history taking, vital signs, vitamin D serum level, sensory and motor assessment. Before and after the study.

Serum vitamin D Level:

The assessment was carried out at the laboratory of Nassar hospital in Shoubra El Khaima using BioPlex® 2200 System. Venous blood samples (5ml) were collected from each patient in the three groups before and after the study. Venous blood samples were collected in the morning at 9 a.m. The samples were collected in anticoagulant free tubes (EDTA K3).

Quality of life (QOL):

The quality of life was assessed using Short form health survey (SF-12). The SF-12 contains 12 items. All SF-12 items came from the SF-36. It includes eight dimensions: Physical functioning, role limitations due to physical health problems, bodily pain, general health, vitality, social functioning, role limitations due to emotional problems and mental health **[18]** Montazeri et al., 2009).

b- Treatment procedure:

Cycle adjustments:

Seat height was adjusted to comfortable position. A suitable height is when the knee is slightly bent and the middle of the foot is straight above the pedal axle with the pedal in its lower position. The seat height was adjusted by loosening the lever on the seat tube. The handlebar setting shall give a comfortable position when cycling. The handlebar was adjusted by loosening the quick release lever (Biodex LBC, Biodex Inc., New York).

Vitamin D supplementation:

It was taken by subjects in groups (A and B). One capsule containing (cholecalciferol 400 IU) was taken every day **[17]**.

Statistical design and data analysis:

- Statistical analyses were performed using SPSS software (version 20).
- Descriptive statistics and paired *t*-test to compare between pre and post treatment results within each group. Also, independent (unpaired) *t*-test to compare for pre and post treatment between group.
- All statistically significant differences were determined with confidence interval of 95% and significance was set at $p \leq 0.05$.

Results

The purpose of this study was to evaluate the effect interval training combined with vitamin D supplementation on quality of life in women with vitamin D deficiency. The patients were assigned into two groups; group (A) included 20 patients who received a program of interval training exercise for one hour, 3 sessions per week in addition to vitamin D for twelve weeks, group (B) included 20 patients who received vitamin D only for twelve weeks.

General characteristics of the subjects:

The mean values of age and BMI in group (A) were 34.77±2.64 year and 30.17±3.51Kg/m^2 respectively and in group (B) were 34.77 ±2.39 year and 30.21±3.85Kg/m^2 respectively (Table 1).

Table (1): General characteristics of patients in all groups.

Variables	Group A	Group B	*p*-value
Age (year)	34.77±2.64	34.77±2.39	0.819
BMI (kg/m^2)	30.17±3.51	30.21±3.8	0.970

Data are expressed in means ± SD. BMI: Body mass index.
$p>0.05$: Non-significant.

The 12-item health survey (SF-12):

A- *Physical component score (PCS):*

a- *Pre-study mean values of PCS in all groups:*

Pre-study mean value of PCS in group (A) was 45.60±4.46, in group (B) 43.93±3.59.

Comparison of the pre-study mean values of PCS among all groups revealed no significant differences (p=0.330) (Table 2).

Table (2): Pre- and post-PCS mean values in two groups.

Items	PCS (Mean ± SD)		*t*-value	*p*-value
	Group A	Group B		
Pre-treatment	45.60±4.46	43.93±3.59	1.130	0.330
Post-treatment	51.86±4.24	45.86±4.73	8.040	0.001 *
Mean difference	6.26	1.93		
% of change	13.72%	4.39%		
t-value	5.000	2.300		
p-value	<0.001 *	0.031 *		

PCS: Physical component score. *p*-value: Probability.
SD : Standard deviation. *Significant: $p \leq 0.05$.

b- Comparison of pre and post study mean values of PCS within groups:

The mean values of PCS pre and post study in group (A) were 45.60±4.46 and 51.86±4.24 respectively. There was a significant increase ($p<0.001$). The percentage of increase was 13.5%. The mean values of PCS pre and post study in group (B) were 43.93±3.59 and 45.86±4.73 respectively. There was a significant increase ($p=0.031$). The percentage of increase was 4.3% (Table 2).

c- Post-study mean values of PCS among groups:

Post- study mean value of PCS in group (A) was 51.86±4.24, in group (B) was 45.86±4.73 and in group (C) was 47.53±3.64. The analysis of variance revealed that there were significant differences in post study mean values of PCS among groups ($p=0.001$) (Table 2).

B- *Mental component score (MCS):*

a- Pre-study mean values of MCS in all groups:

Pre-study mean value of MCS in group (A) was 46.20±3.96, in group (B) was 44.60±3.86.

Comparison of the pre-study mean values of MCS among all groups revealed no significant differences ($p=0.507$) (Table 3).

b- Comparison of pre and post study mean values of MCSwithin groups:

The mean values of MCS pre and post study in group (A) were 46.20±3.96 and 51.53±2.99 respectively. There was a significant increase ($p<0.001$). The percentage of increase was 11.4%.

The mean values of MCS pre and post study in group (B) were 44.60±3.86 and 46.33±4.57 respectively. There was a significant increase ($p=0.010$). The percentage of increase was 3.8% (Table 3).

Table (3): Pre- and post-MCS mean values in two groups.

Items	MCS (Mean ± SD)		*t*-value	*p*-value
	Group A	Group B		
Pre-treatment	46.20±3.96	44.60±3.86	0.690	0.507
Post-treatment	51.53±2.99	46.33±4.57	8.900	0.002*
Mean difference	5.33	1.73		
% of change	11.54%	3.88%		
t-value	5.400	2.900		
p-value	<0.001*	0.01*		

MCS: Mental component score. *p*-value: Probability.
SD : Standard deviation. *Significant: $p\leq0.05$.

c- Post-study mean values of MCS among groups:

Post-study mean value of MCS in group (A) was 51.53±2.99, in group (B) was 46.33±4.57. The analysis of variance revealed that there were significant differences in post study mean values of PCS among groups ($p=0.002$).

Discussion

The patients were assigned randomly into two groups. The first group (A) included 20 patients who participated in an interval training exercise program with vitamin D supplementation (cholecalciferol 400 IU/day). The second group (B) included 20 patients who received vitamin D supplementation only (cholecalciferol 400 IU/day). All the patients were evaluated before and after the study by blood sample analysis of serum vitamin D level and Short form health survey (SF-12).

The level of serum vitamin D in all groups was assessed in all groups pre and post study. The results of the study proved that there was a significant increase serum vitamin D in all groups (A=39.84%, B=24.96%) with more significant increase in group A than either of and B ($p=0.003$ and 0.002 respectively).

The present study comes in accordance with Verbrugghe et al. **[19]** who conducted a study to compare the effect of interval training exercise on patients with non specific musculoskeletal pain. It concluded that interval aerobic exercise appears to be a feasible rehabilitation approach inpatients with non specific musculoskeletal pain. Outcomes including pain intensity, functional disability and quality of life improved following the interval training exercise protocol.

The results of the present study also agreed with the finding of Yilmaz et al., **[20]** who conducted a recent, small, controlled interventional study (n=58) on patients with chronic nonspecific and widespread musculoskeletal pain and mean 25-OHD levels of 20nmol/L at baseline, vitamin D supplementation with the same dose, for three months, also showed a statistical significant improvement in pain and quality of life.

In line with the present study, a study done by [21]Witham et al., (2010) to investigate the effects of vitamin D supplementation on physical function and quality of life in older patients. Witham et al., [22]concluded that, 100 000 U of vitamin D taken every 10 weeks does not improve aerobic capacity or quality of life in older patients with heart failure.

The results of the present study agreed with the results of Isaksen et al., **[21]** who conducted a study to find out the effects of aerobic interval training on measures of anxiety, depression and

quality of life in patients with ischemic heart failure and revealed that interval training exercises showed significant improvements in several SF-36 subscores at 12 weeks. So, aerobic interval training program resulted in significant improvements in several measures of quality of life.

In accordance with the present study, a study was conducted to investigate the effect of vitamin D supplementation on quality of life in women with type 2 diabetes. Fifty women with type 2 diabetes were enrolled into weekly vitamin D supplementation (ergocalciferol, 50,000 IU) for six months. vitamin D supplementation induced a significant improvement in both components of SF-12 survey. The study concluded that vitamin D supplementation can improve the health status in T2DM women **[23]**.

The results of the present study contradicted with the finding of Hoffmann et al., **[23]** who conducted a review on the association between Vitamin D supplementation and health-related quality of life and reported that there was no overall association between vitamin D supplementation and health-related quality of life (using the SF-36). The contradictory between the present and study may be attributed to the small sample size (10 Participants only) and the short duration (2 weeks only) of study.

Conclusion:

Based on the findings of this study, interval training combined with vitamin D supplementation are effective for improving quality of life in women with non-specific muscle pain and should be added to the care of such patients.

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فاعلية التدريب الفاصل مع مكملات فيتامين D على نوعية جودة الحياة لدى النساء المصابات بنقص الفيتامين

الخلفية: يؤثر نقص فيتامين د على الأ فراد فى جميع الفئات العمرية فى جميع أنحاء العالم.

الهدف: هدفت هذه الدراسة إلى التعرف على فعالية التدريب الفاصل مع مكملات فيتامين د على نوعية الحياة لدى النساء المصابات بنقص فيتامين.

الموضوع والطرق: شاركت ٤٠ امرأة مع نقص فيتامين د فى هذه الدراسة. تراوحت أعمارهم بين ٤٠ و٥٠ سنة. تم تعيينهم بشكل عشوائى فى مجموعتين. ضمت المجموعة الأولى (أ) ٢٠ مريضاً شاركوا فى برنامج تمرين فاصل مع مكملات فيتامين د. ضمت المجموعة الثانية (ب) ٢٠ مريضاً تلقوا مكملات فيتامين د فقط. تم إجراء التدريبات الفاصلة لمدة ساعة واحدة، ثلاث مرات فى الأسبوع على فترة إجمالية قدرها ١٢ أسبوعاً. تم تقييم نوعية الحياة من خلال المسح الصحى القصير (SF-12).

النتائج: قبل الدراسة، لم يكن هناك فرق كبير فى متوسط القيم لجميع المتغيرات بين المجموعتين. بعد الدراسة، كان هناك تحسن كبير فى كل من مكونات SF-12 فى جميع المجموعات مع اختلاف كبير بين مجموعتين ($p<0.05$).

الخلاصة: التدريب الفاصل المشترك ومكملات فيتامين D فعالة لتحسين نوعية الحياة لدى النساء المصابات بفيتامين D نقص واحد منهم.