

## Effect of Combined Exercises Program on Physical Fitness, Anxiety and Depression among Older Adults with Type 2 Diabetes Mellitus

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### Abstract

**Background:** Type 2 Diabetes Mellitus is one of the most prevalent health problems worldwide. It is associated with physical disabilities, low physical fitness levels, and psychological problems as depression and anxiety. **Aim:** Determine the effect of combined exercises program on physical fitness, anxiety and depression among older adults with type 2 diabetes mellitus. **Method:** A quasi-experimental (pre and post intervention) design. This study was conducted in geriatric outpatient clinic in Specialized Medical Hospital, Mansoura University, and involved a purposive sample of 61 older adults diagnosed with type 2 diabetes mellitus. **Tools:** Mini-Mental State Examination, Demographic and Clinical Data Structured Interview Sheet, Physical Fitness Tests, Generalized Anxiety Disorder Questionnaire, and Geriatric Depression Scale Short Form. **Results:** This study indicates 52.5% of the participants were males. There was a statistically significant improvement of physical fitness tests, anxiety and depression, particularly among young elderly males, who were married, with higher education, had enough income, and who were living with their families. Also a statistically negative correlation was found between the mean score of anxiety and depression of the studied older adults and physical fitness tests. **Conclusion:** Combined exercises program proved to be effective in improving physical fitness and it was successful in decreasing anxiety, and depression among elderly patients with type 2 diabetes. **Recommendation:** Regular exercises should be recommended for diabetic elderly patients in order to improve their physical fitness, alleviate anxiety and overcome depression.

**Keywords:** Anxiety, Combined Exercises, Depression, Older Adults, Physical Fitness, & Type 2 Diabetes Mellitus.

### Introduction

In the 21<sup>st</sup> century, diabetes has been considered as a significant economic and public health burden. Diabetes affects 29.1 million individual in the United States and 366 million people globally (**Centers for Disease Control and Prevention, 2022 & US Department of Health and Human Services; 2014**). As a result of rapid growth in the aging population, the prevalence of diabetes is increasing. More than 134.6 million elderly people worldwide suffer from diabetes and by 2035, that number is expected to rise to 252.8 million. In the next 20 years, it's anticipated that the prevalence of diabetes would rise dramatically in developing countries. Additionally, by 2030, there will be more than 82 million elderly with diabetes in developing countries. (**Sharoni et al., 2017**).

Diabetes mellitus (DM) is a disorder associated with chronic hyperglycemia and impaired metabolism of lipids, carbohydrates, and proteins that is caused by insufficient insulin secretion or defect in insulin action either partially or completely. There are two primary types of diabetes; type 1 (T1D) insulin-dependent diabetes mellitus and type 2 (T2D) non-insulin-dependent diabetes mellitus. T2D is most

prevalent type of DM among elderly, it accounts for 90% to 95% and is predicted to rise to 439 million by 2030 (**Dilworth Facey & Omoruyi 2021, &WHO 2019, Wu et al., 2014**).

Type2 Diabetes is linked to low physical fitness level, wherever diabetics often having worse exercise tolerance than those without the disease. This could be caused by a history of cardiovascular disease, high levels of physical inactivity, obesity, impairment of myocardial perfusion, endothelial dysfunction, mitochondrial function changes, and medications that affect the cardiovascular system's response to exercise (**Nesti et al., 2020, Najafabadi et al., 2018, Hamasaki 2016, Reusch et al., 2013**).

Furthermore, T2D is also accompanying with psychological problems as anxiety and depression that exacerbate the disease and may impact the prediction of cardiovascular risk (**Chu et al., 2021**). Depression prevalence is high in elderly with T2D compared with those without diabetes. According to many studies, the global prevalence of depression in diabetic people has increased from 20% to 32%, and it is linked with a 36–64% increased risk of developing depression. Thus it has been identified as a common co-morbid condition that associated with

depression's worse outcomes, including higher mortality rates. (Dibato et al., 2022 & Deischinger et al., 2020). Furthermore people with T2D have increased threat of developing general anxiety disorder by 14 times compared to individuals without diabetes (Bickett & Tapp, 2016).

Exercise has been considered as the "gold standard" in the management strategies of diabetes and it is crucial for preventing and controlling the disease (Kirwan, Sacks & Nieuwoudt, 2017). Regular moderate-intensity exercises, such as aerobic, balancing, resistance, and flexibility exercises, are proven to have a positive outcome on psychological health in addition to physical fitness and health. Physical fitness consist of several different components, as aerobic fitness, strength of muscle, flexibility, agility, and balance, and is often defined as the capability to accomplish the daily life activities efficiently and without fatigue. The relationship of physical fitness with health is one of the most important aspects; it's the ability to demonstrate skills that are associated with a lower risk of prematurely developing hypokinetic illnesses (Intana et al, 2019 & Mendes et al, 2016).

Physical fitness, especially aerobic fitness, is a strong predictor of cardiovascular events, and is inversely associated with cardiovascular mortality in patients with T2D. It is also linked with better quality of life and decreased fall risks (Dibato et al, 2022).

Hence the achieving and/or maintaining an appropriate level of physical fitness through different exercises technique as (aerobic and strengthen exercises) are an important goal in management of T2D. Exercises are tools that helping diabetic elderly patients in performing activities of daily living, increasing their reserve capacities, strengthen endurance, and thus maintaining the ability to accomplish daily tasks, reducing physical disabilities associated with the disease to maintain independent living, and enhance mental health and health related quality of life. Additionally, numerous researches on individuals with T2D have demonstrated that higher physical activity levels are accompanying with less depressive and anxiety symptoms as well as an enhancement in overall quality of life. (Youssef, 2019, Colberg et al., 2016). So the gerontological nurse should encourage diabetic elderly to participate in at least 30 min. of moderate-intensity activity on most days of the week. So this study was conducted to determine the effect of combined exercises program on physical fitness, anxiety and depression among older adults with type 2 diabetes mellitus.

### Significance of the study

Egypt is one of the top ten countries with the highest number of diabetic patients. According to the

International Diabetes Federation 2021 (IDF), there are 10.9 million diabetics in Egypt, 24.0% of whom are elderly persons. By 2045, it is anticipated that there will be 20 million diabetics in Egypt, 24.7% of whom would be elderly. (Abouzyd et al., 2022 & IDF Diabetes Atlas 2021). DM is associated with poor exercise tolerance, anxiety, and depression which complicate the disease prognosis, and cause many complications as heart disease, falls, which negatively affect patient's quality of life (Chu et al., 2021). Physical activity plays a crucial role as a non-pharmacological intervention in T2DM, anxiety and depression treatment. As a result of exercises effect on enhancing physical and psychological status of diabetic older adults the combination of aerobic and resistance exercise has been recommended by the European Society of Cardiology, American College of Sports Medicine, and Belgian Physical Therapy Association (Pan et al., 2018).

### Study aim

Determine the effect of combined exercises program on physical fitness, anxiety and depression among older adults with type 2 diabetes mellitus.

### Study hypothesis

- Elderly patients with T2D who are engaged in the combined exercises program will report an improvement in physical fitness.
- Elderly patients with T2D who are engaged in the combined exercises program will report a decrease in the level of anxiety and depression.

### Subjects and Method

#### Study design:

This study used a quasi-experimental (pre and post intervention) design. It carried out on a purposive sample of 61 Egyptian elderly patients with T2D attending geriatric outpatient clinics of specialized medical hospital, Mansoura University. It included both males & females aged 60 years or above with T2D more than one year with normal cognitive function, their glycated hemoglobin (HbA1c) less than 10 gm %, and without limitations in gait or balance, nor usage of a cane or other equipment to get around. In addition, they did not participate in other exercise programs in the last 6 months.

#### Exclusion criteria were:

Patients with further types of DM, severely uncontrolled T2D (HbA1c  $\geq$  10gm %) & patients with any grade of cognitive impairment. Moreover, patients had frailty and/or risk of falls; Patients taking drugs affect the cognition or balance.

#### Sampling:

The sample size was calculated using G power program using the following data: effect size 0.5,  $\alpha$  error prop 0.05, Two tails, power (1- $\beta$  err prop) 97 %

using variance between two dependent means (matched pairs). Sample size was 61 diabetic elderly.

**Tools:** This study used five tools to gather the essential data:

**Tool I: Mini- Mental State Examination (MMSE):** MMSE was developed by **Folstien (1999)**. It was translated into Arabic language by **Elokl (2008)**, validated and tested for its reliability ( $r = 0.93$ ) by **Abd El Moniem (2012)**. It was used to assess the elder's cognitive function. It contains 11 items that assess the memory, orientation to time and place, attention, calculation naming, repetition, registration, language, praxis and copying of a design. Its total score is 30 points classified as: a score from 24 to 30 indicates normal cognitive function; a score from 18 to 23 indicates mild cognitive impairment, while a score from 0 to 17 indicates severe cognitive impairment.

**Tool II: Demographic and clinical data structured interview sheet**

This tool was developed by the researchers based on relevant literature review (**Mendes et al, 2016**). It includes two parts:

**Part I: demographic characteristics of older adults:** As; age, sex, educational level, marital status, occupation before retirement, monthly income, living condition and residence.

**Part II: Clinical data of older adults:** such as history of the disease, medication taken, duration of the disease, DM complication, presence of other diseases and body mass index calculation.

**Tool III: Physical fitness was measured by the following tests:**

- 1. 6-Minute Walk Test (6MWT):** It was used to measure aerobic fitness of older adults; which the elderly were encouraged to walk as far as possible in 6 minutes in a closed circuit, and the walking distance was recorded (**Rikli & Jones 1998**).
- 2. 30-Second Chair Stand Test (30 SCST):** It was used to evaluate muscle strength (lower limbs); from the seated position; the elders were encouraged to complete as many full stands as possible within thirty seconds. The score is the total number of stands within 30 seconds (more than halfway up at the end of 30 seconds counts as a full stand). Incorrectly executed stands are not counted. (**Jones et al., 1999**).
- 3. Timed Up and Go Test (TUGT):** It was used to assess agility/balance for older adults. TUGT measures the time required for the patient to stand up from a chair, walk a distance of 3m, turn around, walk back to the chair, and sit down. When the patient takes time more than or equal to 14 second it predicts a risk of fall (**Podsiadlo & Richardson, 1991**).

**4. Chair Sit and Reach Test (CSRT):** It was used to assess flexibility (lower limbs and lumbar spine) of elderly. Ask the elderly to sit on a chair, with the preferred leg extended and to place the right hand over the left, then encourage the patient to slowly reach forward as far as he can by sliding his hands along the extended leg, towards the foot. The distance between the tip of fingertips and the toes is measured. If the fingertips touch the toes the score is zero, if they don't touch measure the distance between the fingers and the toes (a negative score). If they overlap, measured by how much (a positive score). Perform two trails (**Wells & Dillon, 1952**).

**Tool IV: Generalized Anxiety Disorder Questionnaire (GAD-7)**

This Questionnaire was developed by **Spitzer (2006)**. It is a seven-item self-administered instrument used to assess the severity of generalized anxiety disorder (GAD). Ask elderly person in each item to rate the severity of his or her symptoms over the past two weeks. Response options contain "not at all", "several days", "more than half the days" and "nearly every day".

**Scoring**

The GAD-7 Questionnaire is based on four points likert scale where "not at all" equal 0, "several days" equal 1, "more than half the days" equal 2 and "nearly every day" equal 3". The total score ranges from 0 to 21.

The anxiety severity level divided as the following scores:

- (0 - 4) means minimal anxiety
- (5 - 9) means mild anxiety
- (10 - 14) means moderate anxiety
- 15 and more means severe anxiety

**Tool V: Geriatric Depression Scale (GDS-SF)**

**Short Form:** It was developed by **Sheikh and Yesavage (1986)**, to measure depression and general wellbeing of the elderly. It involves of 15 items self-reported instrument. It was translated into Arabic and approved to be valid and reliable by **Elhuseiny (2013)**. It is based on two points likert scale, where yes equal one (1) or no equal zero (0). The elder chooses the best answer either yes or no based on how he/ she has felt over the moods last week. The total score ranges from 0 to 15 and it can be obtained through adding the items together. The score (0 - 4) = no depression, (5 - 8) = mild depression, (9 - 11) = moderate depression and (12 - 15) = severe depression.

**Development of combined exercises program:**

- According to the international exercise recommendations for patients with type 2 diabetes and prevention of falls the combined exercise program was prepared. Each session included the

combination of aerobic, strength resistance, agility/balance and flexibility exercise.

- The exercise sessions were given firstly in hospital for a period of one month and in groups of 3-5 elderly. The rest of program period the elders practiced the exercises at their homes under continuous contact and supervision from the researchers.
- Low-cost materials as chairs, bottles of water filled with sand (0.5 L;  $\pm$  0.75 kg), dumbbells (1, 2 and 3 kg), and fitness balls were used.
- Over 3 consecutive weeks, exercise sessions were conducted through 6 sessions, two sessions weekly. Each session lasted about 60 minutes while being supervised by the researchers.

#### **Program includes:**

**Session 1:** Introduction about DM definition, causes, signs and symptoms, risk factors, complications and management.

**Session 2:** Types and importance of exercises that improve physical fitness.

**Session 3:** Aerobic exercise (30 min): Encourage the elderly to practice moderate-continuous brisk walking in hospital corridor.

- Running in place for 5 min as a type of warm-up

**Session 4:** Resistance exercise for muscle strengthening lasted about 20 minutes in the health education room. Three exercises for each of lower and upper limbs totaled six exercises in each session. Body weight, chairs, sand bottles, dumbbells, and fitness balls were used when exercising. These exercises were performed in a circuit format, alternating between lower limb and upper limb and torso activities with no rest in between exercises and a one-minute break in between circuits. The number of circuits increased gradually from one (the adaption period) to four (the last three months).

-Begin with a simple exercise load and gradually increase it in accordance with the degree of fatigue of local muscle experienced during the final repetitions of each exercise. The elderly should be encouraged to alternate between performing 10 repetitions of the bilateral exercises and 20 repeats of the unilateral exercises.

**Session 5:** Encourage the elderly to perform agility/balance exercise for 10 min. It includes simple balance exercises were performed as side leg raise, and hip flexion exercise.

**Session 6:** includes a 5-minute of flexibility exercise in which elderly used chairs for support while doing sequences of static and dynamic stretches. After holding a static position for 15 seconds, 10 repetitions of dynamic stretching were completed.

#### **Methods of teaching:**

- PowerPoint presentation
- Videos

- Booklet (handout)
- Demonstration and re demonstration

#### **Procedure**

- The researchers started to take an official approval from the responsible authorities of Faculty of Nursing, Mansoura University.
- Approval was obtained from the head of geriatric outpatient clinic - Specialized Medical Hospital - Mansoura University.
- The researchers translated Tool IV (Generalized Anxiety Disorder Questionnaire) (GAD-7) into Arabic language, and then back translation was done by an expert in English language from Faculty of Education, English Department, Mansoura University to ensure the validity of tool translation.
- The English version of different tests measuring physical fitness (tool III) and Arabic version of tool V (Geriatric Depression Scale (GDS-SF) Short Form) were used in the study.
- The content validity of study tools was assured by a jury of 5 specialists in (Gerontological nursing and Geriatric medicine).
- Reliability of tool IV (Generalized Anxiety Disorder Questionnaire (GAD-7) was tested by the researchers. It was assured by means of r coefficient ( $r=0.84$ ).
- According to the schedule of the clinics, the researchers visited it 2 days per week (Saturday and Wednesday).
- All elders attending the clinic for one month were surveyed, and the studied elderly were selected according to the study criteria.
- Before the beginning of the program, all selected elderly were subjected to a thorough medical evaluation to get their medical history (including drug usage and comorbid conditions), measure their baseline heart rates, and check for any absolute or relative contraindications to vigorous intensity exercise.
- General examination was done in selected hospital by the physician for all selected patients as measuring body mass index (BMI), brachial blood pressure, HbA1c, liver function tests & creatinine.
- Before exercising, blood glucose levels were examined. The elderly were advised to take a snack and check their blood sugar again after 10-15 minutes to make sure it was rising before beginning the exercises if it was below 80 mg/dl. Exercise was not advised for participants whose blood sugar levels were higher than 250 mg/dl until they fell below that threshold.
- To collect the necessary information of the elderly as their address and telephone number each elderly person was interviewed individually by researchers (face – to face interview).

- A pilot study was conducted with 10% of participants (6) selected from geriatric outpatient clinic, Mansoura general hospital, Ministry of health. These patients were excluded from the study.
- The researchers developed an educational booklet in simple Arabic language that included information about DM and the combined exercises which distributed to every participant in the study.
- The researchers demonstrated the exercise program to teach elderly patients how to perform the exercises.
- The caregivers of elderly were present when the researchers applied the program.
- The elderly re- demonstrated the exercise program under the instruction of the researchers
- A period of data collection was 8 months from the first of October 2022 to the end of May 2023.

**Program Evaluation:** It was done after 3 months and 6 months of the program.

**Ethical Considerations:** After the explanation of the purpose of study, the researchers began to obtain Research Ethics Committee approval of Faculty of

Nursing Mansoura University with ref. no (0292), then obtained written consent from elderly. The participants were informed that they were voluntary to participate and that they could withdraw from the study at any time.

### Statistical analysis

Data were analyzed using with (SPSS) version 20. Descriptive appropriate statistical tests were utilized as frequent, percentage, mean, and standard deviation. As well as inferential statistics were used; Paired sample t- test was used to compare the means of two variables for a single group. Pearson's coefficient was used to test correlation between two normally distributed quantitative variables. Cohen's d was used to test effect size. Graphs were done for data visualization using Microsoft Excel. If the probability of error is less than 5% ( $P < 0.05$ ), the results were considered significant, and highly significant if the probability of error is less than 0.1% ( $P < 0.001$ ).

## Results

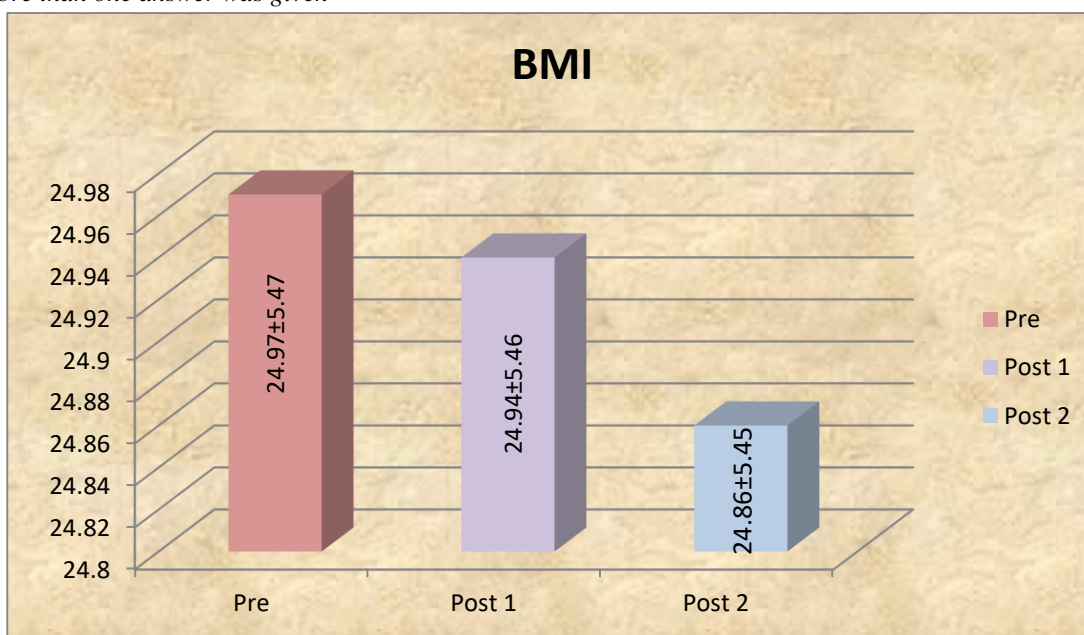
**Table (1): Demographic characteristics of the studied older adults**

Demographic Characteristics	No (%) (n= 61)
<b>Age (years):</b>	
60 <65	29 (47.5)
65 <75	30 (49.2)
75 & more	2 (3.3)
<b>Min – Max</b>	60.00 - 76.00
<b>Mean ± SD</b>	65.03 ± 4.19
<b>Sex:</b>	
Male	32 (52.5)
Female	29 (47.5)
<b>Marital status:</b>	
Married	42 (68.9)
Widow	11 (18.0)
Divorced	8 (13.1)
<b>Place of residence :</b>	
Urban	57 (93.4)
Rural	4 (6.6)
<b>Educational level :</b>	
Illiterate	24 (39.3)
Read and write	17 (27.9)
Basic education	10 (16.4)
Higher education	10 (16.4)
<b>Work before retirement:</b>	
Yes	39 (63.9)
No	22 (36.1)
<b>Present work:</b>	
Yes	25 (41.0)
No	36 (59.0)
<b>Monthly family income:</b>	
Enough	31 (50.8)
Not enough	30 (49.2)
<b>Living arrangements:</b>	
With family	45 (74.7)
Alone	16 (26.2)

Table (2): Medical history and medication used of the studied older adults

Items	No (%) (n=61)
<b>Having chronic illnesses other than DM:</b>	
Yes	40 (65.6)
No	21 (34.4)
<b>Duration of DM ( years):</b>	
1-5	23 (37.7)
5-10	25 (41.0)
> 10	13 (21.3)
<b>Type of medications used#:</b>	
Vitamins	35 (57.4)
Analgesics	32 (52.5)
Diuretics	17 (27.9)
Anti-hypertensive	17 (27.9)
<b>Therapeutic regimen used:</b>	
Oral antidiabetic drugs	25 (41.0)
Insulin+ oral antidiabetic drugs	36 (59.0)

# More than one answer was given



Paired –sample t-test (p)<sup>1</sup>: comparing preprogram and 3 months after the program.

Paired –sample t-test (p)<sup>2</sup>: comparing preprogram and 6 months after the program.

# 4 older adults withdraw 6 months after the program

Figure (1): Effect of combined exercises program on body mass index among the studied older adults

Table (3): Effect of combined exercises program on Physical fitness tests among the studied older adults

Item	Pre	Post 1	Post 2
	N=61	N=61	N=57 <sup>#</sup>
	Mean ± SD	Mean ± SD	Mean ± SD
<b>6-Minute Walk Test (m)</b>	529.50±69.14	581.96±65.21	635.96±63.21
<i>t</i> -test (p) <sup>1</sup>		-37.582 (<0.0001) **	
<i>t</i> -test (p) <sup>2</sup>		-60.647 (<0.0001) **	
<i>d</i>		4.81	
<b>30-Second Chair Stand (reps)</b>	9.18±0.84	11.19±0.89	15.03±2.28
<i>t</i> -test (p) <sup>1</sup>		-123.000 (<0.0001) **	
<i>t</i> -test (p) <sup>2</sup>		-23.491 (<0.0001) **	
<i>d</i>		15.75	
<b>Timed Up and Go Test (s)</b>	8.93±0.91	7.60±0.82	5.75±0.76
<i>t</i> -test (p) <sup>1</sup>		21.911 (<0.0001) **	
<i>t</i> -test (p) <sup>2</sup>		47.533 (<0.0001) **	
<i>d</i>		2.81	

Item	Pre	Post 1	Post 2
	N=61	N=61	N=57 <sup>m</sup>
	Mean ± SD	Mean ± SD	Mean ± SD
Chair Sit and Reach Test (cm)	-5.24±0.84	-3.19±0.94	0.29±0.84
<i>t</i> -test (p) <sup>1</sup>		-56.278 (<0.0001) **	
<i>t</i> -test (p) <sup>2</sup>		-199.750 (<0.0001) **	
<i>d</i>		7.21	

Paired –sample *t*-test (p) 1: comparing preprogram and 3 months after the program.

Paired –sample *t*-test (p) 2: comparing preprogram and 6 months after the program.

*d*=cohen's *d* estimating effect size between post1 and pre program

(m): Meter, (Reps): repetitions, (S): Seconds, (cm): Centimeter

# 4 older adults withdraw 6 months after the program

**Table (4): Effect of combined exercises program on anxiety and depression among the studied older adults**

Item	Pre	Post 1	Post 2
	N=61	N=61	N=57
	Mean ± SD	Mean ± SD	Mean ± SD
Anxiety	8.52±2.218	7.57±2.00	6.35±1.72
<i>t</i> -test (p) <sup>1</sup>		16.045 (<0.0001) **	
<i>t</i> -test (p) <sup>2</sup>		18.074 (<0.0001) **	
<i>d</i>		2.05	
Depression	6.47±1.40	5.55±1.31	4.61±1.16
<i>t</i> -test (p) <sup>1</sup>		21.635 (<0.0001) **	
<i>t</i> -test (p) <sup>2</sup>		26.368 (<0.0001) **	
<i>d</i>		2.77	

Paired –sample *t*-test (p) 1: comparing preprogram and 3 months after the program.

Paired –sample *t*-test (p) 2: comparing preprogram and 6 months after the program.

*d*=cohen's *d* estimating effect size between post1 and pre program

# 4 older adults withdraw 6 months after the program

**Table (5): Relation between physical fitness tests, anxiety, and depression of studied older adults and their demographic characteristics after 6 months follow up**

Demographic Characteristics	6MWT	30SCS	TUGT	CS&RT	Anxiety	Depression
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
<b>Age (years)</b>						
60 <65	670.37±48.55	16.56±0.7	5.56±0.58	-0.48±0.75	5.22±1.48	4.33±0.83
65 <75	614.29±48.8	13.86±2.32	5.79±0.69	0.00±0.77	7.18±1.06	4.64±1.1
≥ 75	475.00±35.36	11.00±0.00	8.00±0.00	-2.00±0.00	10.00±0.00	8.00±0.00
Test of significant	F=20.637 P=<0.0001**	F=14.119 P=<0.0001**	F=22.857 P=<0.0001**	F=8.071 P=<0.0001**	F=24.957 P=<0.0001**	F=13.428 P=<0.0001**
<b>Sex</b>						
Male	663.33±52.41	16.47±0.73	5.7±0.7	-0.33±0.84	5.27±1.44	4.27±0.83
Female	605.56±60.97	13.44±2.38	5.81±0.83	-0.26±0.86	7.56±1.12	5.00±1.36
Test of significant	T=3.847 P=<0.0001**	T=6.636 P=<0.0001**	T=-0.564 P=0.575	T=-0.328 P=0.744	T=-6.652 P=<0.0001**	T=-2.489 P=0.016*
<b>Marital status</b>						
Married	648.72±57.91	15.54±2.04	5.72±0.72	-0.31±0.86	5.87±1.7	4.64±1.09
Not married *	608.33±66.97	13.94±2.46	5.83±0.86	-0.28±0.83	7.39±1.29	4.56±1.34
Test of significant	T=2.329 P=0.024*	T=2.570 P=0.013*	T=-0.528 P=0.600	T=-0.123 P=0.902	T=-3.35 P=0.001**	T=0.256 P=0.799
<b>Place of residence</b>						
Urban	636.11±64.73	15.04±2.35	5.72±0.76	-0.31±0.84	6.3±1.76	4.65±1.17
Rural	633.33±28.87	15.00±0.00	6.33±0.58	0.00±1.00	7.33±0.58	4.00±1.00
Test of significant	T= -0.07 P=0.942	T= -0.027 P=0.978	T=10.361 P=0.179	T=0.625 P=0.534	T=1.013 P=0.316	T= -0.940 P=0.351
<b>Educational level</b>						
Illiterate	628.26±67.13	13.91±2.63	5.57±0.73	-0.13±0.92	6.70±1.69	4.70±1.18
Read and write	660±54.12	15.27±1.75	6.00±0.53	-0.33±0.72	5.93±1.94	5.00±1.00
Basic education	633.33±50	16.22±1.09	5.89±0.78	-0.22±0.83	5.78±1.09	4.00±1.00
Higher education	620±75.28	16.2±1.87	5.7±1.06	-0.70±0.82	6.70±1.89	4.4±1.35
Test of significant	F=1.058 P=0.375	F= 4.195 P=0.01**	F= 1.107 P=0.354	F= 1.096 P=0.359	F= 1.069 P=0.370	F= 1.591 P=0.202

Demographic Characteristics	6MWT	30SCS	TUGT	CS&RT	Anxiety	Depression
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
<b>Current work</b>						
Yes	639.13±72.23	14.78±1.95	6.04±0.82	-0.52±0.79	6.39±2.04	5.22±1.31
No	633.82±57.37	15.21±2.5	5.56±0.66	-0.15±0.86	6.32±1.51	4.21±0.84
Test of significant	T=0.308 P=0.759	T= -0.683 P=0.497	T= 2.458 P=0.017*	T= -1.670 P=0.101	T= 2.458 P=0.886	T= 0.144 P= 0.001**
<b>Monthly family income</b>						
Enough	646.55±56.59	15.86±1.85	5.66±0.67	-0.28±0.84	5.76±1.46	4.34±0.9
Not enough	610±68.66	14.13±2.59	5.73±0.96	-0.27±0.88	7.4±1.35	4.67±1.4
Test of significant	T=1.888 P=0.066	T=2.561 P=0.014*	T=-0.315 P=0.754	T=-0.034 P=0.973	T=-3.630 P=0.001**	T=-0.929 P=0.358
<b>Living arrangements</b>						
Alone	596.67±66.73	13.73±2.55	6.00±0.85	-0.27±0.8	7.67±1.05	4.47±1.41
With family	650±56.31	15.50±2.02	5.67±0.72	-0.31±0.87	5.88±1.68	4.67±1.07
Test of significant	T= -2.998 P=0.004**	T= -2.715 P=0.009**	T=1.468 P=0.148	T=0.167 P=0.868	T=3.836 P=<0.0001**	T= -0.569 P=0.572

Table (6): Correlations between physical fitness tests, anxiety and depression among the studied older adults

Item	N	6-Minute Walk Test			30-Second Chair Stand			Timed Up and Go Test			Chair Sit and Reach Test		
		r (p)			r (p)			r (p)			r (p)		
		Pre	Post 1	Post 2	Pre	Post 1	Post 2	Pre	Post 1	Post 2	Pre	Post 1	Post 2
<b>30-Second Chair Stand</b>													
Pre	61	0.434 (<0.0001)**	----	----	1	----	----	----	----	----	----	----	
Post1	61	----	0.435 (<0.0001)**	----	----	1	----	----	----	----	----	----	
Post2	57	----	----	0.307 (0.020)*	----	----	1	----	----	----	----	----	
<b>Timed Up and Go Test</b>													
Pre	61	-0.392 (0.002)**	----	----	-0.438 (<0.0001)**	----	----	1	----	----	----	----	
Post1	61	----	-0.212 (0.101)	----	----	-0.120 (0.357)	----	----	1	----	----	----	
Post2	57	----	----	-0.369 (0.005)**	----	----	-0.159- (0.237)	----	----	1	----	----	
<b>Chair Sit and Reach Test</b>													
Pre	61	-0.045 (0.733)	----	----	-0.169 (0.193)	----	----	0.022 (0.867)	----	----	1	----	
Post1	61	----	-0.004 (0.973)	----	----	-0.151 (0.245)	----	----	-0.144 (0.268)	----	----	1	
Post2	57	----	----	-0.013 (0.924)	----	----	0.126 (0.351)	----	----	-0.033 (0.810)	----	1	
<b>Total Anxiety score</b>													
Pre	61	-0.526 (<0.0001)**	----	----	-0.566 (<0.0001)**	----	----	0.372 (0.003)**	----	----	-0.143 (0.273)	----	
Post1	61	----	-0.544 (<0.0001)**	----	----	-0.559 (<0.0001)**	----	----	0.099 (0.449)	----	----	-0.089 (0.495)	
Post2	57	----	----	-0.608- (0.000)**	----	----	-0.492 (<0.0001)**	----	----	0.094 (0.488)	----	-0.160- (0.236)	
<b>Total Depression score</b>													
Pre	61	-0.163 (0.208)	----	----	-0.366 (0.004)**	----	----	0.518 (<0.0001)	----	----	0.085 (0.513)	----	
Post1	61	----	-0.202 (0.118)	----	----	-0.338 (0.008)**	----	----	0.284 (0.026)*	----	----	0.036 (0.782)	
Post2	57	----	----	-0.294 (0.026)*	----	----	-0.284 (0.032)*	----	----	0.274 (0.039)*	----	-0.065 (0.632)	

r = Pearson's coefficient correlation test

P < 0.05

Table (1): Shows that, mean age of studied elderly was 65.03 ± 4.19 yrs, 52.5% of them were males, 68.9% were married, 93.4% were living in urban areas, 39.3% were illiterate, 74.7% were living with their families, and 59.0% of them were not working.

Table (2): Reports that 65.6% of the studied older adults had a history of chronic diseases other than DM, 41.0% were suffering from DM since 5-10 years. 59.0% of them used to take insulin and oral hypoglycemic drugs as therapeutic regimen.



**Figure (1):** Illustrates that body mass index of the studied older adults had decreased after 3 months of implementation of combined exercises program ( $p=0.055$ ) and the decrease become significant after 6 months follow up ( $P=0.004$ ).

**Table (3):** Displays a statistically significant improvement of physical fitness tests of the studied older adults for 3 months after the program than before it ( $P<0.0001$ ), with effect size (percent improvement) of these tests (6-Minute Walk Test, 30-Second Chair Stand, Timed Up besides Go Test, and Chair Sit and Reach Test) by (4.81, 15.75, 2.81, 7.21) respectively, and the improvement of physical fitness still significantly for 6 months of follow up ( $p<0.0001$ ).

**Table (4):** Displays a statistically significant improvement of anxiety and depression of the studied older adults for 3 months after the program than before it ( $P<0.0001$ ) and the improvement still apparent at 6 months follow up ( $P<0.000$ ) with effect size (percent improvement) of anxiety and depression by (2.05, 2.77) respectively.

**Table (5):** Demonstrates a statistically significant difference improvement of physical fitness tests, anxiety and depression among young elderly males who were married, with higher education, had enough income, and who were living with families ( $P<0.0001$ ,  $P=0.016$ ,  $P=0.024$ ,  $P=0.01$ ,  $P=0.014$ ,  $P=0.004$ ) respectively.

**Table (6):** Demonstrates that a statistically significant positive correlation existed between the total mean score of 30-Second Chair Stand test and 6-Minute Walk Test in both 3 and 6 months after the program ( $p<0.0001$ ,  $p=0.020$ ) respectively. However, a statistically significant negative association was present between the total mean score of 6-Minute Walk Test and Timed Up and Go Test before and 6 months after program ( $p=0.002$ ,  $p=0.005$ ) respectively. Moreover, a statistically significant negative correlation was existed between total mean score of anxiety and depression of studied elders and physical fitness tests including (6-Minute Walk Test, 30-Second Chair Stand) before 3 months and 6 months after the program ( $p<0.0001$ ) ( $p=0.004$ ,  $p=0.008$ ,  $p=0.032$ ) respectively, while there was positive correlation was existed between the total mean score of depression and Timed Up and Go Test before, after 3, and 6 months after program ( $p<0.0001$ ,  $p=0.026$ ,  $p=0.039$ ) respectively.

## Discussion

Increasing obesity and sedentary lifestyle across the world are associated to T2D, which represents alarming, even for the prevalence of many complications in the future. Despite a major genetic component to T2D, it is becoming increasingly clear

that variables related to lifestyle and environment is dramatically increasing the prevalence of the disease in older people. Hence, efforts to stimulate changes in physical activity and diet are considered the keystones of both preventive and therapeutic measures for it (Youssef, 2019). Therefore, the aim of this study was to determine the effect of combined exercises program on physical fitness, anxiety and depression among older adults with type 2 diabetes mellitus.

Low physical fitness level is linked to T2D, and individuals with this condition have lower tolerance of exercise than those without it (Reusch et al., 2013). The main result of current study proved that an exercise program (aerobic + resistance + agility/balance + flexibility) induced significant benefits in physical fitness in older adults with T2D, after six months of intervention. This is in accordance with results of many studies reported a combined program (aerobic + resistance + flexibility) was effective in improving aerobic fitness, muscle strength, and flexibility in individuals with T2D, although different exercises protocols and intervention durations (Grellet et al., 2013 & Tan et al., 2012). Similarly, a study in Portugal by Mendes et al., (2016), on 43 older adults for a period of 9 months of exercises, an Italian study by Galle et al., (2019) & research conducted in Australia by Kirwan, et al., (2021) reported a significant improvement in the performance of the 6-minute walk test, 30-second chair stand test, timed up and go test, and chair sit and reach test were identified between baseline and end-program intervention time points. This may be explained by study program included different combined exercise as walking, resistance and flexibility exercises which it easy to apply and cheap and do not require the use of additional equipment. These exercises can also be performed on ergometers, which include (treadmills, stationary bikes, rowing machines, steppers and elliptical) as well as resistance training machines. In addition may be due to long duration of the program implementation and most of the studied elders were young old, from urban areas, and living with their families who encourage them to apply the program.

Older persons with diabetes who are physically fit appear to have a better chance of losing weight, and physical fitness plays a significant influence in their health (Mendes et al., 2016). The present study's findings stated a significant improvement in the older people' body mass index mean scores 3 months after the program's implementation, and the improvement became statistically significant at 6 months after the program's compared to before it. In this line, many studies done in Malaysia by Mustapa et al., (2021), in Egypt by Youssef, (2019), in Italy by Galle et al.,

(2019) & in Iran by Najafipour et al., (2017) reported a significant improvement in BMI of older subjects with T2D after the program. This may be attributed that long duration and low cost of the program and also due to strict supervision and follow up from the researchers to encourage the studied older adults to compliance with this program.

In those with T2D, anxiety and depression are risk factors for increased morbidity. Up to 28.9% of diabetic patients, particularly women, exhibit a variety of depression symptoms. (Bak et al, 2020). Regular exercise is crucial for preventing several ailments that affect the elderly, as cardiac disease, hypertension, DM, obesity, osteoporosis, depression, anxiety. As a result of these extensive potential health benefits, these moderate exercises like walking is one of the finest ways to enhance both one's physical and mental well-being that can recommend and prescribed to diabetic elderly patients (Nesti et al., 2020). With regard to anxiety and depression among the studied older adults, findings of this study reported a statistically significant decrease of anxiety and depression mean score of the participants after 3 months of program than before it and the improvement still apparent for 6 months of follow up with percent improvement by 2.05 for anxiety and, 2.77 for depression. These finding may be justified by the extended duration of the combined exercise program compared to other studies, in addition, regular physical activity helps to increases insulin receptors besides insulin sensitivity and regulate normal glucose uptake into peripheral tissues, thus it contributing to blood glucose control, which in turn leading to improvement of patient's mood and reduced anxiety and depression. In accordance with the current study, a research performed by Morga et al., (2021) in USA stated that regular exercise combined with psycho-education may effectively contributing to reduce the intensity of depressive manifestations in women with metabolic syndrome. Also other studies done in Australia by Kirwan, et al., (2021), in Egypt by Youssef, (2019) & in Brazil by de Oliveira et al., (2019) concluded that physical exercise contribute to lessen the symptoms of anxiety and depression in diabetic elderly. On contrary to this study, a study performed in Lithuania by Zupkauskiene et al., ((2022), stated that there were no significant difference in anxiety level in participants with metabolic syndrome including type 2 diabetes, who shared in the 8-week aerobic training program. This difference may be attributed to short duration of their exercise program compared with present study program and difference of the socio demographic characteristics in their sample as culture and educational level.

The improvement of physical fitness, anxiety, and depression among diabetic elders are affected by a lot of variables like age, sex, marital status, income, education, and living conditions. As a result of this study, there has been a statistically improvement in physical fitness tests, anxiety and depression among young elderly males. This may be related to that the younger males are more willing to participate in exercise program because they constituted more than half of the study sample and the female may be busy in housekeeping activity or caring family members. This result is in line with other studies by Brun et al., (2020), & Mendes et al., (2016). In addition, existing study demonstrated that there was a significant enhancement in physical fitness and decrease in anxiety and depression amongst married elderly with higher education, and who were living with families. It can be justified by the elders who have social support, especially from life partners that motivate them to engage in the exercise program, in addition the more educated older adults may be more understandable about the importance of exercises and its benefits. Similar finding was stated by other studies done by Youssef, (2019), Lin, et al., (2017), & Schwarzbach et al., (2014).

As for the correlations between physical fitness tests among the studied older adults, the current study showed a statistically positive correlation was existed between the overall mean score of 30-Second Chair Stand test and 6-Minute Walk Test before and after the implementation of combined exercises program. These result in accordance with other researches done in Brasil by Pereira et al., (2022) & in Sweden by Höglund, et al., (2022) reported that there was a strong correlation founded between 6MWT and 30 SCST. This may be attributed to any improvement in any type of exercise is associated with improvement in the other exercise types. Finally, a statistically negative correlation was found between the total mean score of anxiety and depression of the studied older adults and physical fitness tests before, 3months and 6 months after the combined exercises program. The same result was founded in a study done in Australia by Kirwan, et al., (2021), revealed that there was a decrease in depression and anxiety level in participants after the program. This can be explained by regular moderate physical activity improves mental well-being and reduces other symptoms of anxiety and depression. Also regular exercise can improve mood and self-esteem and help in reducing stress.

## Conclusion

It could be concluded that combined exercises program was successful in enhancing physical fitness

and it effective in decreasing anxiety, and depression among diabetic elderly patients.

### Recommendations:

Regular exercises should be recommended for diabetic elderly patients in order to improve their physical fitness, alleviate anxiety and overcome depression; furthermore the gerontological nurses should apply such exercises programs in- other different health care settings in order to enhance physical fitness of diabetic elderly patients.

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