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OUTCOMES OF PHYSICAL FITNESS FOR YOUNG MALES WITH TYPE II DIABETES IN KSA

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ABSTRACT

Background: Diabetes mellitus is one of the common public problems that its prevalence increase incredibly in the last three decades in KSA. The purpose of this work is to investigate the physical fitness of young male subjects with type 2 diabetes mellitus in KSA. Also, study the reliability of ALPHA-FIT test battery as easy, quick physical tools to test the physical fitness among Saudi society patients.

Methods: Thirty males with type 2 diabetic were participated in the study and compared with thirty healthy volunteers represent the control group. The participants were investigated for their physical fitness by the ALPHA-FIT test battery. The seven categories of the test battery that forming the essential physical fitness for adults health and function.

Results: The results of the study showed that there was a significant reduction in the physical fitness of the diabetic group compared with the control group. The cardiorespiratory fitness, the hand-grip is showing muscular strength, jump-to-reach indicating lower limbs power and strength, modified push-up owing to the trunk and upper limbs muscular endurance, standing on one-leg referring to balance state all results showing p-value < 0.05. In comparing both groups, there were no significant differences between diabetic and control groups regarding body mass index and waist circumference measures p-value > 0.05.

Conclusion: Musculoskeletal and cardiorespiratory fitness were significantly lowered in patients with diabetes compared to age matching people. Health awareness and early physical intervention are recommended to prevent this reduction of fitness.

Keywords: Physical fitness, ALPHA-FIT test battery, cardiorespiratory fitness, Endurance, Muscle strength, Diabetes mellitus.

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INTRODUCTION

Diabetes mellitus (DM) is considered a general health problem in KSA. Its prevalence was duplicated in the last three decades in both developed and developing countries. More than one-third (34.1 %) of adults are considered to be diabetic. Overall, the prevalence of diabetes in KSA is, 30 %, or about 4 million, Saudis aged over fifteen years old were obese. The range of DM prevalence ranged from 27.6% among women to 34.1% among men. [1,2,3]

The International Diabetes Federation (IDF) predestined that there would be 334 million patients with diabetes for 2025. [4] The hospitals or community-based surveys that taken from the subjects with diabetes indicate the clinical features of DM and their comorbidities. The Saudi population is over 20 million and is rapidly growing, and the number of diabetic subjects increased progressively. [5]

Diabetes mellitus of type 2 is considered as a predisposing factor for premature mortality, and it is related to many severe medical conditions, such as cardiovascular disease, neuropathy, retinopathy, and kidney disease. [6]

There are many domains of test batteries on health fitness have been recommended that used to appreciate the different physical fitness parameters. Assessing levels of physical activity and fitness (ALPHA-FIT) test battery is one of these test batteries.[7] Committee for the Development of Sport of the Europe Council designed the ALPHA-FIT test battery to evaluate health-related fitness among individuals from age 18 -69, communities and population models. The ALPHA-FIT test battery is composed of simple and relatively inexpensive tests, which can be administered by health team members either as a portion of or together with the regular physical education program for patients with diabetes. [8]

The utmost known physical fitness test batteries are EURO-FIT, FITNESS-GRAM, and the updated one the ALPHA-FIT test battery. ALPHA-FIT test battery has been depended on stable scientific evidence to provide a set of safe, available, valid and reliable tests that have been scientific evidence-based proven to be related to the current and future function and health. [9]

Investigation of physical fitness among young males with type 2 diabetes has addressed by a few previous studies using valid and reliable famous test battery as ALPHA-FIT test battery in KSA.

My work was purposed to checkthe physical fitness of young male subjects with type 2 diabetes mellitus in KSA. Also, study the reliability of ALPHA-FIT test battery as valid, feasible, and safe physical tools to test the physical fitness among Saudi society patients.

MATERIALS AND METHODS

Research design

A prospective randomized study was done at the medical center of Majmaah University and physical therapy department, Al Majmaah, KSA. The Declaration of Helsinki principles were followed in this research; the study protocol was submitted to the Institutional Review Board of the Basic & Health Science Research Center at Majmaah University, and ethical approval was obtained.Approval No.: MUREC-Oct.16/COM-2018/5. Participants provided an informed written consent form before entering the study.

Thirty male patients with type 2 diabetes aged 35 to 45 years were included in this investigation represent group I. Thirty non-diabetic volunteers were participated to represent the control group (Group II); they matched in age to the diabetic group. Inclusive criteria: all subjects were ambulant without assistance and with a history of type 2 diabetes, glycated hemoglobin test (HbA1c) was between 7 and 10, the age of participants ranged from 35 to 45 years old, the mean duration of diabetes was 6.63±1.4 with range of 5-9 years and subjects were not participate in regular exercise/diet programs for the preceding 6 months. Exclusion criteria: subjects with a history or clinical evidence of orthopedic, neurological, or cardiopulmonary disorders were excluded.

Procedure and measures

The latest HbA1c was to be used to evaluate long term metabolic monitoring of the patients. The ALPHA-FIT Test Battery was be used to examine the body fitness of the subjects with type 2 diabetes, thorough seven measurements including body composition, motor balance, musculoskeletal system fitness strength, and endurance and cardiopulmonary fitness.Table (1) shows the series of test items of the fitness for health the ALPHA-FIT test battery for adults.

Table 1: Shows the series of examination items for the ALPHA-FIT Test Battery for adults.

Fitness component	Fitness factor	Fitness test category
Body composition	1- Fat distribution 2- Obesity	• Waist Circumference (WC) • Body mass index (BMI)
Motor	3- Balance	• One-leg stand
Musculoskeletal	4- Upper body muscle strength 5- Lower body muscle strength	• Hand grip dynamometer • Jump-and-reach test
	6- Muscular endurance Trunk	• Modified push-up test
Cardiorespiratory	7- Submaximal aerobic capacity (VO_{2max})	• 6 minutes' walk test, predicted (6MWT)

VO_{2max}; maximum oxygen consumption.

The body mass index (BMI) was examined through the participant's weights, and heights to detect the degree of obesity and body composition usually indicate peripheral obesity. Central obesity and fat distribution were investigated by measuring the waist circumference (WC). The objective of the test was to check the percent of abdominal fat tissue. The procedure of the waist circumference test was done as follows. The participant was standing with feet apart by about 10 inches in front of the examiner. The tape measurement was put around the abdominal at umbilicus level, midway between the iliac crest bone and the number12th rib bone. During the normal exhalation, the

three times repeated measurements were taken. The result was calculated to the nearest 0.5cm, and the mean of the measurements was recorded. If there is more than 1 cm difference among the three measurements,two –extra measurements are done. [8]

The one-leg stand test was being done to examine the postural control and balance by decreasing the body space of support. From a standing position, the participant move to one-leg stand position of the dominant leg. The participant was moving the heel of the other leg on the medial side of the knee. The participant kept up his arms, hanged beside the body without closing eyes. The participant was trying to keep in the one-leg position for the longest time. The results were calculated by seconds until 60 seconds. [10]

To assess the upper and lower limbs musculoskeletal fitness, the handgrip test, and the test of the vertical jump (VR)were used. The hand dynamometer was applied to examine the strength of the upper limb muscle of the dominant hand from the neutral position of the shoulder with extension elbow position. The test was done two times, and a higher score was recorded.For measuring the strength of lower extremities muscles, the vertical jump test was suitable. The subject stands at eight-inch away from the wall and facing to it. The procedure was done by jumping as high as possible. Outcomes of maximum distance jumped was be recorded. The upper-body and trunk muscular endurance were measured by modified push-up. From a prone position, the practitioner, try to doing as much as possible of push-ups. The total time of the test was 40 seconds.The total number of complete correctly performed push-up was recorded[11].

The six minutes' walk test (6MWT) was be used to determine the cardiopulmonary fitness. It was conducted on a 30-meter indoor track. Then we counted the distance that was being walked.Then through certain formula: VO_{2max} = 4.948+ 0.023*Mean 6 MWD (m.) was being used to determine VO_{2max}(ml. / kg.min.).[12, 13]

Randomization

Random assignment of subjects was conducted after the eligible patients had been determined. Revision of inclusive and exclusive criteria's of the work was done to select the participants and record all patients who achieve the requirements of the study.

RESULTS

Statistical analysis was applied by SPSS version 22. The achievement of significance was determined at the level of P < 0.05. The parametric analysis using paired t-test was performed to detect the level of the results significant between diabetic group (group I) and non-diabetic group (group II).

The demographic data of all subjects in each group shown in Table (2). The results appeared that no differences between the demographics of the participants in the diabetic group (groupI) and the non-diabetic group (group II). The results present that both groups have similar characteristics regarding age, height, weight, and no significant difference between group I and group II as p-value > 0.05.

Table 2: Shows the demographic characteristics of the group (I) diabetic and group (II) control group.

Variable	Group I			Group II			t-value	p-value	Sig.
	X± SD	Range		X± SD	Range				
		Min.	Max.		Min.	Max.			
Age (year)	41.7± 7	35	45	40.5± 3.83	35	44	1.217	.229	NS
Duration (years)	6.63± 1.4	5	9	-	-	-	-	-	-
HbA1c (%)	8.24± 0.81	7.1	9.6	-	-	-	-	-	-
Weight (Kg.)	79.5± 7.12	66	99	78.5± 6.73	65	98	.559	0.578	NS
Height (m)	1.76± 0.1	1.66	1.87	1.75± 0.1	1.65	1.88	0.645	0.521	NS

X±SD; mean and stander deviation, NS; not significant

Concerning Table (3), the comparing of BMI and WC showed no significant difference between both groups with a p-value equal to 0.414 and 0.184, respectively.

Table 3: Shows the waist circumference, body composition for a group I, and group II.

Variable	Group I	Group II	t-value	p-value	Sig.
	X±SD	X±SD			
BMI ($kg./m^2$)	25.86± 1.99	25.48± 1.56	0.823	0.414	NS
Waist Circumference (cm)	82± 7.06	84.6± 7.88	-1.346	0.184	NS

X±SD; mean and stander deviation, BMI; body mass index.

As illustrated in Table (4), there were a significant reduction in mean values of total walked distant, VO2 max, time of one-leg stand test, numbers of repetition of modified push up test, the height of vertical jump test and power of grip strength test between group I and group II.All of these variables had a significant level of difference between group I and group II at the level of p-value < 0.05.

Table 4: Shows the cardiopulmonary fitness, strength, balance, endurance, motor, and musculoskeletal system fitness for a group I and group II.

Variable	Group I	Group II	t-value	p-value	Sig.
	X±SD	X±SD			
One-leg stand test (Sec.)	26.67± 4.1	34.33±4.24	-7.13	0.000	*
Vertical jump test (cm.)	35.4± 4.6	44±4.2	-7.562	.001	*
Grip strength test (Newton)	55.3± 8.43	68±11	-5.019	0.005	*
Modified push up test (number of repetition)	13.7± 3.04	20.13±2.54	-5.994	0.001	*
Total distance (m)	477± 21.7	515±35.6	-4.992	0.006	*
VO_2 max (ml./kg./min.)	15.9± 0.47	16.9±0.56	-7.492	0.001	*

X±SD; mean and stander deviation, VO_2 max; maximum oxygen consumption, sig *; significant.

DISCUSSION

Physical fitness is generally decreased with diabetes mellitus, several studies evaluated the physical fitness of diabetic patients, but most of these studies concentrate in type I diabetes and not evaluated the patients as a complete battery test, in addition to most of the assessment concentrate on old age diabetic patients and few studies evaluated this category of this age. So these studies add knowledge about the evaluation of physical fitness by the new test the ALPHA-FIT test battery among young male Saudi population.

In this study, I investigated the musculoskeletal and cardio-respiratory fitness of young male with type 2 diabetes using the standardized ALPHA-FIT test battery (Assessing levels of physical activity and fitness). The results of the diabetic group had compared with resembling demographic control group. Men with type 2 diabetes had reduced physical fitness levels in most of the examination`s outcomes in comparing to the other non-diabetic peers.

The current study results revealed that there was no significant (P>0.05) difference in the mean values of BMI which was (25.86±1.99) in group I and it was (25.48±1.56) in group IIwith p-value = 0.414. Also, the outcomes of WC did not appear any significant difference (P>0.05). The mean values of WC were (82 ±7.06 cm) in group I, and it was (84.6±7.88 cm)in group II, with a p-value equal to 0.184. The results of the measurement of BMI and WC were similar to the findings of many studies whose finding the mean value of BMI and WC were similar to the currentresults. [14, 15, 16]

Olufemi et al.(2014), and Mehtap et al.(2003)evaluated the level of physical fitness in subjects with diabetes mellitus type II. They tested and measuring cardiopulmonary fitness in patients with diabetes and made comparison with the healthy control men. All outcomes results showed lowering of cardiopulmonary fitness factors in diabetic patients. [17, 18]

However, this is the first work, that made a parallel evaluation of Musculoskeletal, body composition, and cardiorespiratory in young males with type 2 diabetes using the ALPHA-FIT battery among the Saudi population. This battery of examinations is united and vastly used application for evaluation of the physical fitness of adults between the ages of 18-69 years. The cause of why diabetes patients showed impaired musculoskeletal and cardiovascular on various tests is not clear. They mentioned that the reduction of physical fitness in patients with diabetic might occur due to the decrease of physical activity and other physiological changes resulting from the pathogenesis of diabetes [19].

It is noted that patients with diabetes have lower physical activity due to the apprehension of hypoglycemia incidence during the physical activity, in addition to the skills of patients with diabetes to carry out such examinations are lower than subjects without diabetes. [20, 21]

The balance in subjects with diabetes was lower than normal subjects, as showed in the results of the outcome. The mean time of the one-leg stand test was a 26.67±4.1 sec. for the group I compared to 34.33±4.24 sec. for group II at the level of p-value <0.05.

It comes in agreement withwork of Timar et al.(2016), they evaluate the balance in 89 male patients with type 2 diabetic having to mean age 61 years by single leg stand test (SLS). They found that SLS time is decreased with diabetic neuropathic patients than diabetic without overt neuropathy 9.33 ± 1.8 and 10.3 ± 2.0 respectively with p-value = 0.003.The decrease in the time of balance in the SLS test is due to older aged patients and neuropathy.[10, 22]

The functional capacity was investigated by Olufemi et al.(2014), in thirty patients with diabetes type II and compared to thirty age matching control subjects. Patients with diabetes had lower values of the Jump-stretch and handgrip.[18] This also supported by previous work whose study handgrip strength, which is important parameter of hand function, for 76 subjects with Diabetes type 2 Mellitus and comparing the results with age-matched 47 control subjects. They concluded that hand strength outcomes results were significantly decreased in the diabetic group. I corresponded with the control group.[16, 23]

The increase in insulin resistance is known to be one of the primary metabolic adaptations of diabetes, which lead to a decrease in glucose use and insulin receptors sensitivity for skeletal muscles and throughout the body.The harmful effect of diabetes on skeletal muscle may be explained due to the decrease in the expression of glucose transporter-4 protein and mitochondria enzyme activity. [24]

Vertical Jump can be used for the assessment of performance and activities of occupational and sports purposes. Earlier studies reported the relationship between the vertical jump and the anthropometric factors. Coaches and researchers have used the vertical jump as a method for evaluating physical fitness of the lower extremities. The test is valid and reliable for male and female, and all ages [25, 26, 27]. In this study, the results of the VR test outcomes were decreased in diabetic subjects.

The decrease of muscle strength and atrophy that occur in patients with diabetes are due to nerve axonal loss and neuropathy, especially in flexors and extensors of the knee joints and the planter and dorsi flexors of the ankle joint. The result of assessment muscle strength by the isokinetic dynamometer for ankle flexors and extensors muscles, knee flexors and extensors muscles of 36 type 2 patients, and matched with 36 non-diabetic subjects. They found that there was a decrease in muscle strength accompanied by axonal loss. [28]

Endurance is an essential component of physical fitness. Our patients with type 2 diabetes had lower test values than healthy peers for the modified push up test, suggesting that endurance is decreased in these patients also. Boshra et al. (2014), who found a decrease in endurance capabilities in 18 patients with diabetes. The development of diabetes mellitus may combine some neuromuscular and vascular deterioration. These changes may affect the muscle endurance and performance. However,the relation between

muscle endurance and duration of diabetes is needed for further investigation. [29]

In the current study, I evaluated the maximum aerobic capacity by using the 6MWT,for estimation of maximum oxygen consumption VO_{2max} which is non-expensive and straight forward methods to determine the maximal aerobic power, especially when the gas analysis is impractical or unavailable. The results of Robertet et al. support it., that concluded that the general equation could be used to accurately estimate VO_{2max} from mean 6MWT among a group of patients. The more patient characteristics, the more ability for estimation of VO_{2max} and more of variability. [12]

The result of the current study is supported by the work of Mehtap et al.(2003).They found a significant reduction in 6MWT in the diabetic group. In addition to significantly decreased of VO_{2max} at the level of (P<0.05). In our study, there were lower VO2 max outcomes in group I than group II. The reduction of VO_{2max}, refer to the need for regular practice of training exercises for preventing the deterioration of cardiorespiratory fitness for the patient with type 2 diabetes. [17]

CONCLUSION

This study found that cardiopulmonary fitness, strength, balance, endurance, motor, and musculoskeletal system fitness are lower in patients with diabetes type 2 than in age-matched control subjects. The ALPH-FIT test battery is easy and useful method for assessment of physical fitness for patients with diabetes type 2. The battery also helps to the detection of the individual needs of exercise type and pattern that contribute to better control of diabetic and improve the physical status. However, more studies are needed to assess the physical fitness of female patients with type 2 diabetic.

Ethical Consideration

The subjects were signed the informed consent forms before entering the intervention.

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Competing interests

The author report that there is no competing of interesting.

REFERENCES

[1] American Diabetes Association. Standards of medical care in diabetes.Diab. Care. 2017;40(Suppl.1):S1–S135.

[2] William H, Thomas D, James D, et al.Standards of Medical Care in Diabetes. Diab. Care. 2016; 39(Suppl.1):S1-S112.

[3] Khalid A, Khalid A, Samia B. Prevalence of diabetes mellitus in a Saudi community. Ann Saudi Med. 2011;31(1):19–23.

[4] Guariguata L, Whiting D, Weil C, et al.The International Diabetes Federation diabetes atlas methodology for estimating global and national prevalence of diabetes in adults. Diabetes Res Clin Pract. 2011;94:322–32.

[5] Reem A, Amer B, Maha A, et al. Prevalence of diabetes mellitus and its relation with obesity in Turaif (Saudi Arabia) in 2017. Electron Physician. 2017; 9(10):5531–5535.

[6] Albache N, AlAli R, Rastam S, et al.Epidemiology of Type 2 diabetes mellitus in Aleppo, Syria. J Diabetes. 2010;2(2):85–91.

[7] Vanhees L, Lefevre J, Philippaerts R, et al.How to assess physical activity? How to assess physical fitness? Eur J Cardiovasc Prev Rehabil. 2005; 12:102–114.

[8] Fitness for Health: The ALPHA-FIT test battery for adults aged 18-69 Tester's Manual provisional handbook. Published by European Union, DG SANCO, and the UKK Institute for health promotion research, tampere, FINLAND. Republished on the Internet www.ukkinstituutti.fi Finland March 2008.

[9] Jonatan R, José Castro P, Vanesa R, et al.Field-based fitness assessment in young people: the ALPHA health-related fitness test battery for children and adolescents. Br J Sports Med. 2011;45:518-524. doi:518 10.1136/bjsm.2010.075341.

[10] Timar B, Timar R, Gaiță L, et al. The impact of diabetic neuropathy on balance and on the risk of falls in patients with type 2 diabetes mellitus: A cross-sectional study. PLOS One Journal. 2016;27(4):1-11.

[11] Fogelhom M, Malmberg J, Santtila M, et al.Waist circumference and BMI are independently associated with the variation of cardio-respiratory and neuromuscular fitness in young men. International journal of obesity. 2006;30:962-969.

[12] Robert R, Jayasimha M, Istvan W, et al.The six minute walk test accurately estimates mean peak oxygen uptake. BMC Pulmonary Medicine. 2010;10:31.

[13] Ari M, Jaana S, Harri S, et al.Six-minute walk test: a tool for predicting maximal aerobicpower (VO2 max) in healthy adults. Clin Physiol Funct Imaging. 2018;1-8. doi: 10.1111/cpf.12525.

[14] Nor Shazwani N, Suzana S, Hanis Y, et al.Assessment of physical activity level among individuals with type 2 diabetes mellitus at Cheras health clinic, Kuala Lumpur. Mal J Nutr. 2010;16(1):101-112.

[15] Ryoko K, Susumu S, Munehiro M, et al.Reference Values for Cardiorespiratory Fitness and Incidence of Type 2 Diabetes. J Epidemiol. 2014; 24(1):25-30.

[16] Chiao-Nan C, Lee-Ming C, Ying-Tai W. Clinical measures of physical fitness predict insulin resistence in people at risk for diabetes. Physical therapy. 2008; 88(11):1355-1364.

[17] Mehtap O, Sevinc B, Ayse O. Evaluation of physical fitness in patients with type 2 diabetes mellitus. Diabetes Research and Clinical Practice. 2003; 60:171-176.

[18] Olufemi O, Olatunde O, Kolawole O, et al.Physical activity among type-2 diabetic adult Nigerians. Annals of African Medicine. 2014; 13(4):189-194.

[19] Britta W, Barbara E, Martin T, et al.Type 2 diabetes is associated with lower cardiorespiratory fitness inde-

pendent of pulmonary function in severe obesity. Exp Clin Endocrinol Diabetes. 2017;125(5): 301-306.
[20] SheriC, RonaldS, Bo Fernhall, et al.Exercise and Type 2 Diabetes. Diabetes Care. 2010; 33(12): e147 - e167.
[21] Sigal J, Kenny P, Wasserman H, et al.Physical activity/ exercise and type 2 diabetes: a consensus statement from the American Diabetes Association. Diabetes Care. 2006;29(6):1433–8.
[22] Dixon J, Knight T, Binns E, et al.Clinical measures of balance in people with type two diabetes: A systematic literature review. Gait Posture. 2017;58:325-332.
[23] Cetinus E, Buyukbese A, Uzel M, et al. Hand grip strength in patients with type 2 diabetes mellitus. Diabetes Res Clin Pract. 2005;70(3):278-86.
[24] Sue Kim, Ji-Young K, Duk-Chul L, et al.Combined impact of cardiorespiratory fitness and visceral adiposity on metabolic syndrome in overweight and obese adults in Korea.PLOS ONE. 2014;9(1):e85742.
[25] Hanjabam S, Shalini G, Konthoujam M, et al.Anthropometric basis of vertical jump performance: a study in young Indian national players. Journal of Clinical and Diagnostic Research. 2017;11(2): CC01-CC05.
[26] Healy R , Kenny C, Harrison J. Assessing reactive strength measures in jumping and hopping using the Opto jump TM System. J Hum Kinet. 2016;54: 23-32.
[27] Liliana B, Camelia B. A comparative study on the indirect assessment of leg extensor power using simultaneously the jump-and-reach test from alpha-fit and the optojump system. The 13th International Scientific Conference eLearning and Software for Education. 2017;3: 154-160.
[28] Andersen H, Nielsen S, Mogensen E, et al.Muscle strength in type 2 diabetes. Diabetes. 2004;53(6):1543-8.
[29] Boshra H, Farid B, Mohammad T. The comparison of muscle strength and short-term endurance in the different periods of type 2 diabetes. Journal of Diabetes & Metabolic Disorders. 2014;13(22):1-10.