The Effectiveness of Acceptance and Commitment Therapy and Combined with Aerobic Training on Anxiety Symptoms, Insulin Resistance and Lipid Profile in Women with Type 2 Diabetes

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Abstract

Objective: The aim of the present study was to examine the effectiveness of Acceptance and Commitment Therapy (ACT) combined with aerobic exercise (AE) on anxiety symptoms, insulin resistance (IR) and lipid profile in women with T2DMmellitus (T2DM).

Materials and Methods: In the present study, 60 T2DM women with a mean age of 33.5 (± 3.52) years were selected from the patients who were referred to the specialized clinic Petroleum Industry in summer 2020. They were randomly divided into four groups of ACT (n=15), AE (n=15), ACT combined with AE (n=15), and the control group (n=15). Intervention programs were performed for 10 weeks, and then indices were collected before and after the intervention using blood tests and Beck Depression Inventory.

Results: ACT led to a significant decrease in anxiety and LDL (*P*-value: 0.001). Moreover, AE significantly reduced the anxiety index and increased HDL (*P*-value: 0.001). In addition, the effect of ACT and exercise significantly reduced anxiety (*P*-value: 0.001) and LDL index (*P*-value: 0.03) and also increased HDL (*P*-value: 0.03). However, indices of blood glucose, insulin, insulin resistance, total cholesterol, and triglycerides did not indicate any significant changes in the intervention groups as compared with the control group (*P*-value>0.05).

Conclusion: According to the obtained findings, the use of psychological intervention along with AE could lead to a significant change in the symptoms of anxiety and some lipid indices in T2DM women. Also caused a non-significant improvement in glycemic index and can be regarded as a solution for diabetics.

Keywords: ACT, Aerobic training, Anxiety, Lipid profile, Diabetes

Introduction

Diabetes is a non-communicable disease with a silent epidemic and can have a profound effect on a person's individual, social, and psychological functioning (1). Hyperglycemia is caused by impairments in insulin secretion and insulin

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receptor function or both and is associated with hyperglycemia, impaired metabolism of carbohydrates, lipids, proteins, and psychological symptoms (2).

As insulin resistance (IR) is defined as a decrease in the optimal function of muscle cells for glucose uptake in response to insulin secreted by pancreatic beta cells, it is recognized as one of the pathobiological signs of various diseases including type 2 diabetes mellitus (T2DM) (3). Anxiety disorders are one of the psychological consequences in diabetics and play a central role in the development and control of diabetes in patients. Anxiety is a psychological and physiological state that has cognitive, physical, emotional, and behavioral components, and in fact all human beings experience anxiety in their daily lives (4,5).

Aerobic exercise (AE) has beneficial effects on the cardiovascular system and plays a significant role in regulating blood glucose, improving insulin function, improving metabolism of proteins and fats, preventing the complications of diabetes, improving muscle flexibility and strength (6). The results of a study conducted by Ericson et al. revealed that regular exercise training improves the whole-body glucose level by insulin in IR individuals. In addition, failure to engage in regular physical activity may also lead to increased IR (7).

Therefore, considering the possible effect of exercise training on blood glucose and insulin secretion, it seems that one of the factors affecting T2DM is exercise training. In a study by Aliza et al., eight week of aerobic exercise in non-obese men with T2DM improved IR (8). As IR is defined as a decrease in the optimal function of muscle cells for glucose uptake in response to insulin secreted by pancreatic beta cells, this index is recognized as one of the pathobiological signs of various diseases including T2DM (3).

The effect of physical activity on fat metabolism by increasing insulin sensitivity and high density lipoprotein (HDL-c) and reducing Triglyceride and low density lipoprotein (LDL-c) leads to improved fat and glucose metabolism (6,8). One of the third-wave cognitive-behavioral therapies, i.e. Acceptance and Commitment Therapy (ACT), is a therapeutic approach that uses acceptance, mindfulness, commitment, and behavior change processes to create more psychological flexibility (9-11).

According to investigations performed in other studies, it can be stated that many studies have been conducted exclusively in the field of psychological problems and aerobic exercise with a focus on diabetes and other research topics; however, what distinguishes the present study from other similar studies is conduction of a concomitant study combining a therapeutic approach based on acceptance and commitment with aerobic exercise. Furthermore, given that no interdisciplinary study has been conducted in this field, the present study aimed at evaluating the effectiveness of ACT combined with aerobic exercise on anxiety symptoms, insulin resistance, and lipid profile in women with T2DM.

Materials and Methods

This quasi-experimental research consisted of female patients with T2DM, who were referred to the specialized clinic of the Northwestern Petroleum Industry Health Organization (Tabriz). Criteria for entering the study were women undergoing drug treatment for T2DM (They only used metformin), having an age range of 30-60 years, having at least two years of T2DM duration and, having clinical signs of anxiety (Beck Anxiety Test), and receiving no regular exercise trainings over the past 6 months.

The statistical sample included 60 patients that were randomly divided into four groups: psychological interventions based on ACT, aerobic exercise, psychological interventions based on ACT combined with aerobic exercise, and the control group. 12 patients dropped out of the project in the middle of the study for various reasons (No replacement), However, the number of persons in each group

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was not less than the normal size (n=12). The present study employed Beck Anxiety Test (pre- and post-test) and laboratory blood tests (blood glucose, insulin, and lipid profile) that was performed before and after the study. Before conducting the research, a briefing session was held with the presence of all subjects that were informed on the objectives of the study as well as the procedures of holding the counseling sessions and exercise trainings, performing blood tests, and creating a virtual communication channel.

Moreover, the duration, place, and schedule of the research were explained to the subjects. Then, the consent form with respect to participation in the study was completed by the subjects.

The program of psychological interventions was carried out in the form of a treatment workshop based on ACT according to the treatment protocol of the following table (12).

Exercise training program lasted 10 weeks, 3 sessions per week for 40-60 minutes and included warming-up, aerobic exercise, and cooling-down steps. The mentioned program was performed in one of the equipped sports clubs of the National Iranian Gas Company of East Azerbaijan in a suitable atmosphere under the supervision of a sports coach and a general practitioner. Exercise intensity of the aerobic exercise program was designed based on the maximum heart rate; hence, trainings were performed with an intensity of 50-75% of the maximum heart rate (Table 2).

Blood samples were collected and then centrifuged. To measure blood factors, blood serum was stored in a freezer at -70 ° C. Blood glucose level was measured by enzymatic calorimetric method and glucose oxidase technology using a special glucose kit (Pars Azmoon, Tehran, Iran) with the sensitivity of 5 mg/dL. Insulin levels were measured using ELISA kit. IR was calculated by evaluating the homeostasis model based on the equation HOMA-IR = [fasting glucose (mmol/L) × fasting insulin (mU/L)/22.5]. Moreover, total cholesterol, HDL, LDL, and triglyceride were measured using a kit of Pars Azmoon, Iran with the sensitivity of 5 mg/dL. LDL was also calculated based on Friedwald formula LDL = TC-(TG/5+HDL).

Statistical analysis

All statistical analyses were performed using SPSS/Win software, Version 23. Kolmogorov-Smirnov test was used to ensure normal data distribution. The analysis of covariance was used to compare the differences between the groups by controlling the effect of the pretest. Moreover, in case of significant differences between the groups, the Bonferroni post hoc test was used at a significance level of 5%.

Ethical considerations

The present study with the ethical code of IR.IAU.TABRIZ.REC.1398 was approved by the Organizational Ethics Committee for

Table 1. Description of the psychological intervention program

Sessions	Workshop Content
Session 1 - 2	Physiological, behavioral, intellectual, and cognitive symptoms caused by stress, Strategies, and Their management
Session 3 - 4	Awareness of how diabetes occurs, Genetic issues, Medication therapy, and Strategies to treat diabetes
Session 5 - 6	Introduction to interpersonal problems, Causes of interpersonal problems, How to overcome interpersonal problems
Session 7 - 8	Schemas and how they are formed, Identification of early incompatible schemas
Session 9 - 10	Attention to consciousness by practicing the five senses, Meditation
Session 11 - 12	How schemas affect interpersonal relationships with schematic-origin behaviors in three behavioral areas
Session 13	Identification of how the mind works, Practice with metaphors

Table 2. Exercise program details.

Week	Warm-up (minute)	Training (minute)	Cooling (minute)	Total training time	Intensity (HRmax)
1-2	5	30	5	40	55-50%
3-4	5	35	5	45	60-55%
5-6	5	40	5	50	65-60%
7-8	5	25	5	55	70-65%
9-10	5	25	5	60	75-70%

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Biomedical Research on date 2019-5-21. (At the end of the study, exercise and psychological interventions were performed in the volunteer control group).

Results

Descriptive information of the four groups presenting the mean and standard deviation of research variables after psychological interventions and exercise trainings as compared with before the intervention is provided in Table 3 and 4.

The *P*-value corresponding to table 3,4 shows the results of analysis of covariance test with pre-test adjustment in order to compare the post-test mean between groups. Also according to the table above, there is a significant difference between the groups in anxiety, LDL and HDL indices.

ACT approach significantly reduced anxiety symptoms and LDL levels in diabetic women (*P*-value= 0.001). However, ACT did not significantly alter blood glucose, insulin, IR, triglyceride, total cholesterol, and HDL indexes (*P*-value> 0.05).

The results indicated that aerobic exercise also significantly reduced anxiety symptoms (*P*-value =0.001), significantly increased HDL (*P*-value =0.008), and non-significantly decreased LDL (*P*-value =0.06). In addition, aerobic exercise did not significantly change blood glucose, insulin, IR, triglyceride, and total cholesterol indexes (*P*-value> 0.05).

Furthermore, the effect of ACT combined with aerobic exercise significantly increased HDL (*P*-value= 0.035) and significantly reduced anxiety symptoms (*P*-value= 0.001) and LDL index (*P*-value= 0.03). Moreover, ACT combined with aerobic exercise did not significantly change blood glucose, insulin, IR, triglyceride, and total cholesterol indexes (*P*-value >0.05).

Discussion

Findings of the present study with respect to anxiety index revealed that ACT, AE, and ACT combined with AE, as compared to the control group, significantly reduced anxiety symptoms. These results are consistent with the results of some studies such as FARAHI, Keshavarz, and Hor. The findings of FARAHI et al. have shown that the application of ACT

Table 3. The baseline characteristics of patients in intervention and control groups

Groups / Variable	Act mean (±SD)	Ae mean (±SD)	ACT+AE mean (±SD)	Control mean (±SD)	*P*-value
Age	52.33 (±3.94)	50.40 (±7.21)	47.33 (±5.54)	51.45 (±4.03)	0.103
Weight	77.006 (±4.32)	83.27 (±17.06)	81.33 (±14.9)	83.60 (±9.92)	0.607
BMI	31.58 (±78.85)	33.3 (±6.14)	32.90 (±6.24)	32.52 (±6.27)	0.808
Anxiety	22.06 (±78.85)	20.00 (±7.22)	22.08 (±8.36)	19.5 (±3.64)	0.793
Glucose (FBS)	118.86 (±20.86)	115.45(±23.37)	125.00 (±33.52)	110.80 (±28.94)	0.307
Insuline	10.62 (±10.27)	14.63 (±5.69)	12.00 (±4.90)	13.06 (±7.67)	0.435
Homa - Ir	3.33 (±3.3)	4.25 (±2.52)	3.47 (±4.56)	3.88 (±6.10)	0.779
Tryglyceris	148.93 (±54.4)	119.81 (±37.39)	152.58 (±50.14)	123.3 (±43.82)	0.233
Cholestrol	169.13 (±30.11)	178.6 (±36.61)	160.08 (±38.41)	145.8 (±38.31)	0.19
LDL	101.48 (±27.74)	109.64 (±21.38)	104.4 (±27.24)	111.04 (±29.33)	0.345
HDL	39.2 (±7.72)	44.80 (±6.83)	36.08 (±7.63)	37.8 (±6.66)	0.08

Table 4. Comparison of variables in the four groups studied after interventions

Variable	ACT mean (±SD)	AE mean (±SD)	ACT + AE mean (±SD)	Control mean (±SD)	*P*-value
Anxiety	17.46 (±3.75)	16.72 (±4.19)	16.66 (±3.14)	19.7 (±4.29)	0.001*
Glucose (FBS)	113.13 (±10.82)	109.18 (±15.72)	113.27 (±16.50)	112.10 (±11.17)	.858
Insuline	9.54 (±5.02)	9.38 (±4.10)	9.54 (±4.86)	13.75 (±6.85)	0.171
HOMA - IR	2.63 (±1.23)	3.08 (±1.37)	2.57 (±1.17)	3.76 (±1.77)	0.182
Tryglyceris	161.06 (±63.81)	129.00 (±39.03)	143.08 (±45.89)	138.7 (±75.02)	0.683
Cholestrol	158.4 (±9.38)	178.63(±38.92)	159.41 (±26.74)	157.5 (±43.82)	0.341
LDL	85.81 (±20.27)	98.35 (±9.42)	94.15 (±12.15)	112.8 (±29.48)	0.016*
HDL	41.8 (±9.32)	46.72 (±9.42)	41.75 (±7.61)	36.6 (±5.92)	0.044*

* Significant differences between groups (*P*-value ≤ 0.05).

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can be used as an effective psychological intervention in the quality of life of patients with T2DM (13,14). Hor pointed to the significance of the results in their study and stated that the effect of treatment was maintained on the psychological health of t2dm patients at follow-ups (15).

Khanjani et al. in their research on the relationship between anxiety and blood cholesterol stated that the symptoms of disease phobia, obsessive compulsive disorder, and anxiety in individuals with high cholesterol were more than those with low cholesterol. Therefore, the findings suggested that high cholesterol levels may be associated with symptoms of anxiety and stress (16). The findings of the present study confirmed that the symptoms of anxiety caused an increase in cholesterol levels, so it is consistent with the findings of the mentioned study that the reduction of anxiety symptoms caused a decrease in cholesterol levels although this finding was restricted to clinical and laboratory observations. Nazari and et al. concluded that 12 weeks of training reduced cortisol and improved stress and anxiety in these patients (17).

According to conducted studies, it can be stated that one of the most important problems of patients with T2DM is the existence of anxiety and defects in their mental health function due to problems caused by this disease. ACT has assisted these patients become more in contact with the present moment and their present life experiences and to get rid of the thought that T2DM may have a major impact on their future. In addition, this approach has a cognitive-behavioral aspect and can be an effective way to improve the mental health of patients with T2DM. In this respect, the role of activity and aerobic exercise is highlighted according to conducted studies because exercise is able to decrease anxiety and help to treat diabetes. Moreover, the findings of the present study on lipid profile and blood glucose level have revealed that although ACT approach and AE did not have a significant effect on lowering blood glucose, TG, cholesterol, insulin, and IR, they clinically had noticeable and positive changes in the recovery process of patients with T2DM, as compared with the control group. In addition, the ACT and AE had a significant reducing effect on LDL and increasing effect on HDL, respectively. Furthermore, the combined effect had a significant effect on reducing LDL and increasing HDL.

Nasiri et al. in their studies concluded that blood glucose and IR decreased significantly after 8 weeks of combined training; however, insulin levels did not change significantly (18). The results of Tofighi and Babaei indicated that a 12-week period of aerobic exercise decreased the serum lipids of the subjects, and participation in these trainings resulted in a significant positive change in the levels of HDL-C, LDL-C, TC, and TG (19).

It should be mentioned that exercise plays a key role in preventing and controlling IR, pre-diabetic conditions, gestational diabetes, T2DM, and diabetes-related health problems. AE improves insulin function and is effective in managing blood glucose, blood lipids, blood pressure, and quality of life. However, it should be noted that exercise must be performed regularly and continuously in order to enjoy the mentioned benefits (20). The limitation of the present study was the lack of full participation of all individuals until the end of the study. Moreover another limitations was the lack of precise control of the subjects' nutrition and their daily activities.

Conclusions

Overall, each of the methods proposed in the study can be positively effective in reducing psychological and physical symptoms; however, it seems that the combined effect of the two methods in terms of statistical and clinical observations can have additional effects on the trend of decreasing diabetes and its side effects.

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Conflict of Interest

The authors have not any conflict of interest.

References

1. Firouzkouhi M, Abdollahimohammad A, Babaeepur M, Maghroun A, Mir E. The Relationship Between Worry Domains and Quality of Life in Patients with Type II Diabetes. Journal of Diabetes Nursing. 2016;4(4):21-9.(in Persian)
2. Innes KE, Selfe TK. Yoga for adults with type 2 diabetes: a systematic review of controlled trials. Journal of diabetes research. 2016;2016.
3. Yue P, Jin H, Aillaud M, Deng AC, Azuma J, Asagami T, et al. Apelin is necessary for the maintenance of insulin sensitivity. American journal of physiology-endocrinology and metabolism. 2010;298(1):E59-67.
4. Rajput R, Gehlawat P, Gehlan D, Gupta R, Rajput M. Prevalence and predictors of depression and anxiety in patients of diabetes mellitus in a tertiary care center. Indian journal of endocrinology and metabolism. 2016;20(6):746.
5. Singh SK, Gorey KM. Relative effectiveness of mindfulness and cognitive behavioral interventions for anxiety disorders: meta-analytic review. Social Work in Mental Health. 2018;16(2):238-51.
6. Daryanoosh F, Shkibaie M, Zamanie A, Mohammadi M. Effect of aerobic exercise and alpha lipoic acid supplement on insulin resistance in females with type 2 diabetes. Journal of Gorgan University of Medical Sciences. 2015;17(3).(in Persian)
7. Eriksson J, Tuominen J, Valle T, Sundberg S, Sovijärvi A, Lindholm H, et al. Aerobic endurance exercise or circuit-type resistance training for individuals with impaired glucose tolerance?. Hormone and Metabolic Research. 1998;30(01):37-41.
8. Alizadeh AA, Rahmani-Nia F, Mohebbi H, Zakerkish M. Effects of eight weeks aerobic exercise on plasma levels of orexin a, leptin, glucose, insulin, and insulin resistance in males with type 2 diabetes. Iranian Journal of Diabetes and Obesity. 2015;7(2):62-8.
9. Livheim F, Hayes L, Ghaderi A, Magnusdottir T, Högfeldt A, Rowse J, et al. The effectiveness of acceptance and commitment therapy for adolescent mental health: Swedish and Australian pilot outcomes. Journal of Child and Family Studies. 2015;24(4):1016-30.
10. Symanzik T, Lohaus A, Job AK, Chodura S, Konrad K, Heinrichs N, et al. Stability and change of attachment disorder symptoms and interpersonal problems in foster children. Mental Health & Prevention. 2019;13:35-42.
11. Frazier LD. The past, present, and future of the biopsychosocial model: A review of The Biopsychosocial Model of Health and Disease: New philosophical and scientific developments by Derek Bolton and Grant Gillett. New Ideas in Psychology. 2020;57:100755.
12. Fiese BH, Celano ME, Deater-Deckard KE, Jouriles EN, Whisman MA. APA handbook of contemporary family psychology: Foundations, methods, and contemporary issues across the lifespan, Vol. 1. American Psychological Association; 2019.
13. Farahi S, Khalatbari J. Effectiveness of Acceptance and Commitment Therapy on the Life Expectancy, Resilience and Death Anxiety in Women with Cancer. International Journal of Applied Behavioral Sciences. 2019;6(3):9-19.(in Persian).
14. Keshavarzade AH, Rafei Z, Mirzae A. The effectiveness of Acceptance and Commitment Therapy (ACT) on general anxiety.2018;17(3)289-296.(in Persian)
15. Hor M, Manshaee GR. Effectiveness of acceptance and commitment therapy on mental health of the patients with type 2 diabetes in the city of Isfahan. Iranian Journal of Diabetes and Metabolism. 2017;16(6):309-16.
16. Khanjanee Z, Poursharifie H, Mashinchi Abbassi N & Hashemi T. Serum Cholesterol Levels and Anxiety Diorders. Health Psychology.2013;2(2):62-78.(in Persian)
17. Nasiri S, Banitalebi E, Rabiei V. Study of blood sugar and lipid profile changes after eight weeks of combined training in women with type 2 diabetes. Journal of Jiroft University of Medical Sciences. 2017;4(1):114-24.(in Persian)
18. Nazary Gilannejad T, Gaeini AA, Foroughi Pordanjani A, Omidi N. Comparing the Effect of 12 Weeks of Hatha Yoga and Aerobic Exercise on Serum Cortisol Values, Stress, Anxiety and Depression in Women with Diabetes Type 2. Razi Journal of Medical Sciences. 2017;24(157):81-9. (in Persian)
19. Tofigi A, BaBai S. The effect of 12 weeks aerobic exercise training on depression indices and lipid profiles in obese women. Journal of Urmia Nursing and Midwifery Faculty. 2015;13(2):154-62.(in Persian).

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[DOI: 10.18502/ijdo.v13i1.5748]

20. Saremi A. Sporting exercises and diabetes mellitus type 2: a review on evidences.2011;2(3)171-181.(in Persian)

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[DOI: 10.18502/ijdo.v13i1.5748]