

THE EFFECT OF A 6-MONTHS MODERATE-INTENSITY WALKING EXERCISE PROGRAM ON MENTAL HEALTH, QUALITY OF LIFE, AND SLEEP SUBJECTIVE QUALITY IN NON - ACTIVE ELDERLY PEOPLE WITH TYPE 2 DIABETESVahid Bakhshalipour¹Bisotoon Azizi²Siavash Khodaparast Sareshkeh³**ABSTRACT**

Type 2 diabetes is a common, costly, and chronic disease that people with this disease have a lower level of health than other people. The purpose of this study was to examine the effect of a 6-months moderate-intensity walking exercise program on mental health, quality of life, and sleep subjective quality in non - active elderly people with type 2 diabetes. The method of this study was semi empirical with a design of pre-test-post-test with the control group. Forty subjects were purposely selected by the convenience sampling. Three standard questionnaires with a high validity and validity and an appropriate training protocol were used for a period of six months. The collected data were analyzed by Pearson correlation coefficient and One Way ANOVA. The results showed that there was no significant difference between variables before the intervention ($P>0.05$), but that there was a significant difference between the control and experimental groups after the intervention ($p<0.05$). The regular aerobic exercise can be an example of promotion programs for mental health in type 2 diabetic patients and it can be effective in the improvement of the quality of life and sleep subjective quality and in the reduction of the amount of glucose in the elderly people.

Key words: Walking. Mental health. Quality of life. Sleep subjective quality. Non-active elderly people. Type 2 diabetes.

1-Sama technical and vocational training college, Islamic Azad University, Lahijan Branch, Siyahkal, Iran.

2-Department of Physical Education, Piranshahr Branch, Islamic Azad University, Piranshahr, Iran.

3-Department of Physical Education and Sport Science, Lahijan Branch, Islamic Azad University, Guilan, Lahijan, Iran.

RESUMO

O efeito de um programa de caminhada de seis meses com intensidade moderada na saúde mental, qualidade de vida e qualidade subjetiva do sono em idosos não ativos com diabetes tipo 2

Diabetes tipo 2 é uma doença comum, cara e crônica e as pessoas com esta doença têm um nível de saúde inferior ao de outras pessoas. O objetivo deste estudo foi examinar o efeito de um programa de exercício de caminhada moderada, durante seis meses, sobre a saúde mental, qualidade de vida e qualidade subjetiva do sono em idosos não ativos com diabetes tipo 2. O método deste estudo foi semi-empírico com um desenho de pré-teste-pós-teste com o grupo controle. Quarenta sujeitos foram propositalmente selecionados pela amostra de conveniência. Três questionários padrão com alta validade e um protocolo de treinamento apropriado foram utilizados por um período de seis meses. Os dados coletados foram analisados pelo coeficiente de correlação de Pearson e One Way ANOVA. Os resultados mostraram que não houve diferença significativa entre as variáveis antes da intervenção ($P> 0,05$), mas que houve diferença significativa entre os grupos controle e experimental após a intervenção ($p <0,05$). O exercício aeróbico regular pode ser um exemplo de programas de promoção da saúde mental em diabéticos tipo 2 e pode ser efetivo na melhora da qualidade de vida e qualidade subjetiva do sono e na redução da quantidade de glicose em idosos.

Palavras-chave: Caminhada. Saúde mental. Qualidade de vida. Durma qualidade subjetiva. Idosos não ativos. Diabetes tipo 2.

E-mails:

vahidbakhshalipour@yahoo.com

bistonazizi@gmail.com

INTRODUCTION

Type 2 diabetes is a chronic disease that is rapidly growing in the world. Environmental and genetic factors such as lack of exercise, type of diet, family history, insulin resistance, and dysfunction of beta cells are involved in the development of disease (Peters and collaborators, 2013).

It is a common and costly disease that affects more than 230 million people around the world despite the ability for its control (Keykha and collaborators, 2013).

These figures are a serious warning for the field of health communities. People with type 2 diabetes have a poor ability to control their blood glucose and insulin resistance with high blood pressure, high blood lipid, and atherosclerosis. So, the blood glucose control is the primary goal and the blood lipid control is the second goal in patients with diabetes (Waryasz, 2010).

Researchers believe that the prevalence of type 2 diabetes in recent decades is due to the reduction of physical activities and the excessive obesity in people (Gill and Cooper, 2008; LeMura and Von Duvillard, 2004; Sharma and Knowlden, 2012).

People with type 2 diabetes have a lower level of health than other people (Gram and collaborators, 2010). People with type 2 diabetes have emotional problems, including anxiety, aggression, and depression in addition to physical problems (Mehtiyev, 2012). A human's mental health is one of the important dimensions of individuals' health that plays an important and critical role in the assurance and efficiency of each community (Hadipour and collaborators, 2014).

It should be accepted that the human's mental health section is one of the most important areas for sustainable development of health in human societies that is directly related to human's health and has a major responsibility to maintain and improve health in the human community (Kawano, 2008). A look at the complications of type 2 diabetes and individuals' poor mental health in recent years and its negative effects, especially on mental health (Lincoln and collaborators, 2011; Maller and collaborators, 2006; Nilsson and collaborators, 2011) require a high effective and efficient method for the prevention and the treatment of type 2 diabetes and the increase of mental health level in people with type 2

diabetes (Ahmadi and collaborators, 2006; Larijani, 2010).

Exercise is one of the most health good habits or health promotion behaviors that has positive effects on human's health and quality of life and it can reduce the risk of psychological and physical disorders and increases individuals' mental health (Fuentes and Díaz, 2010; Hoyt, 2012).

On the other hand, we must accept that type 2 diabetes reduces individuals' quality of life in all dimensions of life (Ahmadi and collaborators, 2012). Quality of life is considered as an essential indicator of health. Since quality of life includes many dimensions such as individuals' physical health, mental health, social communication, family life, emotions, physical functions, spirituality, and job life, so its importance is twofold (Figueira, 2009).

A regular exercise program is one of the important and effective mechanisms that researchers recommend it (Shahrjerdi and collaborators, 2010) to improve mental health and quality of life (Morgan and collaborators, 2013; Yavari, 2012).

Sleep disorders is one of the complications that people with type 2 diabetes experience it and report about it. A poor quality sleep has harmful effects on health (Hung and collaborators, 2013). A high Sleep quality has a restorative and protective role for psychological and neurological functions. Also, sleep is one of the most important processes of circadian cycles that plays a significant role in individuals' health and involves in the reconstruction of physical and emotional forces (Faraut and collaborators, 2012; Iwata and collaborators, 2011).

It has been observed in these surveys that the increase or decrease in the duration of nighttime sleep was associated with an increase in the prevalence of diabetes or an inappropriate control of glucose in patients with diabetes (Nakajima and collaborators, 2008). A poor sleep quality has a negative effect on insulin and it is an effective predictor in the development of type 2 diabetes (McNeil and collaborators, 2013).

The disturbance in elderly individuals' sleep quality and quantity can lead to negative outcomes, including fatigue, excessive daytime sleepiness, daily dysfunction, emotional and mental disorders, and the reduction of quality

of life (Crowley, 2011; Irwin and collaborators, 2008; Yang and collaborators, 2012).

On the other hand, studies show that variables of sleep quality and quality of life affect each other (Seferoğlu and collaborators, 2013). We can increase sleep quality in type 2 diabetic patients through the creation of health interventions (Cooper and collaborators, 2015).

Also, individuals' psychological characteristics such as depression symptoms have a significant effect on the reduction of sleep quality that it indicates the relationship between sleep quality and mental health in patients with diabetes (Chia and collaborators, 2011). The regular exercise can be an option for non-pharmacological treatment of metabolic dysfunction and sleep disorders, especially in older individuals (Lira and collaborators, 2011a; Passos and collaborators, 2010; Santos and collaborators, 2007) that we should consider the intensity, volume, and duration of exercise in these individuals (Lang and collaborators, 2013; Petersen and Pedersen, 2005).

The creation of an appropriate and free intervention to prevent and treat type 2 diabetes and increase the level of mental health, quality of life, and sleep subjective quality in patients with diabetes seems necessary due to the increase of type 2 diabetes in people and many problems that this disease creates for patients with this disease. We can prevent the waste of time and money with a proper planning and take a positive step in the treatment of this disease.

Therefore, the purpose of this study was to examine the effect of a 6-months moderate-intensity walking exercise program on mental health, quality of life, and sleep subjective quality in non-active elderly people with type 2 diabetes.

MATERIALS AND METHODS

The method of research was semi empirical and applied that has been conducted through field method with a design of pre-test, post-test with the control group.

Participants

The statistical population of this study was non-athlete women and men (45-65 years old). Forty subjects were purposely selected by the convenience sampling. the main condition

for the entry in this research were the disease of Type 2 diabetes according to doctor's diagnosis and medical records, the use of metformin 500 mg or Glibenclamide 5 mg, no history of cardiovascular disease, the lack of physical activity during the last year, the lack of use of insulin to reduce blood glucose, poor sleep quality, poor mental health, and poor quality of life.

Instruments and tasks

The instrument of this study was Pittsburgh's Sleep Quality Index (PSQI), Quality of Life Questionnaire (SF-36), and Goldberg's General Health Questionnaire-28 (GHQ-28). Pittsburgh's Sleep Quality Index has seven subscales and the sum of scores of the 7 subscales forms the total score that it is from 0 to 21. A total score of six or more means poor sleep quality. The coefficient of validity of this questionnaire has been approved by numerous researchers in many countries.

The aim of quality of life Questionnaire is to assess physical and psychological health that is obtained by the combination of the eight components scores of health. This questionnaire has 36 questions that assess eight different areas. The scoring method of this test is that the lowest score is zero and the highest score is 100 points in this questionnaire. The score of each dimension is determined by the score of the titles in that dimension. Goldberg's General Health Questionnaire-28 (GHQ-28) measures four components of non-psychiatric disorders such as somatic symptoms, anxiety and sleep disorders, social dysfunction, and depression.

Likert's scoring method was used for each component on the basis of 0-3. The scoring criteria is the severity of the evaluated symptoms and the higher score indicates the severity of the symptoms. Accordingly, a person with a score of 23 and lower is considered as a healthy and a person with a score of 24 and higher is suspected to have a disorder.

Procedure

All subjects were randomly divided into 4 groups (experimental groups: 10 women and 10 men) and (a control group: 10 women and 10 men). All groups of this study were

homogenized in terms of demographic indicators. All subjects were asked to complete mental health, quality of life, and sleep subjective quality questionnaires in this study. All subjects were asked to complete these questionnaires again for the statistical analysis at the end of the training protocol.

Training protocol

The training protocol included an aerobic training program for 24 weeks and 3 sessions a week. The subjects' program execution started in the first week with an intensity of 40-45% of the maximum heart rate and lasted for 25 minutes and it was performed with an intensity of 70-80% of the maximum heart rate for 45 minutes in the fourth week. This intensity continued until the end of the training week (5 minutes to the time of training and 5% to the intensity of training were added every week).

Each training session was included 15 minutes of warm-up with kinds of running, stretching movements, and 45 minutes of walking. The cooling was performed by stretching movements for 10 minutes at the end of each session. The maximum heart rate was calculated from the formula (age - 220) and each person's training heart rate was calculated using the maximum heart rate and rest heart rate of the Caroni's method.

Subjects were asked to walk 1600 meters after the warm-up. The subjects' heart

rate was monitored during the test by the Polar heart rate meter and the time was recorded with a stopwatch. The researchers controlled the intensity of the training through heart rate for each subject at each step of the training and if it was necessary, they increased or decreased the intensity of the training and provided the required feedback for subjects.

Data analysis

The collected data were classified by descriptive statistical methods and were analyzed by Pearson correlation coefficient and One Way ANOVA. The SPSS software (version 21) was used for data analysis ($\alpha \leq 0.05$).

RESULTS

The subjects' mean of age was 58 ± 4.1 years. There was no significant difference between four groups in the variables of quality of life, mental health, and sleep subjective quality before the intervention (table 1).

Women with type 2 diabetes had a better condition in quality of life, depression, somatic symptoms, and mental health after the intervention ($p < 0.001$). Also, the scores mean of experimental and control groups in men with type 2 diabetes showed a significant difference in the variables of mental health, quality of life, and sleep subjective quality ($p < 0.00$, table 2).

Table 1 - The results of one-way ANOVA in four groups before the intervention.

Variable	Source of changes	Sum of squares	df	Mean Square	ANOVA
Depression	Between group	1.31	3	0.11	0.14
	Within group	35.41	40	0.72	
Somatic symptoms	Between group	15.27	3	5.11	2.49
	Within group	81.00	40	2.00	
Social dysfunction	Between group	6.14	3	2.11	0.66
	Within group	51.79	40	1.18	
Anxiety	Between group	3.57	3	1.17	1.06
	Within group	46.89	40	1.07	
Mental health (total)	Between group	28.00	3	9.59	1.09
	Within group	381.00	40	8.69	
Quality of life	Between group	30.00	3	9.19	0.32
	Within group	215.00	40	7.14	
Sleep subjective quality	Between group	1.69	3	0.21	0.31
	Within group	30.00	40	0.69	

Table 2 - The comparison of the score mean of variables in the experimental and control groups after the intervention in terms of gender.

Variable	Gender	Group	Score mean	T-test	P
Depression	Women	Experimental	4.9 ± 1.2	17.21	0.01
		Control	14.2 ± 1.1		
	Men	Experimental	11.0 ± 1.1	15.83	0.01
		Control	14.7 ± 0.9		
Somatic symptoms	Women	Experimental	6.1 ± 2.1	8.29	0.01
		Control	13.5 ± 1.9		
	Men	Experimental	7.2 ± 3.1	13.72	0.01
		Control	13.9 ± 1.6		
Social dysfunction	Women	Experimental	8.1 ± 1.7	11.22	No significant
		Control	13.1 ± 2.2		
	Men	Experimental	13.3 ± 2.3	10.19	0.01
		Control	14.1 ± 1.2		
Anxiety	Women	Experimental	6.0 ± 3.1	10	0.01
		Control	13.0 ± 1.1		
	Men	Experimental	13.0 ± 1.7	18.57	No significant
		Control	1.9 ± 13.8		
Mental health (total)	Women	Experimental	18.0 ± 9.0	7.01	0.01
		Control	41.0 ± 3.1		
	Men	Experimental	29.4 ± 6.1	11.92	0.01
		Control	41.8 ± 2.3		
Quality of life	Women	Experimental	69.2 ± 8.1	6.25	0.01
		Control	57.2 ± 6.1		
	Men	Experimental	91.3 ± 13.5	6.19	0.01
		Control	72.2 ± 9.7		
Sleep subjective quality	Women	Experimental	4.2 ± 1.9	4.7	0.01
		Control	9.8 ± 1.2		
	Men	Experimental	5.3 ± 1.2	3.6	0.01
		Control	8.3 ± 1.2		

DISCUSSION AND CONCLUSION

The purpose of this study was to examine the effect of a 6-months moderate-intensity walking exercise program on mental health, quality of life, and sleep subjective quality in non - active elderly people with type 2 diabetes. Over the past years, physical activity has always been recognized as the core of healthy behaviors and has been associated with a reduction of chronic lifestyle-related illnesses (Micklesfield and collaborators, 2003).

According to the United States Department of Health and Human Services, regular physical activity as a non-pharmacological and effective intervention has many psychological and psychological benefits that it can be effective in the improvement of blood glucose levels in people with type 2 diabetes and increases the level of mental health and quality of life in these individuals (Van der Heijden and collaborators, 2013).

Today, the basic principles of type 2 diabetes control are the knowledge and awareness (Lincoln and collaborators, 2011),

the control of complications of diabetes (McNeil and collaborators, 2013), diet (Terada and collaborators, 2013), and the medicine and physical activity that it increases the low cost and non-pharmacological nature of physical activity and its therapeutic value (Sebbani and collaborators, 2012).

There is a belief in the scientific community that a regular physical activity plays an important role in the management of type 2 diabetes, especially glycemic control (Terada and collaborators, 2013), the increase of insulin sensitivity (Reid and collaborators, 2010), the reduction of body fat (Shamsi and collaborators, 2010), blood pressure (Lira and collaborators, 2011b), changes in fat profile, and the prevention of advanced risk factors for cardiovascular diseases and it reduces significantly glycated hemoglobin and blood glucose (Ahmadi and collaborators, 2012) and reduces hyperlipidemia (Yavari and collaborators, 2012) and increases psychological benefits for a patient and improves the level of anxiety and mental health in people with type 2 diabetes (Hayes and collaborators, 2008).

There was a significant difference between the experimental and control groups in this study. The results of this study showed that a 6-months moderate-intensity walking exercise program could improve the levels of mental health, quality of life and sleep subjective quality in non - active elderly people with type 2 diabetes. In this regard, various studies have also confirmed the effectiveness of an exercise program on the variables of the present study (Harrison and collaborators, 2012; Hoyt and collaborators, 2012; Lira and collaborators, 2011a; Morgan and collaborators, 2013).

The results of this study are consistent with the results of Sardar and collaborators (2010) study. They examined the effect of aerobic exercise training on mental health and quality of life in patients with type 2 diabetes mellitus. The results of their study showed that the aerobic exercise training had a positive effect on mental health and quality of life in patients with type 2 diabetes (Sardar and collaborators, 2010). Also, the results of this study showed that a regular exercise program can reduce physical problems and anxiety and improve the levels of mental health, quality of life, and sleep subjective quality in people with type 2 diabetes.

This result is consistent with the results of Schuch and collaborators (2011) study. The effectiveness of a regular exercise program on the level of mental health, quality of life, and sleep subjective quality in people with type 2 diabetes is so clear that sports activities can increase physical fitness and abilities through a proper and principled training protocol and increase the sense of self-efficacy and self-esteem in people with type 2 diabetes (Chia and collaborators, 2011; Santos and collaborators, 2007; Stroth and collaborators, 2010).

Physical activities create biological and biochemical changes and improve mental health and this leads to improve the quality of life and reduce individuals' anxiety before bed and thus improves individuals' sleep subjective quality (Dua and collaborators, 2010; Passos and collaborators, 2010). The theory of endorphin production and secretion can be one of possible mechanisms of exercise effectiveness on mental health that exercise and regular physical training brain affects the mood and cognitive and emotional functions of the brain with the effectiveness on the

secretion of endorphins, norepinephrine, catecholamines, serotonin, and other neurotransmitters of the brain (Lincoln and collaborators, 2011; Schuch and collaborators, 2011).

Shahrjerdi and collaborators (2010) examined the effect of an aerobic program on mental health and quality of life in 18 subjects with type 2 diabetes for eight weeks. The results showed that exercise was effective and this result was consistent with the results of this study (Gilcrest and Mayo, 2004). The research findings in the University of Pennsylvania (2007) and the results of Gilcrest and Mayo's (2004) study emphasized the effectiveness of an exercise program on the mental health and quality of life in men with type 2 diabetes mellitus that this result was consistent with the results of the present study (Gilcrest and Mayo, 2004).

The regular exercise is one of these mechanisms for the improvement of sleep subjective quality (Wang and Youngstedt, 2014). The regular exercise is an effective strategy to cope with sleep disorders, obesity, and diabetes (Kathryn, 2011). The results of this study were consistent with the results of Erlacher and collaborators (2014) that they examined the effects of exercise on sleep in adults with sleep chronic problems (Erlacher and collaborators, 2014). Another study was conducted with this variable and was consistent with the results of this study. The results indicated that eight weeks of walking had a significant effect on sleep quality in elderly people and some metabolic indicators (Passos and collaborators, 2010).

Also, Schuch and collaborators (2011) studied a moderate exercise training for 60 minutes/day, 3 days/week for 24 wk at a work rate equivalent to the ventilatory aerobic threshold in fourteen male sedentary, healthy, elderly volunteers. The results showed that sleep quality, insulin resistance, and metabolic problems improved and this result was consistent with the present study (Lira and collaborators, 2011b).

The scientific data from this study and other studies show this fact that may the effect of aerobic training on the improvement individuals' mental health with type 2 diabetes may be related to the effect of aerobic exercise on the structure and muscle biochemistry and maximum oxygen consumption and desired changes (such as the increase of oxidative

enzyme and capillary density) and thus it improves the process of glucose transport and decreases the insulin resistance of cells. Physical activity is associated with mental health and quality of life such as mood, anxiety and depression, self-perception, and mental health, so the increase of planning on physical activity leads to improve the level of quality of these indicators.

On the other hand, it seems that the melatonin hormone that plays an important role in sleep is affected by the level and concentration of the secretion of this hormone from physical activities and it affects the pineal gland in the short term and increases the level of 6-sulfatoxymelatonin (a result of the metabolism of melatonin). It should also be noted that physical activity increases fatigue and provides some degree of relaxation for a person's sleep that it may lead to increase sleep subjective quality in people with diabetes type 2.

Overall, the findings of this study showed that a 6-months moderate-intensity walking exercise program could increase the level of mental health, quality of life, and sleep subjective quality in non - active elderly people with type 2 diabetes.

REFERENCES

- 1-Ahmadi, A.; Hasanzade, J.; Rahimi M. M., Lashkari, L. Factors influencing quality of life in patients with type 2 diabetes and Bakhtiari province. *North Khorasan Uni J Med Sci*. Vol. 3. Num. 1. p.13-17. 2012.
- 2-Ahmadi, E.; Shikh Alizadeh, S.; Shirmohamadzadeh, M. Experimental study of the effect of exercise on mental health of students. *Tabriz University of Teacher Education*. Vol. 29. p.19-29. 2006.
- 3-Chia, Y.; Tung, P.; Chin, L.; Chang, M. Sleep quality among community-dwelling elderly people and its demographic, mental, and physical correlates. *Journal of the Chinese Medical Association*. Vol. 75. Num. 2. p. 75-80. 2011.
- 4-Cooper, A.J.M.; Westgate, K.; Bragea, S.; Prevost, A. T.; Griffin, S.J.; Simmons, R.K. Sleep duration and cardio metabolic risk factors among individuals with type 2 diabetes. *Sleep Medicine*. p. 119-125. 2015.
- 5-Crowley, K. Sleep and sleep disorders in older adults. *Neuropsychol. Rev*. Vol. 21. Num. 1. p. 41-53. 2011.
- 6-Dua, J.S.; Cooper, A.R.; Fox, K.R.; Graham, S. A. Exercise training in adults with congenital heart disease: Feasibility and benefits. *Int J Cardiol*. Vol. 138. Num. 2. p. 196-205. 2010.
- 7-Erlacher, C.; Erlacher, D.; Schredl, M. The effect of exercise on self-rated sleep among adults with chronic sleep complaints. *Journal of Sport and Health Science*. p. 1-10. 2014.
- 8-Figueira, H.A.; Giani, T.S.; Beresford, H.; Ferreira, M.A.; Mello, D.; Figueira, A.A.; Figueira, J.A.; Dantas, E.H. Quality of life (QOL) axiological profile of the elderly population served by the Family Health Program (FHP) in Brazil. *Arch Gerontol Geriat*. Vol. 49. Num. 3. p. 368-372. 2009.
- 9-Faraut, B.; Boudjeltia, K.Z.; Vanhamme, L.; Kerkhofs, M. Immune, inflammatory and cardiovascular consequences of Sleep restriction and recovery. *Sleep Med Rev*. Vol. 16. Num. 2. p. 137-149. 2012.
- 10-Fuentes, J.; Díaz, C. Analysis of heart rate during a tennis training session and its relationship with heart-healthy index. *J Sport Health Res*. Vol. 2. Num. 1. p. 26-34. 2010.
- 11-Gilcrest, D.M.; Mayo, K. Type 2 Diabetes, Health Disparities and Exercise: A Review of the Literature. *Journal of Multicultural Nursing & Health*. Vol. 10. Num. 2. p. 62. 2004.
- 12-Gill, J.M.; Cooper, A.R. Physical activity and prevention of type 2 diabetes mellitus. *Sports Medicine*. Vol. 38. Num. 10. p. 807-824. 2008.
- 13-Gram, B.; Christensen, R.; Christiansen, C.; Gram, J. Effects of nordic walking and exercise in type 2 diabetes mellitus: A randomized controlled trial. *Clin J Sport Med*. Vol. 20. Num. 5. p.355-361. 2010.
- 14-Hadipour, M.; Abolhasani, F.; Molavi Vardanjani, H.; Eyboosh, S. Individual and environmental determinants of health related quality of life in Iranian patients with type II diabetes. *Iran South Med J*. Vol. 16. Num. 6. p. 428-435. 2014.

- 15-Hayes, C.; Herbert, M.; Marrero, D.; Martins, C.; Muchnick, S. Diabetes and exercise. *Diabetes Educ.* Vol. 34. Num. 1. p. 37-40. 2008.
- 16-Harrison, C.L.; Stepto, N.K.; Hutchison, S.K.; Teede, H.J. Impact of intensified exercise training on insulin resistance and fitness in obese women with and without polycystic ovary syndrome. *Clin Endocrinol (Oxf)*. Vol. 76. Num. 3. p. 351-357. 2012.
- 17-Hoyt, L.T.; Chase-Lansdale, P.L.; McDade, T.W.; Adam, E.K. Positive youth, healthy adults: Does positive well-being in adolescence predict better perceived health and fewer risky health behaviors in young adulthood? *J Adolesc Health*. Vol. 50. Num. 1. p. 66-73. 2012.
- 18-Hung, H.C.; Yang, Y.C.; Ou, H.Y.; Wu, J.S.; Lu, F.H.; Chang, C.J. The relationship between impaired fasting glucose and self-reported sleep quality in a Chinese population. *Clin Endocrinol (Oxf)*. Vol. 78. p. 24-51. 2013.
- 19-Irwin, M.R.; Olmstead, R.; Motivala, S.J. Improving sleep quality in older adults with moderate sleep complaints: a randomized controlled trial of Tai Chi Chih. *Sleep*. Vol. 31. Num. 7. p. 1001-1008. 2008.
- 20-Iwata, S.; Iwata, O.; Iemura, A.; Iwasaki, M.; Matsuishi, T. Determinants of sleep patterns in healthy Japanese 5-year-old children. *Int J Dev Neurosci*. Vol. 29. Num. 1. p. 57-62. 2011.
- 21-Kathryn, J. Aerobic exercise improves self-reported sleep and quality of life in older adults with insomnia. *Sleep Med.* available in PMC 2011. 2011.
- 22-Kawano, Y. Association of job-related stress factors with psychological & somatic symptoms among Japanese hospital nurses: effect of departmental environment in acute care hospitals. *J Occup Health*. Vol. 50. Num. 1. p. 85-79. 2008.
- 23-Keykha, M.; Janghorbani, M.; Amini, M. The prevalence of type 2 diabetes, metabolic syndrome and cardiovascular risk factors Pshdyabt and their first-degree relatives of patients with type 2 diabetes. *J Kerman Uni Med Sci*. Vol. 20. Num. 2. p. 115-128. 2013.
- 24-Lang, C.; Brand, S.; Feldmeth, A.K.; Holsboer-Trachsler, E.; Pühse, U.; Gerber, M. Gerber Increased self-reported and objectively assessed physical activity predict sleep quality among adolescents. *Physiology & Behavior*. Vol. 120. p. 46-53. 2013.
- 25-Larijani, B. Diabetes and exercise. Tehran, Iran: Institute of Endocrinology and Metabolism. p. 4-15. 2010.
- 26-LeMura, L.M.; Von Duvillard, S.P. Clinical exercise physiology: application and physiological principles. Philadelphia, PA: Lippincott Williams and Wilkins.
- 27-Lincoln, A.K.; Shepherd, A.; Johnson, P.L.; Castaneda-Sceppa, C. The impact of resistance exercise training on the mental health of older Puerto Rican adults with type 2 diabetes. *J Gerontol Series B Psychol Sci Soc Sci*. Vol. 66. Num. 5. p. 567-570. 2011.
- 28-Lira, F.S.; Pimentel, G.D.; Santos, R.V.; Oyama, L.M.; Damaso, A.R.; Oller do Nascimento, C.M.; Viana, V.A.; Boscolo, R.A.; Grassmann, V.; Santana, M.G.; Esteves, A.M.; Tufik, S.; de Mello, M.T. Exercise training improves sleep pattern and metabolic profile in elderly people in a time-dependent manner. *Health and Disease*. Vol. 10. p. 1-6. 2011a.
- 29-Lira, F.S.; Rosa, J.C.; Dos Santos, R.V.; Venancio, D.P.; Carnier, J.; Sanches Pde, L.; Nascimento, C.M.; de Piano, A.; Tock, L.; Tufik, S.; de Mello, M.T.; Dâmaso, A.R.; Oyama, L.M. Visceral fat decreased by long-term interdisciplinary lifestyle therapy correlated positively with interleukin-6 and tumor necrosis factor-alpha and negatively with adiponectin levels in obese adolescents. *Metabolism*. Vol. 60. p.359-365. 2011b.
- 30-Maller, C.; Townsend, M.; Pryor, A.; Brown, P.; Leger, L. Healthy nature healthy people: contact with nature' as an upstream health promotion intervention for populations. *Health Promot. Int.* Vol. 21. p. 45-54. 2006.
- 31-Mehtiyev, T. Stress, anxiety, depression and erectile dysfunction in patients with diabetes mellitus. *Georgian Med News*. Vol. 220. p. 77-81. 2012.

- 32-McNeil, J.; Doucet, É.; Chaput, J.P. Inadequate Sleep as a Contributor to Obesity and Type 2 Diabetes. *Canadian Journal of Diabetes*. Vol. 37. p. 103-108. 2011.
- 33-Micklesfield, L.; Rosenberg, L.; Cooper D.; Hoffman, M, Kalla, A., Stander, E. Lambert. Bone mineral density and life time physical activity in South African women. *Calcif Tissue int*. Vol. 73. p. 463-469. 2003.
- 34-Morgan, A.J.; Parker, A.G.; Alvarez-Jimenez, M.; Jorm, A.F. Exercise and Mental Health: An Exercise and Sports Science Australia Commissioned Review. *J Exerc Physiol Online*. Vol. 16. Num. 4. p. 22-35. 2013.
- 35-Nakajima, H.; Kaneita, Y.; Yokoyama, E.; Harano, S.; Tamaki, T.; Ibuka, E.; Kaneko, A.; Takahashi, I.; Umeda, T.; Nakaji, S.; Ohida, T. Association between sleep duration and hemoglobin A1C level. *Sleep Med*. Vol. 9. p. 745-752. 2008.
- 36-Nilsson, K.; Sangster, M.; Konijnendijk, C. C. Introduction. In K. Nilsson, M. sangester, C. Gallis, T. Hartig, S. de Vries, K. Seeland, and collaborators (Eds.), *Forests, trees and human health*. pp. 1-19. Springer Netherlands. 2011.
- 37-Passos, G.S.; Poyares, D.; Santana, M.G.; Garbuio, S.A.; Tufik, S.; Mello, M.T. Effect of acute physical exercise on patients with chronic primary insomnia. *J Clin Sleep Med*. Vol. 6. p. 270-275. 2010.
- 38-Peters, K.E.; Chubb, S.A.; Davis, W.A.; Davis, T.M. The Relationship between Hypomagnesaemia, Metformin Therapy and Cardiovascular Disease Complicating Type 2 Diabetes: The Fremantle Diabetes Study. *PLoS One*. Vol. 8. Num. 9. p.74355. 2013.
- 39-Petersen, A.M.; Pedersen, B.K. The anti-inflammatory effect of exercise. *J Appl Physiol*. Vol. 98. p. 1154-1162. 2005.
- 40-Reid, R.; Tulloch, H.; Sigal, R.; Kenny, G.; Fortier, M.; McDonnell, L.; and collaborators. Effects of aerobic exercise, resistance exercise or both, on patient-reported health status and well-being in type 2 diabetes mellitus: a randomized trial. *Diabetologia*. Vol. 53. Num. 4. p. 632-640. 2010.
- 41-Santos, R.V.; Tufik, S.; de Mello, M.T. Exercise, sleep and cytokines: is there a relation? *Sleep Med Rev*. Vol. 11. p. 231-239. 2007.
- 42-Sardar, M.A.; Sohrabi, M.; Shamsian, A.A.; Aminzade, R. Effects of aerobic exercise training on the mental and physical health and social functioning of patients with type 2 diabetes mellitus. *Iran J Endocrinol Metab*. Vol. 11. Num. 3. p. 251-256. 2010.
- 43-Schuch, F.B.; Vasconcelos-Moreno, M.P.; Fleck, M.P. The impact of exercise on quality of life within exercise and depression trials: A systematic review. *Mental Health and Physical Activity*. Vol. 4. Num. 2. p. 43-48. 2011.
- 44-Sebbani, M.; Adarmouch, L.; Elansar, N.; Elmghari, G.; Amine, M. An audit of type 2 diabetes management in a diabetes center in Marrakech. *Sante Publique*. Vol. 25. p. 3. p. 325-330. 2012.
- 45-Seferoğlu, F.; Şahan, A.; Karaman, T.; Erman, A. The relationship between tennis skill acquisitions with sleep quality and quality of life. *Procedia - Social and Behavioral Sciences*. Vol. 93. p. 1811-1814. 2013.
- 46-Shamsi, M.; Sharifirad, G.; Kachoyee, A.; Hassanzadeh, A. The Effect of Educational Program Walking Based on Health Belief Model on Control Sugar in Woman by Type 2 Diabetics]. *Iranian Journal of Endocrinology & Metabolism*. Vol. 11. Num. 5. p. 491-495. 2010.
- 47-Shahrjerdi, S.H.; Shavandi, N.; Golpaigani, M.; Sheikh, Hosseini, R. Impact strength and resistance training on glycemic control, quality of life and mental health in women with type 2 diabetes. *Iran J Diabetes Metab*. Vol. 9. Num. 1. p. 35-44. 2010.
- 48-Sharma, M.; Knowlden, A.P. Role of yoga in preventing and controlling type 2 diabetes mellitus. *J Evid Based Complementary Altern Med*. Vol. 17. Num. 2. p. 88-95. 2012.
- 49-Stroth, S.; Reinhardt, R.K.; Thone, J.; Hille, K.; Schneider, M.; Härtel, S.; Weidemann, W.; Bös, K.; Spitzer, M. Impact of aerobic exercise training on cognitive functions and affect associated to the COMT polymorphism in

young adults. *Neurobiol Learn Mem.* Vol. 94. Num. 3. p. 364-372. 2010.

50-Terada, T.; Friesen, A.; Chahal, B.S.; Bell, G.J.; McCargar, L.J.; Boule, N.G. Exploring the variability in acute glycemic responses to exercise in type 2 diabetes. *Journal of diabetes research.* p. 1-6. 2013.

51-Van der Heijden, M.; Van Dooren, F.; Pop, V.J.; Pouwer, F. Effects of exercise training on quality of life, symptoms of depression, symptoms of anxiety and emotional wellbeing in type 2 diabetes mellitus: A systematic review. *Diabetologia.* Vol. 56. Num. 6. p. 1210-1225. 2013.

52-Wang, X.; Youngstedt, S.D. Sleep quality improved following a single session of moderate-intensity aerobic exercise in older women: Results from a pilot study, *Journal of Sport and Health Science.* Vol. 3. Num. 4. p. 338-342. 2004.

53-Waryasz, G.R.; McDermott, A.Y. Exercise prescription and the patient with type 2 diabetes: a clinical approach to optimizing patient outcomes. *J Am Acad Nurse Pract.* Vol. 22. Num. 4. p. 217-227. 2010.

54-Yang, P.Y.; Ho, K.H.; Chen, H.C.; Chien, M.Y. Exercise training improves sleep quality in middle-aged and older adults with sleep problems: a systematic review. *J. Physiother.* Vol. 58. Num. 3. p. 157-163. 2012.

55-Yavari, A.; Najafipur, F.; Asgarzade, A.; Niafar, M.; Mobseri, M.; Dabagh Nikokheslat, S. Effects of aerobic training, strength and composition on glycemic control and cardiovascular risk factors in type 2 diabetic patients. *Med J Tabriz Uni Med Sci.* Vol. 33. Num. 4. p. 91-28. 2012.

ACKNOWLEDGEMENTS

We appreciate all subjects with type 2 diabetes who participated in this study.

Received for publication in 04/26/2018

Accepted in 08/05/2018