



Available online freely at www.isisn.org

Bioscience Research

Print ISSN: 1811-9506 Online ISSN: 2218-3973

Journal by Innovative Scientific Information & Services Network



RESEARCH ARTICLE

BIOSCIENCE RESEARCH, 2018 15(3):1601-1609.

OPEN ACCESS

Effect of Aerobic Exercise on Depression and Insomnia in Egyptian Geriatrics Parkinson's Population

Tamer I. Abo Elyazed¹, Islam Mahmoud Abd-allah Al-Azab², Moataz Mohamed El Semary², Moshref A.³, Sally Said Abd-Elhamed⁴ and Amira Mohamed El Gendy⁵

¹Physical Therapy for Internal Medicine Department, Faculty of Physical Therapy, Beni-Suef University, **Egypt**

²Physical Therapy for Neuromuscular disorder and its Surgery Department, Faculty of Physical Therapy, Cairo University, **Egypt**

³Psychiatry Department, Faculty of Medicine (Boys), Al-Azhar University, **Egypt**

⁴Internal Medicine Department, Faculty of Medicine for Girls, Al-Azhar University, **Egypt**

⁵Physical Therapy for Basic Science Department, Faculty of Physical Therapy, Cairo University, **Egypt**

*Correspondence: Tamer.i.aboelyazed@gmail.com Accepted: 05 June 2018 Published online: 31 July 2018

Somatic and mental functions of the majority of Parkinson's patients during different stages of their diseases could be affected by great neurotransmitter changes. Recently, regular exercise considered as a modern alternative tool to improve Parkinson's patients symptoms. Aims: The trial intends to evaluate the effect of aerobic exercises on depression and insomnia in Geriatrics Parkinson's Egyptian Population. Place and Duration of Study: Outpatient clinic of the Faculty of Physical Therapy, Cairo University, between July 2017 and October 2017. Methodology: 30 geriatrics Egyptian individuals (15 males and 15 females), their age ranged from 65-70 years and their body mass index was less than 30 kg/m² attached to this study after meeting the study requirements. Self-rating depression scale (SDS) and Insomnia Severity Index have been used to assess all patients before and after treatment program, A program of exercise (walking on a treadmill) started for 30 minutes at 40-50% of heart rate reserve (HRR) for 12 weeks 3 times/week. Results: Self-rating depression scale (SDS) and Insomnia Severity Index showed highly significant decrease ($p < 0.001$) in scores, after the 12 weeks of exercise training. Conclusion: Regular physical activity appears to be an adjunctive tool to decrease depression and insomnia that considered as common symptoms of geriatrics Parkinson's Egyptian population.

Keywords: Geriatrics; parkinsonism; exercise; depression; insomnia.

INTRODUCTION

Depressive disturbance are common among patients with Parkinson's disease (PD). Regardless that these disturbances could influence other clinical aspects of PD, non motor features as regression of life quality, cognitive deficits, functional disability and emotional stress all of that could be the result of depressive disturbance. Pathophysiology of PD depression remains limited. However, underscoring the importance of PD depression timely detection and concerted management,

clinical studies demonstrated that medications and psychotherapies used for management of PD depression (Lama et al., 2017).

Movement disorders characterized by tremors, rigidity and bradykinesia prove the diagnosis of PD; However PD patients through their course disease show neuropsychiatric disturbance such as depression, anxiety, insomnia as sleep disturbance and cognitive changes. These disturbances require more attention beyond motor features toward non motor features (Lama et al., 2017). PD neuropsychiatric disturbances usually

distressing patients and families more than motor aspects (Avidan et al., 2013).

Depression reported as the most frequent non motor feature of PD, it occurs in 40%-50% of patients with PD (Laura, 2013). Late life depression is an urgent elderly health problem as a result of its devastating sequences. Greater self-neglect, increased risk of decreased physical, cognitive and social functioning and increased risk of suicide all of which drive to mortality rate progress among PD patients (Amy et al., 2009). At the same time, major depression appears at earlier ages more than older adults (Anne et al., 2018).

Depression symptoms affecting general population differ from patients of PD, so it may be treated inadequately. PD patients with insomnia should be examined for signs of depression as it may lead to treat the cause of the complain (Ehrt et al., 2006).

Difficulties initiating sleep, maintaining sleep or waking up earlier than desired in the morning stated as characteristics of chronic insomnia by the international classification of sleep disorders (SDs). The most frequent SD in PD patients is insomnia with a wide prevalence range of (27%-80%). Maintenance insomnia with frequent awakenings and sleep fragmentation is more frequent in PD patients (81%). While initial and terminal insomnia may also be present by less prevalence (18%-40%) (Giuseppe et al., 2017). Increased sleep latency, frequent and prolonged intra-sleep awakenings proved by video- polysomnographic studies. (Giuseppe et al., 2017 and Peeraully et al., 2012). Neurodegenerative process of PD is a vital element to develop insomnia in addition to female gender, depression, an anxiety and PD duration. Other factors like pain, cough, cold and heat sensations considered as contributing factors for sleep fragmentation. Literature data are conflicting about drugs relation to insomnia (Zoccolella et al., 2011).

Most common non motor manifestations of geriatric PD are insomnia and sleep disorders which have a negative feedback on quality of PD patient life. Several specifications for PD patients with sleep disorders (SDs) differ from general population SDs regarding to diagnosis, management and implication, In spite of wide range of similar characteristics between the two populations (Peeraully et al., 2012).

Nocturnal and diurnal manifestations as insomnia, rapid eye movement, excessive daytime sleepiness and sleep behavior disorders are all included to sleep disorders. Depletion of large amount of cerebral amines which play a role in initiation and maintenance of sleep as a result of neurodegenerative

process in geriatrics PD leads to SDs. This depletion can negatively affect the network which regulates sleep- wake cycle (Zoccolella et al., 2011). Few clinical trials on SDs treatment have been conducted, despite the significant prevalence of SDs in PD patients. The enhancement of daytime alertness, consolidation of nocturnal sleep and the amelioration of the quality of life are the result of proper management of SDs in PD (Ratti et al., 2015).

Patients and families education about possibility of treatment and recovery of depressive disorders in geriatrics PD is important. Neglected treatment of depression extends beyond mood symptoms to functional disability, earlier initiation of dopaminergic therapy, physical and cognitive deterioration. Usually depressive disturbance are not recognized in clinical settings and may be missed to be treated (Aarsland et al., 2009). To close that gap, this study focuses on aerobic training for elderly as recent comprehensive approach to PD with high clinical outcomes.

Recently, pharmacological treatments of PD could be assisted by aerobic exercises which have been widely used. Aerobic training could reduce inflammation, suppress oxidative stress and stabilizing calcium homeostasis which all would promote brain health (Swathi et al., 2009). Central nervous system plasticity changes in relation to aerobic exercise in healthy older rodents had been shown in studies which relate these changes to synaptogenesis, enhanced glucose utilization, angiogenesis and neurogenesis (Russo et al., 2000). Treadmill training as a model for aerobic exercise has been proved by many studies as well as beneficial in improving balance and physical function in individuals with PD (Hai-Feng et al., 2014).

For any treatment to be useful it must be characterized by two dimensions: first it must be easy applicable in many usual situations and second it must be inexpensive. Aerobic exercise is considered one of the cheapest and applicable treatment methods for many physical conditions and for these reasons it was included in the current study.

MATERIALS AND METHODS

Thirty geriatrics Parkinson's Egyptian patients (15 male and 15 female) participated into this study. They were selected from different nursing homes in Cairo- Egypt, they were physically examined to be sure that they hadn't any physical problems that interfere with the program of exercises. They all were non-smokers and at the same socioeconomic

standard. Also, they had no history of renal, liver or endocrinal disorders, or cardiorespiratory affection. Then every participant in this study signed a consent form after a demonstration about the aim and the procedure would be done in this study. Their age was ranged from 65 up to 70 years old. Their BMI were not exceeding 30 Kg/m². None of participants were on diabetic drugs. Medical examination (CBC, ECG, Blood glucose level, liver function test and kidney function test) for patient selection and follow up every one month during the study was done at internal medicine outpatient clinic, Al-Zahra university hospital, Al-Azhar University. The patients were randomly divided into two equal groups by GraphPad Quick Calcs website (2017).

The control group (B) received selected physical therapy program (designed for Parkinson's patients) in the form of strengthening exercise for lower limb and stretching exercise of the upper and lower body 3 times/week for 3 months. The study group (A) received the same selected physical therapy

program of group (B) in addition to aerobic exercise in the form of walking on treadmill. The aerobic training program was lasted for 30-40 minutes begins as walking with no resistance on the treadmill as warm up stage for 5-10 minutes then 20-30 minutes of walking with exercise intensity at 40% to 50% of heart rate reserve and followed by another 5-10 minutes cooling down stage as walking without resistance. "The THR= [40% to 50% (maximal heart rate -resting heart rate)] + resting heart rate]. Maximum heart rate was detected according to Borg scale for rating perceived exertion. The total time of exercise was 40 minutes, the treatment sessions were repeated 3 times/week for 3 months (Lisa et al., 2013).

All the participants were given Zung self-rating depression questionnaire (Zung et al., 1965) before and after treatment interventions, as in (Fig.1). Also Insomnia Severity Index (Bastien et al, 2001) was given to the participants before and after treatment interventions as in (Fig. 2)

Zung Self-Rating Depression Scale				
Patient's Initials: _____		Date of Assessment: _____		
Please read each statement and decide how much of the time the statement describes how you have been feeling during the past several days.				
Make check mark (✓) in appropriate column.	A little of the time	Some of the time	Good part of the time	Most of the time
1. I feel down-hearted and blue				
2. Morning is when I feel the best				
3. I have crying spells or feel like it				
4. I have trouble sleeping at night				
5. I eat as much as I used to				
6. I still enjoy sex				
7. I notice that I am losing weight				
8. I have trouble with constipation				
9. My heart beats faster than usual				
10. I get tired for no reason				
11. My mind is as clear as it used to be				
12. I find it easy to do the things I used to				
13. I am restless and can't keep still				
14. I feel hopeful about the future				
15. I am more irritable than usual				
16. I find it easy to make decisions				
17. I feel that I am useful and needed				
18. My life is pretty full				
19. I feel that others would be better off if I were dead				
20. I still enjoy the things I used to do				

Figure (1): Zung self-rating depression questionnaire. Adapted from Arch Gen Psychiatry (Zung et al., 1965)

Formula for converting raw scores to self-rating depression scale (SDS) index:

Most or all of the time = (4)	Below 50 Within normal range
Good part of the time = (3)	50-59 Minimal to mild depression
Some of the time = (2)	60-69 Moderate to marked depression
None or a little of the time = (1)	70 and over Severe to extreme depression

clinical screening: insomnia severity index

1. Please rate the **SEVERITY** of your sleep problem(s).

	None	Mild	Moderate	Severe	Very Severe
--	------	------	----------	--------	-------------

Difficulty falling asleep:
Difficulty staying asleep:
Problem waking up too early:

2. How **SATISFIED**/dissatisfied are you with your current sleep pattern?

0	1	2	3	4
Very Unsatisfied			Very Satisfied	

3. To what extent do you consider your sleep problem to **INTERFERE** with your daily functioning (daytime fatigue, ability to function at work/daily chores, concentration, memory, mood, etc.)?

0	1	2	3	4
Not at all Interfere			Interfere Very Much	

4. How **NOTICEABLE** to others do you think your sleeping problem is in terms of impairing the quality of your life?

0	1	2	3	4
Not at all Noticeable			Very much Noticeable	

5. How **WORRIED**/distressed are you about your current sleep problem?

0	1	2	3	4
Not at all Worried			Very much Worried	

<7 none
>7 subthreshold
>14 mod severe
>21 severe

Bastien et al., 2001

Figure (2): Insomnia Severity Index Adapted from (Wickwire et al., 2016)

Statistical analysis

The data were analyzed statistically by using descriptive statistics including the mean, and the standard deviation and dependant samples t-test was used for the comparison between the results. The level of significance, p-value was selected at 5% (p=0.05), p-value > 0.05 indicates non significant results; while p-value < 0.05 indicates significant results and p-value < 0.001 indicates highly significant result.

RESULTS

Thirty geriatrics Parkinson's Egyptian patients (15 male and 15 female) participated into this study. Table (1) showed that mean values of participants ages in group A (GA) and B (GB) were (66.13 ± 5.66) and (65.27±4.96) respectively with no significant difference between the two groups. The mean values of height, weight and body mass index (BMI) showed no significant difference between the two groups.

The mean values of **Zung self rating depression scale** for (GA) and (GB) scores before and after starting the treatment are summarized in table (2). Comparison of (GA) and (GB) scores mean values before starting the treatment by using t-test showed that there was no significant difference between the two groups before treatment. **T-value** of (GA) and (GB) scores mean values before starting the treatment was **0.09** at **P-value = 0.926**. Comparison of (GB) scores mean values showed no significant difference between pre and post treatment values with mean difference (**1.233**) at **P-value (0.138)**. Comparison of (GA) scores mean values showed highly significant difference between pre and post treatment values with mean difference (**6.63**) at **P-value (<0.001)**. **Finally, by comparing** (GA) and (GB) scores mean values for post treatment, highly significant difference was approved where mean difference was (**5.33**) at **P-value (<0.001)**.

Table (1): Mean values, T-values and P-values for age, height, weight and BMI for groups A and B

Item	Study (GA)	Control (GB)	T-value	P-value
	Mean \pm SD	Mean \pm SD		
Age (years)	66.13 \pm 5.66	65.27 \pm 4.96	0.63	0.536
Height (Cm.)	165 \pm 4.64	165.13 \pm 3.76	0.09	0.930
Weight (Kg.)	90.55 \pm 4.45	89.70 \pm 4.73	0.33	0.723
BMI	27 \pm 1.23	27.50 \pm 1.19	0.24	0.784

Table (2): Mean values, mean difference, T-values and P-values for Zung self rating depression scale scores for group A and B

	Zung self rating depression scale						
	Pre test		Post test		Mean Diff.	T-value	P-value
	Mean	\pm SD	Mean	\pm SD			
Study (GA)	55.20	\pm 2.44	48.567	\pm 5.25	6.63	5.83	<0.001*
Control (GB)	55.13	\pm 2.66	53.900	\pm 4.30	1.233	1.53	0.138
Mean Diff.	0.067		5.33				
T-value	0.09		3.69				
P-value	0.926		0.001*				

SD: standard deviation
 $P \leq 0.05 =$ significant*

$P > 0.05 =$ Non-significant
 Diff. = difference

Table (3): Mean values, mean difference, T-values and P-values for Insomnia Severity Index Scale scores for group A and B

	Insomnia Severity Index Scale						
	Pre test		Post test		Mean Diff.	T-value	P-value
	Mean	\pm SD	Mean	\pm SD			
Study (GA)	15.233	\pm 1.16	9.367	\pm 1.12	5.867	22.07	<0.001
Control (GB)	15.367	\pm 1.15	14.067	\pm 2.16	1.300	3.44	0.002
Mean Diff.	0.133		4.700				
T-value	0.45		11.16				
P-value	0.654		<0.001				

SD: standard deviation
 $P \leq 0.05 =$ significant*

$P > 0.05 =$ Non-significant
 Diff. = difference

The mean values of Insomnia Severity Index Scale (GA) and (GB) scores before and after starting the treatment are summarized in table (3). Comparison of (GA) and (GB) scores mean values before starting the treatment by using t-test showed that there was no significant difference between the two groups before treatment. T-value of (GA) and (GB) scores mean values before starting the treatment was 0.45 at P-value = 0.654. Comparison of (GB) scores mean values showed significant difference between pre and post treatment values with mean difference (1.300) at P-value (0.002). Comparison of (GA) scores mean values showed highly significant difference between pre and post treatment values with mean difference (5.867) at P-value (<0.001). Finally, by comparing (GA) and (GB) scores mean values for post treatment, highly significant difference was approved where mean difference was (4.700) at P-value (<0.001).

DISCUSSION

The need for this study emerged from the lack in the literature regarding the treatment of depression and insomnia and their role in PD patients.

Older adult gains great benefits of regular practice of aerobic exercise and physical activity. Significant new evidences showed these benefits. Regarding to recent evidences, exercise and physical activity for elderly with chronic disabilities like Parkinsonism stated growing knowledge for exercise importance and prescription for elderly.

The results of this study showed a statistically highly significant decrease ($p < 0.001$) in Zung self rating depression scale and statistically highly significant decrease ($p < 0.001$) in (Insomnia Severity Index Scale) when comparing mean values between before and after the aerobic training program which was extended for 12 weeks in 3 nonconsecutive times/week. The intensity of exercise was applied in this study ranged from 40% to 50% of heart rate reserve as a moderate intensity. This supported by Hassmen et al., (2000) who concluded that moderate exercise is more effective than strenuous. Because in strenuous exercise when someone pushes him/herself beyond a certain point of acceptable exercising, the exercise will work against the original goal to decrease depression.

Degeneration of dopaminergic neurons and intraneuronal Lewy bodies in the substantianigra pars compacta, discrete loss of noradrenergic and serotonergic neurons; regulation of mood and

reward systems as well as mood disturbances in PD patients and the general population are associated with these mentioned neural systems. Disturbance of serotonergic neurons in the dorsal raphe leads to dysfunction of depression-related orbitofrontal-basal ganglia thalamic circuits. This conceptualization supported by evidence of reduced dopamine transporter activity, frontal blood flow, and caudate-frontal glucose metabolism in depressed patients (Goetz et al., 2005 and Laura, 2013).

The significant improvement of depression related to the current study may be explained by improvement in mood and sleep disturbance through exercise production of higher levels of chemicals in the brain, notably dopamine, serotonin, and nor epinephrine. All of that is effective in countering depression. It is widely recognized that depressed individuals could be assisted by exercise and physical activity which promote quicker and better relief from depression. Antidepressants and psychotherapy work better in combination with exercise and physical activity, many find walking, for example, to be of great help (Happe and Berger, 2001 and Hai-Feng et al., 2014).

Modern treatment of many internal and orthopedic conditions uses therapeutic exercises program as an obligatory complementary method. Interaction recognized between physical fitness and mental well-being in the field of psychiatry. In the meanwhile, regular exercise has been approved as a therapeutic tool in patients suffering from depressive and other psychiatric disorders (Wojtek et al., 2009).

People who practice regular physical activity are less susceptible to depression and chronic physical disorders than sedentary individuals. Walking is the most popular physical activity among adults. Many researchers suggest that at least 30 minutes of exercise a day for at least 3-5 days a week is significantly improves symptoms of depression. If it's initially too difficult to do more exercise, smaller amounts of activity as 10-15 minutes have been used for improvement in the short time. So, small bouts of exercise may be enough to get started (Alexandre et al., 2014).

The results of this study were in agreement with the Updated Recommendation from the American College of Sports Medicine (ACSM) and the *American Heart Association* (AHA) for Adults (2006), who stated that a controlled program of physical exercise for older parkinsonism patients and older normal adults alleviates symptoms of anxiety and depression, and its inclusion in

primary healthcare programs should be considered.

Results of this study provide new insight into the relationship between depression and Insomnia. Insomnia contributes to the development of depression and also commonly occurs as a symptom of depression in general population. Accumulated evidences on the efficacy of exercise for disturbed sleep as a non pharmacologic treatment option have proven well, as exercise has long been associated with better sleep (Paluska and Schwenk, 2000).

The improvement of the patients included as a sample in the current study by aerobic exercise may be explained by the work of Alexandre et al., (2014) whom stated that aerobic exercise promote brain health by reducing inflammation, suppressing oxidative stress, and stabilizing calcium homeostasis.

Moilanen et al., (2012), stated that night sweats, mood swings, and irritability were significantly reduced after a program of aerobic training for 50 minutes four times weekly for 24 weeks. Subjective sleep quality in PD patients showed improvement in relation to exercise training, with even a low dose of exercise resulting in greatly reduced odds of having significant sleep disturbance (Jonas et al., 2012 and Christopher, 2014).

Improvement in fitness observed in present study can also be attributed to improvement in sleep duration and sleep quality as a result of exercise program. Better and longer sleep following exercise conduction as a result of shorter sleep onset latency and less sleep fragmentation. This improvement related to mood enhancement and feelings of higher mental and physical energy after exercise. These findings come in accordance with other studies which showed the effect of exercise on anxiety symptoms reduction and decreased level of depression, which in turn will lead to sleep maintenance (Ehrt et al., 2006 and Brand et al., 2014).

Exercise improves subjective and objective sleep in patients with chronic primary insomnia. The longitudinal effects of aerobic exercise on sleep pattern were investigated by Shapiro et al., (1984) they observed significant increase proportion in slow wave sleep (SWS) after 18 weeks of exercise. They also demonstrated that a large SWS proportion indicate good sleep quality as SWS is the deepest part of sleep (Shapiro et al., 1984 and Youngstedt, 2005).

Patients and non patients population were

also investigated for the effect of exercise on sleep architecture (Driver et al., 1988, King et al., 2008 and Kline et al., 2011). As far as we know, our study is the First randomized controlled trial investigating the effects of aerobic exercise on depression and insomnia on Parkinsonism patients, measured under free-living conditions. Other studies conducted in different methodology and population agreed with increased sleep duration observed after moderate daily aerobic exercise (King et al., 1997, Gambelunghe et al., 2005 and Reid et al., 2010), these findings also confirmed by animal studies (Gambelunghe et al., 2001 and Gambelunghe et al., 2005).

This confirmed with that of Youngstedt (2005) who said that sleep serves an energy conservation function, a body tissue restitution function, or a temperature down-regulation function have all predicted a uniquely potent effect of exercise on sleep because no other stimulus elicits greater depletion of energy stores, tissue breakdown, or elevation of body temperature, respectively. Aerobic exercise considered as a potentially attractive and adjuvant treatment for insomnia, as it provide a healthy, simple, inexpensive, and safe means of improving sleep (Driver and Taylor, 2000 and Mansikkamäki et al., 2012).

The result of this study was in agreement with Buman and King (2010) as they stated that physical exercise is one such alternative that is inexpensive and affects numerous health systems simultaneously. The current literature indicates that brisk walking as a moderate amounts of exercise, are sufficient to improve sleep quality.

CONCLUSION

A program of 12-week moderate aerobic exercise is effective in improving the self-assessment of sleep quality and reducing depression in geriatrics with Parkinsonism and appears to be an alternative cheap and easy method to decrease depression and insomnia that occur in geriatric Parkinsonism patients. So, geriatrics Parkinson's Egyptian patients could improve their mood and sleep quality.

Ethical Approval

The study was approved by ethical committee of Faculty of Physical Therapy, Cairo University.

CONFLICT OF INTEREST

Authors have declared that no competing interests exist.

ACKNOWLEDGEMENT

The authors would like to thank all patients and their caregivers for participating in this study.

AUTHOR CONTRIBUTIONS

TIA and IMAA designed and confirmed the study objectives and procedures and also wrote the manuscript. AM and SSA performed diagnosis and medical follow-up. MME and AME performed data collection and analysis. TIA and IMAA reviewed the manuscript. All authors read and approved the final version.

Copyrights: © 2017 @ author (s).

This is an open access article distributed under the terms of the [Creative Commons Attribution License \(CC BY 4.0\)](https://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author(s) and source are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.

REFERENCES

- Aarsland D, Marsh L and Schrag A. (2009): Neuropsychiatric symptoms in Parkinson's disease. *MovDisord.* ; 24:2175–2186.
- AlexandreAbilio de Souza Teixeira, Giselle Soares Passos, Francieli Silva Ruiz, Eduardo da Silva Alves, et al..(2014): Improvements in Chronic Primary Insomnia after Exercise Training Are Correlated with Changes in Metabolic and Hormonal Profile. *Journal of Hormones* Volume, Article ID 246342, 6 pages
- American College Of Cardiology /American Heart Association (2006): Methodology Manual for ACC/AHA Guideline Writing Committees. American College of Cardiology Foundation and the American Heart Association, Inc.
- Amy Fiske, Julie Loebach Wetherell, and Margaret Gatz.(2009): Depression in Older Adults. *Annu Rev ClinPsychol*; 5: 363–389.
- Anne Stark, Hanna Kaduszkiewicz, Janine Stein et al..(2018): A qualitative study on older primary care patients' perspectives on depression and its treatments - potential barriers to and opportunities for managing depression. *BMC FamPract*; 19: 2.
- Avidan A, Hays RD, Diaz N, Bordelon Y et al., (2013): Associations of sleep disturbance symptoms with health-related quality of life in Parkinson's disease. *J Neuropsychiatry ClinNeurosci* ;25(4):319-26.
- Bastien CH, Vallières A, Morin CM. (2001): Validation of the Insomnia Severity Index as an outcome measure for insomnia research. *Sleep Med.*; 2(4):297-307.
- Brand S, Kalak N, Gerber M, et al..(2014): High self-perceived exercise exertion before bedtime is associated with greater objectively assessed sleep efficiency [published online June 18, 2014]. *Sleep Med.* doi:10.1016
- Buman M and King A. (2010): Exercise as a treatment to enhance sleep. *American Journal of Lifestyle Medicine*;4(6):500-14
- Christopher E. Kline. (2014): The Bidirectional Relationship Between Exercise and Sleep: Implications for Exercise Adherence and Sleep Improvement. *American Journal of Lifestyle Medicine* vol. 8 • no 6
- Driver HS, Meintjes AF, Rogers GGet al.. (1988): Submaximal exercise effects on sleep patterns in young women before and after an aerobic training programme. *ActaPhysiol Scan Suppl* 574: 8-13.
- Driver HS and Taylor SR (2000): Exercise and sleep. *Sleep Med Rev* 4: 387-402.
- Ehrt U, Bronnick K, Leentjens AF, et al..(2006): Depressive symptom profile in Parkinson's disease: a comparison with depression in elderly patients without Parkinson's disease. *Int J Geriatr Psychiatry*;21:252–8.
- Gambelungho C, Mariucci G, Rossi R, et al., (2005): Effects of light physical exercise on sleep in middle-aged rats. *Int J Sports Med* 26: 327-331.
- Gambelungho C, Rossi R, Mariucci G, et al..(2001): Effects of light physical exercise on sleep regulation in rats. *Med Sci Sports Exerc* 33: 57-60.
- Giuseppe Loddo, Giovanna Calandra-Buonaura, Luisa Sambati et al..(2017): The Treatment of Sleep Disorders in Parkinson's disease: From Research to Clinical Practice. *Front. Neuro*;8:42.
- Goetz CG, Wu J, Curgian LM, et al.. (2005): Hallucinations and sleep disorders in PD: six-year prospective longitudinal study. *Neurology*;64:81–6.
- GraphPad Software,inc. retrieved from <https://www.graphpad.com/quick-clacs/randomize1.cfm>,(2017).
- Hai-FengShu, Tao Yang, Si-Xun Yu et al..(2014): Aerobic Exercise for Parkinson's Disease; A Systematic Review and Meta-Analysis of

- Randomized Controlled Trials. PLOS ONE ;(9) 7.
- Happe S and Berger K. (2001): The association of dopamine agonists with daytime sleepiness, sleep problems and quality of life in patients with Parkinson's disease—a prospective study. *J Neurol*;248:1062–7.
- Hassmen p, koivula n and uutela a. (2000): physical exercise and psychological well-being: a population study in finland. *prev.med.*;30(1):17-25.
- Jonas S. Kjeldsen, MadsRosenkilde, Signe W. Nielsen, et al.. (2012): Effect of different doses of exercise on sleep duration, sleep efficiency and sleep quality in sedentary, overweight men. *Bioenergetics*, Vol. S1, No. 002, p. 1-6.
- King AC, Oman RF, Brassington GS, et al..(1997):Moderateintensity exercise and self-rated quality of sleep in older adults. A randomized controlled trial. *JAMA* 277: 32-37.
- King AC, Pruitt LA, Woo S, et al.. (2008): Effects of moderate-intensity exercise on polysomnographic and subjective sleep quality in older adults with mild to moderate sleep complaints. *J Gerontol A BiolSci Med Sci* 63: 997-1004.
- Kline CE, Crowley EP, Ewing GB, et al.. (2011): The effect of exercise training on obstructive sleep apnea and sleep quality: a randomized controlled trial. *Sleep* 34: 1631-1640. 20.
- Lama M. Chahine, Amy W. Amara and AleksandarVidenovic.(2017): A systematic review of the literature on disorders of sleep and wakefulness in Parkinson's disease from 2005 to 2015. *Sleep Medicine Reviews* ;(35)33-50
- Laura Marsh. (2013): Depression and Parkinson's disease: Current Knowledge. *CurrNeuroNeurosci Rep*; 13(12): 409.
- Lisa M. Shulman, Leslie I. Katznel, Frederick M. Ivey et al.. (2013):Randomized Clinical Trial of 3 Types of Physical Exercise for Patients With Parkinson Disease. *JAMA Neurol.*; 70(2): 183–190.
- Mansikkamäki K, Raitanen J, Nygård CH, et al..(2012): Sleep quality and aerobic training among monopausal women - A randomized controlled trial. *Mauritas* 72: 339-345.
- Moilanen J, Mikkola T and Raitanen J. (2012): Effect of aerobic training on menopausal symptoms-a randomized controlled trial. *Menopause.*; published online Feb 13.
- Paluska S and Schwenk t. (2000): Physical activity and mental health: current concepts. *Sports Med.*;29(3):167-80.
- Peeraully T, Yong M-H, Chokroverty S, et al..(2012): Sleep and Parkinson's disease: a review of case-control polysomnography studies: sleep and Parkinson's disease. *MovDisord*; 27:1729–37.
- Ratti PL, Nègre-Pagès L, Pérez-Lloret S, et al.. (2015): Subjective sleep dysfunction and insomnia symptoms in Parkinson's disease: insights from a cross-sectional evaluation of the French CoPark cohort. *Parkinsonism RelatDisord*; 21:1323–9.
- Reid KJ, Baron KG, Lu B, Naylor E, et al.. (2010): Aerobic exercise improves self-reported sleep and quality of life in older adults with insomnia. *Sleep Med* 11: 934-940.
- Russo-Neustadt AA, Beard RC, Huang YM, et al..(2000): Physical activity and antidepressant treatment potentiate the expression of specific brain-derived Neurotrophic factor transcripts in the rat hippocampus. *Neuroscience* ;101(2):305–12.
- Shapiro CM, Warren PM, Trinder J, et al.. (1984): Fitness facilitates sleep. *Eur J Appl Physiol Occup Physiol* 53: 1-4.
- SwathiGujral, Howard Aizenstein, Charles F. Reynolds III et al..(2009): Exercise effects on depression: Possible neural mechanisms. Review article. *General Hospital Psychiatry*; 49: 2–10.
- Wickwire EM, Shaya FT and Scharf SM (2016): Health economics of insomnia treatments: the return on investment for a good night's sleep. *Sleep Med Rev*; 30:72-82.
- Wojtek J. Chodzko-Zajko and David N. Proctor, (2009): Exercise and Physical Activity for Older Adults. *The American College of Sports Medicine*. DOI: 10.1249/MSS.0b013e3181a0c95c.
- Youngstedt SD (2005) Effects of exercise on sleep. *Clin Sports Med* 24: 355- 365.
- Zoccolella S, Savarese M, Lamberti P, al.. (2011): Sleep disorders and the natural history of Parkinson's disease: the contribution of epidemiological studies. *Sleep Med Rev*; 15:41–50.
- Zung W, Richards C, Short M. (1965): Self-rating depression scale in an outpatient clinic: further validation of the SDS. *Arch Gen Psychiatry*.13(6):508-15.