Effects and Benefits of Physical Therapy in the Mood, Quality of Life and Cognition Psychological and Cognitive Effects of Physical Therapy

Guillermo Cano Escalera[1], Naiara Ozamiz[2], Sonia Ruiz de Azua García[3]

[1]Physiotherapist and Predoctoral Researcher, University of the Basque Country, Neuroscience Department, Psychiatry, Barrio Sarriena, s/n, 48940 Lejona, Vizcaya, Spain, [2]Ph.D., Clinical Psychologist and Assistant Professor, University of the Basque Country, Neuroscience Department, Psychiatry, Barrio Sarriena, s/n, 48940 Lejona, Vizcaya, Spain, [3]Ph.D., Postdoctoral Researcher and Assistant Professor, University of the Basque Country, Neuroscience Department, Psychiatry, Barrio Sarriena, s/n, 48940 Lejona, Vizcaya, Spain, CIBERSAM (Biomedical Research Center in Mental Health Net), University Hospital of Alava, 29 Olaguibel St., 01004, Vitoria, Spain

Abstract

The objective of this study is to quantify the effects of aerobic physical exercise program in the affective, quality of life and cognition aspects. This study included a sample of 40 participants with some physical pathology. All patients answered some questionnaires about clinical symptomatology (STAI, BDI, EUROqOL - 5D) and cognition (WAIS – IV). This battery test was performed before the intervention and after 10 weeks. The intervention was aerobic physical exercise consisting of an elliptical bicycle and walking on a static tape for a total of 45 minutes, three days a week. To evaluate the results, the statistical software IBM SPSS 23 was used. Values indicated a significant improvement in the affective and quality of life tests as well as higher scores in the cognitive tests once the physical exercise was performed. The results showed that aerobic physical activity improves cognitive qualities, affective status and perception of quality of life. The results show very positive possibilities for this field and for its more assiduous implementation as complementary therapy in some physical pathologies.

Keywords: *Aerobic exercise; cognition; mood; quality of life; physical therapy.*

Introduction

The effects of physical exercise in cognition and mood have been studied in general population. The literature references are extensive and comment on improvements in depressive symptoms and emotional states[1], anxiety[2] and advances in cognitive aspects such as attention, information processing speed, or working memory[3-5].

Physical activity such as gymnastics, volleyball and athletic play are an important role in the elimination of anxiety among university students[2]. It has also been shown that in middle-aged adults, a 20-week aerobic exercise program reduced physical anxiety, as well as body weight and body fat[6]. More specifically, aerobic physical exercise combined with yoga and meditation exercises has been shown to reduce the stress levels of a work employee, continuing the effects of this exercise even 6 months after its completion[7]. It has been shown that moderate aerobic exercise in subjects experiencing difficulties regulating their emotions may help to reduce negative emotions[1].

Depression can have detrimental effects on one's health, even resulting in a loss of muscle mass and a poorly regulated hypothalamic-pituitary-adrenal system[8] causing uncontrolled reactions of stress, as well as influencing in the immune system and in the emotions of these people.

As a result, it is shown how aerobic activity is associated with a lower risk of depressive symptoms such as decreased interest or pleasure in activities,

insomnia or hypersomnia, fatigue or loss of energy and recurrent thoughts of death among others[9] in adults[10-11]. The decrease of these symptoms as a result of physical activity is a very positive advance in non-pharmacological treatment.

People who perform physical activity subjectively perceive a higher quality of life than sedentary ones. This perception of a higher quality of life increases in areas such as social relations and psychological functioning[12].

Regarding neuroplasticity, it has been demonstrated that aerobic exercise has a strong influence in increasing cerebral plasticity. This increase happens especially in the hippocampus, the brain region related to learning and memory processes. Therefore, aerobic exercise has been suggested as a promising therapeutic pathway to improve these processes[4]. Physical activity improves working memory[5] and distractibility, more specifically, it has been shown that aerobic exercise and resistance exercise resulted in an improvement in visual and spatial memory[3].

Another important point of cognition is selective attention, which shows how performing previous aerobic exercise creates an improvement in a visual search task[13]. There is also improvement in reaction times in election tests[14].

Regarding information processing, we observe that in a specific double-task[14] moderate intensity exercise improved overall cognitive performance, while low intensity exercise compensated for the negative effects of a double task.

There are studies that show different effects on cognition depending on whether aerobic exercise or strength exercise is performed; the former being the most associated with academic performance and intelligence[15]. It has also been studied that people who participated in more organized and multiple extracurricular physical activities had better cognitive performance in several areas[16].

Finally, the findings in the improvements in the cognition facilitate research about degenerative diseases such as Alzheimer's or Parkinson's[17]. Aerobic exercise intervention in people with early Alzheimer's disease can improve memory performance and reduce hippocampal atrophy [18]. Also, in Parkinson's disease, physical therapy has been shown to improve cognitive functioning and information processing[17]. Regarding other physical pathologies, some researches find how physical exercise are very beneficial in people with osteoarthritis[19], low back pain[20] or cervical pain[21]. Aerobic exercise improves both their psychological functioning and their perception of quality of life.

However, at this moment it is unknown which is the better kind of exercise, frequency and the time of physical activity that the programs need to get significant improvements. The objective of this work is to conduct a pilot study exploring how physical activity affects affective state, quality of life and human cognition in patients with diverse somatic conditions.

Method

Participants: 40 participants were included between 27 and 58 years old with a mean age of 43.48±9.87. The inclusion criteria were ages from 18 to 60 years old, all participants were in the mutual and they had a physical pathology that had failed the usual pharmacological and physiotherapeutic treatment, in a period of at least 3 months.

We excluded participants if they met any of the following criteria: a severe pathology incompatible with aerobic exercise.

All participants were informed that this work was done according to protocols previously established by a committee and they were asked to sign an informed consent explaining what the test consisted of and what the data will be used for. Additionally, participants were required to sign a protection of confidentiality according with the law of Spain. The data was anonymized for statistical analysis so it couldn't be traced back to specific people.

These 40 people answered some questions and questionnaires before beginning the physical therapy intervention to check their affective state, their perception of their quality of life and their cognitive ability. After 10 weeks, participants were evaluated for possible short term changes.

Instruments:

The instruments that were used were the following:

- State-Trait Anxiety Questionnaire (STAI)[22] to evaluated the state anxiety.

- The BDI Beck Depression Inventory (BDI)[23] to detect and evaluate the severity of depression.
- EUROqOL-5D (EQ-5D)[24] to measure health-related quality of life.
- Wechsler Adult Intelligence Scale IV (WAIS-IV)[25] were the Digit-Symbol coding scale evaluates the visomotor speed and processing speed, attention and short-term memory and The Digits (D) test scale assesses attention and distraction resistance and immediate auditory memory and working memory. The Verbal Fluency Task is used to measure both phonological fluency and semantic fluency.

Intervention: The participants perform aerobic exercise at a moderate level for forty five minutes for three days a week. Every fifteen minutes of exercise there is a five minute break.

Physical activity consisted of a thirty minute elliptical cycle with a rest period of five minutes after the first fifteen minutes and after thirty minutes after elliptical cycle fifteen minutes of walking on a treadmill at a constant speed. The moderate level of activity depended on the physical capacity of each person, in a percentage range of between sixty and seventy percent of the maximum heart rate.

If the participants noticed any discomfort or pain they could stop the exercise immediately and rest in order to relieve the discomfort. In the case of a participant not improving, they could take to the nearest health centre to avoid possible subsequent adverse reactions.

Statistical measurement: The statistical software IBM SPSS version 23 was used to analyse data from the sample that composed this pilot study. To verify the sociodemographic characteristics of the sample, we used descriptive and relevant frequencies. To perform a comparison analysis of the patients' psychological status, quality of life and cognitive basal, a non-parametric mean comparison (Mann-Whitney U) was used. A non-parametric comparison was used because the variances were not homogeneous. To compare the effect of physical exercise therapy during the 10 weeks, a t-Student test was made for the comparison of means for related samples.

Results

Basal analysis of the results: Data on mood, quality of life and cognition of patients are presented. Patients had a mean anxiety score of 16.10 and this score indicate anxiety scores within a normal range. Only four patients who participated in the study showed high anxiety scores. The 57.5% of the participants showed absent or minimal depression, 25% showed mild depression, 17.5% showed moderate depression and none of the participants showed serious depression. We found that 60% of the participants had an average perception of quality of life, while 40% perceived a high quality of life.

With regard to cognitive functioning, approximately 50% of the patients did not reach the minimum number of words in phonological verbal fluency. With respect to the semantic fluency, 60% of the participants struggled to reach the minimum number of the words. The performance of the digit-symbol coding task was generally consistent, with 75% of the participants successfully executing the task in normal range; however, with respect to memory, 30% obtained poor results, while 65% obtained average results and 5% high scores.

Pre and post treatment comparison: Table 1 shows the results obtained in cognitive, affective and quality of life tests before exercise after a 10 week period.

Participants showed a 95% confidence level which verified the hypothesis that participants have improved in all the cognitive tests. The cognitive scores in all domains, except in working memory, improve after 10 weeks of intervention. In general, all participants showed a higher score in affective tests and the quality of life after the intervention.

Using the STAI test, which measures anxiety, the average score decreased by more than 6 points, being clinically significant. The BDI test, that measures depression, showed a slight decrease of almost 2 points. With regard to quality of life, the patients showed an increase in the perception of the health status of more than 8 points.

Table 1. Results in pre-test and post-test

	Pretest		Postest		T	p
	Mean	SD	Mean	SD		
Anxiety State (STAI)	16,10	7,629	9,73	5,277	9,362	,000
Depression severity (BDI)	4,65	4,016	2,75	2,743	6,136	,000
Health-related quality of life. EUROqOLPT3	69,13	17,863	77,88	11,260	-5,309	,000
Verbal Fluency - F (WAIS-IV)	9,50	2,364	10,30	2,053	-2,629	,012
Verbal Fluency –S (WAIS-IV)	10,08	2,485	10,88	2,015	-2,611	,013
Verbal Fluency – Animals (WAIS-IV)	12,53	3,234	13,42	2,581	-2,356	,024
Numbers Key PE (WAIS-IV)	10,80	2,066	11,17	2,194	-2,423	,020
Digits - Direct (WAIS-IV)	7,53	1,301	7,85	1,075	-2,061	,046
Digits – Reverse (WAIS-IV)	5,13	1,285	5,42	1,279	-1,740	,090
Digits – PE (WAIS-IV)	8,75	2,362	9,30	1,964	-2,598	,013

The cognitive data shows significant improvements in the three fields of the verbal fluency test, the digit-symbol coding and the digits tests. The reverse digits test did not significant.

Comparing the data obtained in the key of numbers tests and digits tests in the post-test with a sample of standardized with those ages, the average of the score of the digital test approaches the optimal mean for that population. And in the key of numbers test the average of the subjects exceeds the standardized average optimal.

Discussion

The purpose of this study was to verify if there was an improvement after performing physical exercise over a period of time with established guidelines in the cognition, affectivity and quality of life perception. Previous studies show how there is a significant change in various parameters measured in patients who have participated in these activities; however, it hasn´t yet been clarified what type of exercise, duration, frequency and time frame is necessary to reach lasting improvement in both psychological and cognitive aspects. The results of this study are similar with previous results that showed improved psychological parameters. Specifically, participants who underwent 10 weeks of aerobic exercise significantly improved their anxiety and depression scores, these results are reported in previous studies[2].

The quality of life was another parameter evaluated in this study, which tried to verify if the health perception of the subjects improves after patients enrol in the physical exercise therapy. The results show how subjectively patients perceive a higher quality of life during the first 10 weeks of exercise pattern; our data is consistent with these findings[12].

The patients who presented previous physical pathology had difficulties realizing the activities of the daily optimal way. Based on the results of the EUORqOL participants who have problems walking, maintaining personal care, performing daily activities, or managing pain showed improvement and reduction of pain after starting the exercise.

Additionally, other aim of this study is to analyze if the exercise could improve the cognition; specifically, memory, attention, processing speed and verbal fluency. The verbal fluency test and the number key and digits revealed participants showed improvement in attention, semantic memory, working memory, processing speed, visomotor skills and resistance to distraction. These results reinforce that exercise improve several domains of cognition[13,14]. All these parameters are essential for the day to day and an adequate and efficient use of them is a necessary requirement for a correct autonomy and to perform a productive work activity. The cognitive effects of aerobic exercise could be very important because these findings will facilitate research regarding degenerative pathologies as Alzheimer in improving memory performance and reducing hippocampus atrophy[18]. Additionally, the study could benefit subjects who are still healthy and increase their cognitive qualities.

Conclusion

After 10 weeks of aerobic exercise, participants showed significant improvements in all the studied parameters. A re-evaluation is needed to check if they are maintained over time or if there are variations to the low or the high. This allows us to be more precise with the optimum time to guide physical exercise, confirming in this way if aerobic exercise has only short-term effects or if it is necessary to increase the intensity of the exercises in the long run to maintain the effects.

These results of the three parameters show possibility of great advances in complementary therapies, which improve aspects present both in physical therapy and in psychological consultation in patients who maintain ailments for long periods of time.

This study has limitations since the pathology of the patients is not similar and the path and time of the disease either. The ages and gender of the patients is also very heterogeneous. The usual treatment that patients follow is also heterogeneous, as indicated by the corresponding specialist. The intervention exercise is similar in each one, however, it adapts to the aerobic capacity of each of them. Therefore, it is necessary to go deeper into the line of this research.

Ethical Clearance: Taken from The Ethics Committee for Research related to Human Beings of the Mutual center where the investigation was conducted. Ethical and deontological principles in relation to the people taking part in the study and handling the data obtained were complied

Source of Funding: The authors received no external funding

Conflict of Interest: The authors declare no conflict of interest.

References

1. Bernstein, E.E., McNally, R.J. Acute aerobic exercise helps overcome emotion regulation deficits. Cogn.Emot. 2017:31 (4): 834-843.
2. Carek P.J., Laibstain S.E., Carek S. M. Exercise for the treatment of depression and anxiety. Int J Psychiatry Med. 2011:41(1):15-28.
3. Cassilhas, R.C., Lee, K. S., Fernandes, J., Oliveira, M.G., Tufik, S., Meeusen, R., de Mello M. T. Spatial memory is improved by aerobic and resistance exercise through divergent molecular mechanisms. Neuroscience. 2012:202: 309-317.
4. Kandola, A., Hendrikse, J., Lucassen, P.J., Yucel, M. Aerobic exercise as a tool to improve hippocampal plasticity and function in humans: Practical implications for mental health treatment. Front. Hum.Neurosci. 2016:10: 373.
5. Zach, S., Shalom, E. The influence of acute physical activity on working memory. Percept. Mot. Skills. 2016:122(2): 365-374.
6. McAuley, E., Bane, S. M., Rudolph, D.L., Lox, C.L. Physique anxiety and exercise in middle-aged adults. J. Gerontol. B Psychol.1995: 50 (5):229-235.
7. deBruin, E. I., Formsma, A.R., Frijstein, G., Bogels, S. M., 2017. Mindful 2 Work: Effects of combined physical exercise, yoga and mindfulness meditations for stress relieve in employees. A proof of concept study. Mindfulness. 2017: 8 (1) 204–217.
8. Kahl, K.G., Utanir, F., Schweiger, U., Kruger, T. H., Frieling, H., Bleich, S., Gutberlet M., Hartung D. Reduced muscle mass in middle-aged depressed patients is associated with male gender and chronicity. Prog. Neuropsychopharmacol. Biol. Psychiatry. 2017: 2 (76):58-64.
9. American Psychiatric Association. Diagnostic and statistical manual of mental disorders (5th ed.) American Psychiatric Publishing, Arlington, VA. San Francisco; 2013.
10. Ku, P.W., Steptoe, A., Liao, Y., Sun, W.J., Chen, L.J. Prospective relationship between objectively measured light physical activity and depressive symptoms in later life. Int. J. Geriatr. Psychiatry. 2018: 33(1):58-65.
11. Taylor, M.K., Beckerley, S.E., Henniger, N.E., Hernandez, L. M., Larson, G.E., Granger, D.A. A genetic risk factor for major depression and suicidal ideation is mitigated by physical activity. Psychiatry Res. 2017: 249: 304-306.
12. Jürgens, I. Sport practice and perception of quality of life. 2006: 6 (22): 66-74.
13. Bullock, T., Giesbrecht, B. Acute exercise and aerobic fitness influence selective attention during visual search. Front.Psychol. 2014: 5: 1290.
14. Davranche, K., Audiffren, M. Facilitating effects of exercise on information processing. J. Sports Sci. 2004: 22 (5): 419-428.

15. Aberg, M.A., Pedersen, N.L., Toren, K., Svartengren, M., Backstrand, B., Johnsson, Cooper-Kuhn C. M., Aberg N.D., Nilsson M, Kuhn H.G. Cardiovascular fitness is associated with cognition in young adulthood. Proc. Natl. Acad. Sci.U. S.A. 2009: 106(49):20906-20911.
16. Esteban-Cornejo I1, Gómez-Martínez S, Tejero-González CM, Castillo R, Lanza-Saiz R, Vicente-Rodríguez G, Marcos A, Martinez-Gomez D. Characteristics of extracurricular physical activity and cognitive performance in adolescents. the AVENA study. J. Sports Sci. 2014:32(17): 1596-1603.
17. Duchesne, C., Lungu, O., Nadeau, A., Robillard, M.E., Bore, A., Bobeuf, F.,Lafontaine A.L., Gheysen F., Bherer L., Doyon J. Enhancing both motor and cognitive functioning in parkinson's disease: Aerobic exercise as a rehabilitative intervention. Brain Cogn. 2015:99:68-77.
18. Morris, J.K., Vidoni, E.D., Johnson, D.K., Van Sciver, A., Mahnken, J.D., Honea, R.A., Wilkins H. M., Brooks W. M., Billinger S.A., Swerdlow R. H., Burns J. M. Aerobic exerciseforalzheimer's disease: A randomized controlled pilot trial. PLoS One. 2017:12(2).
19. Esser, S., Bailey, A. Effects of exercise and physical activity on knee osteoarthritis. Curr. Pain Headache Rep.2011: 15 (6): 423-430.
20. Meng, X.G., Yue, S.W. Efficacy of aerobic exercise for treatment of chronic low back pain: A meta-analysis. Am. J. Phys. Med.Rehabil. 2015: 94 (5): 358-365.
21. O'Riordan, C., Clifford, A., Van De Ven, P., Nelson, J. Chronic neck pain and exercise interventions: Frequency, intensity, time and type principle. Arch. Phys. Med.Rehabil. 2014: 95 (4): 770-783.
22. Spielberger, C.D., Gorsuch, R.L., Lushene, R.E. Manual for the state-trait inventory. Palo Alto. Consulting Psychological Press; 1970.
23. Beck, A. T., Ward, C. H., Mendelson, M., Mock, J., Erbaugh, J. An inventory for measuring depression. Arch. Gen. Psychiatry.1961: 4: 561-571.
24. EuroQol Group. EuroQol--a new facility for the measurement of health-related quality of life. Health Policy. 1990: 16(3): 199-208.
25. Wechsler, D. Wechsler adult intelligence Scale—Fourth edition administration and scoring manual Pearson, San Antonio, TX; 2008.