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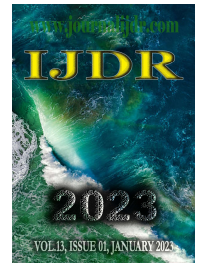
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THE EFFECT OF A TRAINING PROGRAM ON MOBILITY, BALANCE AND THE COURSE OF THE DISEASE IN THE PERSON WITH JUVENILE PARKINSON'S: PRE AND POST INTERVENTION OBSERVATIONAL STUDY

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ABSTRACT

Parkinson's disease (PD) is a slow and progressive neurodegenerative disease that falls into the category of movement disorders. The main symptoms of the disease are four: tremor (even at rest), rigidity, bradykinesia or akinesia and postural instability. In literature it appears that physical exercise has a real benefit for the symptoms of Parkinson's disease. The objective of the study was to investigate the effects of a quarterly exercise program on motor skills of a sample of patients with juvenile Parkinson's (adults up to 65 years). From April to July 2022, the effectiveness of a low intensity physical education program was evaluated in a sample of people diagnosed with juvenile PD (n = 13). The subjects underwent two light gymnastics workouts and one ballroom dance session per week. For the pre and post evaluations the following scales / tests were used: Tinetti Scale, ADL, IADL, Four Step Square Test (FSST), Time Up And Go (TUG). After three months the subjects showed a clear improvement as regards the Tinetti Scale (MT0 = 16.84; MT3 = 23). The ADL and IADL scales had a slight increase at the end of the study (MT0 = 4.15, 4.23; MT3 = 5, 4.36) but were not statistically significant. As for timed tests, they did not show a significant change at the end of the study. The twelve-week training program improved balance and gait in patients with juvenile Parkinson's, but it would be necessary to prolong the study or increase the intensity to obtain valid results on the subject's mobility and autonomy. A proposal is to create, together with the multidisciplinary team, an individualized training program according to the characteristics of the patient.

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INTRODUCTION

Parkinson's disease (PD) is a chronic and progressive neurodegenerative disease that causes disability and increased mortality (Wu *et al.*, 2017). In PD, the cells responsible for the production of dopamine degenerate over time (Intzandt *et al.*, 2018). The pathology generally occurs at the age of 65-70 years and it is more frequent in men (Tysnes *et al.*, 2017). The symptomatology is characterized by motor symptoms such as bradykinesia, rigidity, postural instability and tremor. However, secondary (nonmotor) symptoms such as depression, constipation, urinary incontinence and sleep disorders may also occur. All these symptoms can cause a deterioration in quality of life (Tysnes *et al.*, 2017; Rafferty *et al.*, 2017). It is estimated that almost 6.1 million individuals worldwide are affected by PD (Koop *et al.*, 2019). In the literature we estimate a prevalence of the disease from 108 to 257 per 100,000 people per year and incidence rates from 11 to 19 per 100,000 people per year. In Europe the incidences decrease and vary from 5 to 26 per 100,000 people per year.

These changes observed in prevalence and incidence rates may result from environmental, genetic or different methodologies used in the studies (von Campenhausen *et al.*, 2005). The onset of the disease before the age of 65 is called juvenile Parkinson and it is less frequent. Early onset is usually attributable to genetic abnormalities (5-10% of cases) (Tysnes *et al.*, 2017). In the literature it appears that physical activity (PA) can improve aerobic endurance, muscle strength and walking ability. It can also improve nonmotor symptoms (Kim *et al.* 2019). PA, in association with an adequate drug therapy and a healthy living behavior, is able to slow the progression of the disease. A four-week training program is able to improve balance in people with PD (Gandolfi *et al.*, 2019), while if extended to eight weeks, mobility is also improved (Koop *et al.*, 2019). The promotion of physical exercise by health professionals helps to face up to the problem of physical inactivity among people with neurological diseases (Kim *et al.* 2019), it is important to encourage people with PD to have a regular training program right from the initial stages of the pathology. The nurses' skills are not based only on the promotion of the public administration, but also on the evaluation of the adherence to the therapeutic project and on the progress of the person.

The aim of the study is to investigate the effects of a quarterly exercise program on the motor abilities of a sample of patients with juvenile Parkinson (adults up to 65 years).

MATERIALS AND METHODS

A convenience sample of 13 subjects diagnosed with Parkinson was enrolled with an observational study design (Table 1). The inclusion criteria were age below 65, physical inactivity for at least 3 months and the ability to carry out the proposed tests independently. Subjects joined a light gymnastics training program for an hour twice a week and an hour of ballroom dancing once a week. The light gymnastics training included specific exercises for the trunk, balance, gait and mobility, while in the dance session slow and traditional Waltz, Cha Cha Cha, Mazurca, Bachata and Tango were included. The study lasted three months, from April to July 2022, for a total of four assessments (T0-T1-T2-T3). Reassessment of the scales and tests was performed after each month at the end of the training session. The Tinetti Scale (TMT) was used to evaluate balance and gait, validated at Italian level for people with PD (Ricci *et al.*, 2013; Tinetti *et al.*, 1986; Kegelmeyer *et al.*, 2007; Curcio *et al.*, 2016; Rivolta *et al.*, 2019), composed of two parts (gait, balance) and with a final score from a minimum of 0 to a maximum of 28. The Activity Daily Living (ADL) and Instrumental Activity Daily Living (IADL) scales were used to assess autonomy in daily life activities, with a score from 0 to 6 and from 0 to 7 (Pezzuti *et al.*, 2008; Katz *et al.*, 1970; Lawton *et al.*, 1969). To assess balance and mobility the subjects underwent two timed tests: the Four Step Square Test (FSST) in which a score lower than 9.68 seconds is associated with an increase in the risk of falling, and the Time Up And Go (TUG). The FSST test consists of sequentially bypassing four lines in a cross configuration on the ground, while the TUG measures the time it takes for a person to get up from a chair, walk three meters, go back and sit down again (Nordin *et al.*, 2008; Moore *et al.*, 2017). The analysis of univariate descriptive statistics was carried out on all the study variables, in particular the mean, the standard deviation and the median and the coefficient of variation were calculated for each group. Bivariate analyzes were carried out for the comparison between variables and the correlation indices of each pair of variables were calculated. Subsequently, parametric tests were used, the Analysis of Variance (Anova) test was used for repeated measurements to investigate statistical significance as these variables did not result in a linear trend. Mauchly's preliminary sphericity tests and the Greenhouse-Geisser correction test (F test) were performed. The T-test method was used to obtain the significance of the variation from the time T3 to time T0. Finally, the post-hoc test was performed to assess what groups had statistically significant differences between them. In the preliminary phase, informed consent was given for the processing of personal data. Privacy has been guaranteed by the assignment of an identification code.

RESULTS

The mean value of the TMT was equal to 16.85 at time T0 (median = 18). In subsequent surveys, a progressive increase was noted until reaching an average value of 23.00 (median = 23) at time T3. The correlation indices showed a strong positive relationship between two subsequent surveys since they were all higher than 0.9. The Mauchly sphericity test (p-value = 0.001), the Greenhouse-Geisser correction (p-value = 0.000) and any difference between the periods (T0-T1-T3-T4) are statistically significant. Also in the results of the ADL scale the average undergoes an increase from the time T0 to the time T3, going from 4.15 to 5.00. The linear correlation indices were all above 0.9. The Mauchly sphericity test (p-value = 0.079) and the F test (p-value = 0.001) are in contrast with each other. However, there is an overall difference between the four surveys, only the comparison between T0 and T1 does not appear to be statistically significant (p-value = 0.237). As regards the IADL scale, a slight increase in the average was noted (from 4.23 to 4.77). The correlation indices were higher than 0.9 so there appears to be a strong positive relationship

between the pairs of moments. However, insubsequent investigations, no difference between the average values of the different surveys was found to be statistically significant. In the TUG time test a slight decrease of the average was noticed (decreased from 11.22 in T0 to 10.07 in T3).

Table 1. Characteristics of the study sample (n=13)

Gender Percentage	
Males	61,54%
Females	38,46%
Mean Age	62 ±2,8
Years from diagnosis*	8,7 ± 3,4

*Since the symptomatology occurs after a long time, two years are added at the time of diagnosis

The linear correlation indices were all higher than 0.9 while the Mauchly spherical test (p-value = 0.001) and the F test (p-value = 0.092) were in contrast with each other. In fact, no comparison of the moments is statistically significant. In the FSST time test a rapid decrease of the average was noticed, passing from 12.05 in T0 to 11.17 in T1. The linear correlation indices were all higher than 0.9 while the Mauchly spherical test (p-value = 0.546) and the F test (p-value = 0.001) were in contrast with each other. The comparison between T0 and T2 (p-value = 0.018) and between T0 and T3 (p-value = 0.010) were statistically significant.

DISCUSSION

After the quarterly training program the sample showed a potential improvement in terms of balance and gait. The results obtained are substantially comparable to those described in the literature even considering a longer training period as suggested by other authors (Gandolfi *et al.*, 2019; Hubble *et al.*, 2019; Jenu *et al.*, 2017). A 60-minute training session with low intensity 3 times a week was planned in the survey. Other studies suggest to do a moderate intensity workout for 20-30 minutes 3-5 times a week (Kim *et al.*, 2019) or to use a medium-high intensity BP (Koop *et al.*, 2019; Kim *et al.*, 2019; Schenkman *et al.*, 2017). From the comparison we can see how the intensity variable is not significant in terms of outcome but the training time varies. This allows us to affirm that the PA can be customized according to the needs of each individual or to his physiological characteristics. Younger people could opt for a more intense but shorter training while the older ones could undergo a longer but less intense training session. In literature, researchers have integrated the PA with additional tools such as the treadmill (Schenkman *et al.*, 2017) or the exercise bike (Koop *et al.*, 2019), or by inserting specific training techniques (yoga, aerobic exercises, dance, boxing) (Domingos *et al.*, 2019). Another opportunity to be considered is to carry out the PA in the gym, under the supervision of the personal trainer, or that of exercising a sport. All the proposals described up to now allow to obtain valid results on the progression of the symptoms related to PD.

Regarding the mobility factor, the TUG and FSST tests showed no significant improvements. In fact, an average increase in time was noted in the motor activities provided for in the assessment exercises. In the literature the authors suggest that stretching in dedicated training sessions and weekly re-evaluation of the results may contribute to the reliability of the results obtained. In the proposed program, stretching exercises were performed but not in specific sessions and the re-evaluations were performed monthly (Gandolfi *et al.*, 2019; Shulman *et al.*, 2015). The given mobility is also influenced by the need, required by a low intensity training, to extend the end of training sessions beyond three months. We can therefore conclude that the program could be supplemented by including one-week assessments with dedicated stretching sessions over a period of more than three months. The figure relating to the perceived performance of daily life activities showed a positive trend. Despite this, occasional incontinence, dressing, undressing and personal hygiene continue to be critical factors for the people being studied. This altered perception could be solved by improving the emphasis and

therefore the communication of the results obtained by the person, allowing also to improve the compliance towards the physical exercise. Among the instrumental activities the preparation of drugs, meals, the management of purchases in the shops, transport, care of the house and linen are the cause of embarrassment. All these activities have a social value and in addition to involving the individual in his everyday life they often involve a human relationship. This being said, often individuals with PD tend to marginalize in an attempt to hide the loss of autonomy that the disease implies (Koop *et al.*, 2019; Kim *et al.* 2019; Intzandt *et al.*, 2018; Dupouy *et al.*, 2017).

It is therefore useful to insist on training programs that, by creating groups, lead the individual to the need to socialize. You can propose team games or dance sessions to encourage communication between the subjects and reduce their marginalization. With regard to drug preparation and domestic activities, it is noted that men are supported in percentage terms by a third party (wife or partner). For this it is necessary that the health professional performs an interview with the caregiver to identify the activities of daily and domestic life as therapeutic strategies, in order to increase the perception of improvement. In literature, as in the study conducted, a widely found problem is that of therapeutic adherence. An eight-week training program has been created to be performed at home (Atterbury *et al.*, 2017). Although this program is beneficial for people who have little time to participate in training groups, only the group supervised by the therapist has achieved valid clinical and mobility improvements. The presence of the professional confers greater security in the execution of the exercises since it supervises and corrects the movements of the individual, also assesses the therapeutic adherence. Another survey also showed that interactive video games can improve balance disorders in people with neurological diseases, particularly in PD (Perrochon *et al.*, 2019). It could therefore be a significant alternative to maintain an adequate public administration, even at home, or it could be a valid addition to the training program. It is however the responsibility of the health professional to evaluate the adherence to the therapeutic project and help the individual in choosing the training program most suitable for him and his daily life.

CONCLUSIONS

In literature it emerges that training improves the physical abilities and the course of the pathology in people suffering from Parkinson's disease, in fact the results obtained allow us to say that a low-intensity quarterly physical education program is effective in enhancing motor skills, gait and balance in patients with juvenile Parkinson's. However, to have a significant improvement in mobility it would be necessary to extend the duration of the training or increase its intensity. In the future, one could think about conducting a randomized controlled trial on different training intensities to assess whether there are any significant differences. Given also the poor improvements in terms of perception regarding autonomy in everyday life and in instrumental activities, an active collaboration of the multi-professional team is recommended to establish a personalized training program. Therefore, in the training program the health professional should be constantly present, evaluating the therapeutic adherence and the progress obtained with the PA.

Conflict of Interest Statement: The authors have no conflicts of interest related to this work.

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