Journal of Advanced Sport Technology 4(1): 93-104 Received: March. 10, 2020; Accepted: June. 23, 2020

Original Research

The Effect of Rhythmic Auditory Cue on the Lower Limb Muscle Activity during Cycling in the Elderly Subjects

Shirin Yazdani[1*], Mohammadtaghi Aghdasi[2], Saba Mohammadalinezhad[3]

1. *Department of motor behavior, Faculty of Physical Education and Sport Sciences, University of Tabriz, Tabriz, Iran. Email* Sh_yazdani@tabrizu.ac.ir , *ORCID:* 0000-0002-0549-9694
2. *Department of motor behavior, Faculty of Physical Education and Sport Sciences, University of Tabriz, Tabriz, Iran. Email: mt.aghdasi@yahoo.com , ORCID:* 0000-0001-8921-1856
3. *Department of motor behavior, Faculty of Physical Education and Sport Sciences, University of Tabriz, Tabriz, Iran. Email: saba.mohammadali67@gmail.com , ORCID:* 0000-0002-5169-0342

ABSTRACT

Rhythmic auditory cue is one of the accepted techniques for the rehabilitation and improvement of motor control in the healthy elderly and who with movement disorders. The aim of this study was to determine the effects of auditory cue on the EMG activity of the elderly subjects during cycling. 10 healthy elderly males participated in this study. The EMG activity of rectus femoris (RF), biceps femoris (BF) and tibialis anterior (TA) muscles were recorded using an EMG-USB2+ multichannel system (Bioelettronica Italy) (sampling frequency of 1000 Hz) and bipolar surface electrodes. Using OT BioLab software the signals were processed and the RMS of signals was obtained. For the tests, the subjects were asked to pedal with preferred speed with and without rhythmic auditory cue. Each condition was repeated for three times, and each test lasts for one minute. There was 3-minutes rest between repetitions. Data was analyzed using SPSS software (version 24) and repeated measure analysis of variance and paired sample t-tests with significance level of 0.05. The results showed that, the normalized muscle activity in pedaling with auditory cue was significantly higher than that of pedaling without an auditory cue ($P=0.05$). During pedaling with auditory cue, the normalized EMG activity of right RF and left TA muscles were approximately 1.25 ($p=0.03$) and 1.22 ($p=0.04$) significantly greater than un-cued condition, respectively. In conclusion, rhythmic auditory cue increased the EMG activity of the lower extremity muscles among the elderly. So, in designing an appropriate training and rehabilitation program for the lower extremity muscles in the elderly, the use of auditory cue while pedaling as an easy and low-cost training method can be recommended.

Keywords: cycling, auditory cue, electromyography, elderly

Corresponding Author: Shirin Yazdani, Department of motor behavior, Faculty of Physical Education and Sport Sciences, University of Tabriz, Tabriz, Iran. Email: Sh_yazdani@tabrizu.ac.ir Tel: +989144035737 Fax: 04132356008

Introduction

It is expected that after 50 years the Iranian elderly population will be increased approximately 11% (1). There are some difficulties about health care systems of the elderly people (2). Falls are a major public health concern in this population (3). Approximately 25% to 35% of people aged 65 years or older experience falls each year. The epidemiology of falls shows that more than 50% of the falls occur during some form of locomotion (4). Falling in the elderly people can lead to disability, hospitalizations, and premature death (5,6). Therefore, most of the trainers and physicians exploring the exercises and rehabilitation programs which prevent falling (7).

Recently, rhythmic auditory cues are among the most widely accepted techniques for the rehabilitation and improvement of motor control in the healthy elderly and who with movement disorders (8,9,10). Rhythmic auditory cue is not expensive (11), and it has been considered as an easy-followed method as well as a home-based training program (12,13). Using auditory cue like a metronome, the movement will synchronize with the rhythm of metronome (14). By utilizing this method, Gai et al (2018) reported an increase in spatiotemporal variables of gait like cadence and stride length in the healthy elderly subjects (15). Also, in the elderly with Parkinson diseases, the positive effect of auditory cues with an increase of speed, cadence and stride length, reduction of freezing of gait and improvement of automatic gait have been addressed in many studies (8, 9, 16-19). In another study, Thaut et al., has found that auditory cues during walking improved temporal stride symmetry and consistency in stroke patients (20).

Moreover, from a neurophysiological aspect, the interactions between the auditory cue and the motor systems have been reported by many researchers (21,22). The neuronal network underlying sensorimotor timing has been associated with the beneficial effects of auditory cueing (21,22). In this regard, some studies have shown that auditory cues could be an efficient neuromuscular entrainment signal in the gait of stroke patients and auditory cues increase amplitude and decrease variability of the timing of Gastrocnemius muscle's EMG activity to improve muscular control in gait (20). Also, Rinaldi et al (2014) reported greater muscular activity during walking with auditory cue in association with drug intake in Parkinson patient and they confirmed the hypothesis about the external cues therapy that could be used as a complement to drug therapy in the improvement of locomotor pattern in Parkinson patients (23). Furthermore, Paltsev and Elner (24) and Rossignol and Jones (25) have shown that sound input can modify EMG activity and timing in spinal motor reflexes. Furthermore, in the study of Ridgel et al., in 2015, 3 sessions of high intensity cycling improved motor symptoms in both upper and lower extremities and reduced falling risk in Parkinson subjects. Based on the results of this research, auditory cueing modulates cycling speed of older adults and people with Parkinson disease (26).

According to the literature review, there is a wide range of studies which have investigated the effect of auditory cues on the kinematic variables of gait. But there is a lack of study about investigating the effect of auditory cues during cycling. Previous study of de Aguiar Greca in 2019 has shown that at similar physiological loads, peak compressive and peak shear forces on the knees and ankles during walking were greater than during cycling. Also, ankle moments were significantly smaller during cycling than walking and joint loading during cycling is less than during walking which indicate that in certain pediatric clinical population, cycling may result in less joint pain and thereby reduce barriers to physical activity (27,28,29).

As mentioned above, auditory cues and cycling both have main effect on the motor performance improvement in the elderly subjects. So that, persons with Parkinson diseases increased their pedaling rate in the auditory cueing condition (30). However, the changes of muscle activity during cycling with and without auditory cues has not been well studied, yet. A better understanding of EMG activity during cycling with auditory cues could provide precise information for trainers and physicians in designing an appropriate exercise and rehabilitation programs. So, the aim of this study was to assess the EMG activity of lower limb muscles of elderly subjects during cycling while rhythmic auditory cueing. We hypothesized that rhythmic auditory cue would change lower limb muscles of elderly subjects during cycling.

Material and Methods

Participants

10 healthy elderly males with mean age of 60.7±4.3 years, weight of 71.2±7.7 kg and height of 171.5±4.1 cm respectively participated in this study voluntarily. The participants were fully informed about the purpose and procedure of the experiment. Then, they read and signed an institutionally approved consent form prior to entry. The inclusion criteria consist of no history of falls and independence in daily living activities such as walking. The subjects were excluded if they had a history of neuromuscular and skeletal disorder, pain limiting daily activities, the problems in hearing, vision and vestibular systems, Parkinson disease, balance disorders, Alzheimer, and any fractures or injuries in the lower limbs. All measurements were done in a single session in the morning.

Experiment procedure

Before the recording muscle activity, the preferred speed of pedaling on a bicycle was determined. For this aim, subjects were asked to pedal with the comfortable speed about 2 minutes, then they ride as fast as possible for 20 seconds, after then they return to a comfortable speed for 2 minutes and the speed of the last 2 minutes is recorded as the preferred speed (30). For pedaling with auditory cueing, a metronome beat was used which placed in front of the bike and heard through a pair of speakers. Also, the RPM sensor was used for matching the metronome beats with cycling speed. The subjects should match the pedal speed with metronome beat. For this, the preferred pedaling speed was measured in revolutions per minute (RPM). The metronome was set as, 2 beat per minute (BPM) was equal to 1 RPM. For example, if a subject had a baseline pedaling speed of 30 RPM, the matched metronome rate was 60 BPM (30). The participants should have listened to metronome beat and every time they hear the beat, they should push down on the pedal with their right, left, right, left, etc. (30). The RPM sensor was A Wahoo RPM cadence sensor which has attached to the crankshaft of the bicycle measured the RPM of the participant at 60Hz and it was connected to the computer with Bluetooth. The model of bike was Azimuth AZ R30.

For recording muscle activity, an EMG-USB2+ multichannel system (Bioelettronica Italy) (sampling frequency of 1000 Hz) and bipolar surface electrodes were used to record the activity of the tibialis anterior (TA), rectus femoris (RF) and biceps femoris (BF) muscles bilaterally. Before the tests, the exact location of the electrodes was determined and the skin area were shaved and cleaned with 70% alcohol. Then bipolar surface electrodes were placed parallel to the muscle fibers based on the standard method. The electrode of rectus femoris muscle was placed at the midway between the anterior superior iliac spine and the upper edge of patella (31). The location of the biceps femoris electrode was at 50% of the line between the gluteal line and knee joint (32) and for the tibialis anterior, the electrode was positioned on one-third of the line between the head of the fibula and the internal malleoli (33). The reference electrode was placed on the participant’s wrist. Then the electrodes and wires were fixed by using tape to avoid noise.

After preparing subjects, they were asked to pedal under 2 conditions, including A) pedal with preferred speed without auditory cue and B) Pedal with rhythmic auditory cue which explained above. Each condition was repeated for three times, and each test lasts for one minute. There was 3-minutes rest between repetitions.

To normalize EMG data, electrical activity was recorded during a maximum voluntary isometric contraction (MVIC) for each of the rectus femoris (34), biceps femoris (35) and tibialis anterior (36) muscles. The MVIC tests were performed before the pedaling tests. The gathered signals were processed using OT BioLab software with band pass filter of 10-350 Hz and notch filter of 50 Hz and the RMS of signals were obtained (20). The size of window was set at 200 milliseconds. The mean RMSs of three repetitions was divided by the maximal RMS obtained from the MVIC test of the same muscle and expressed as a percentage of MVIC.

Statistical analysis

The data were processed using the SPSS 24 software. Using the Shapiro-Wilk and Leven tests the normality and homogeneity of variance were determined respectively. Repeated measure analysis of variance and depended t-test were used for statistical analysis with significance level of 0.05.

Results

Table 1 shows the results of normalized EMG activity of RF, BF and TA muscles during pedaling with and without auditory cueing. As it can be seen in this table, during pedaling with auditory cue, the normalized EMG activity of right RF and left TA are approximately 1.25 ($p=0.03$) and 1.22 ($p=0.04$) significantly greater than pedaling without auditory cue respectively. However, there were not any significant differences between the electrical activity of the bilateral BF ($p>0.05$), left RF ($p=0.55$) and right TA muscles ($p=0.28$) between the two conditions.

Also, the result of repeated measure showed that in general, the normalized muscle activity in pedaling with auditory cue was significantly higher than that of pedaling without an auditory cue (figure 1).

Table 1: Normalized EMG activity of right and left rectus femoris, biceps femoris and tibialis anterior muscles during pedaling with and without auditory cue

muscle	Side	Pedaling without auditory cue	Pedaling with auditory cue	P value
rectus femoris	Right	44.5±11	56±20.7	0.03*
	Left	44.5±19.6	47.7±20.2	0.55
biceps femoris	Right	40.1±15.2	50.7±19.8	0.06
	Left	43.3±17.7	46.8±19.2	0.31
Tibialis anteriot	Right	41.1±18	46.7±14.2	0.28
	Left	44±20.2	54.1±21.5	0.04*

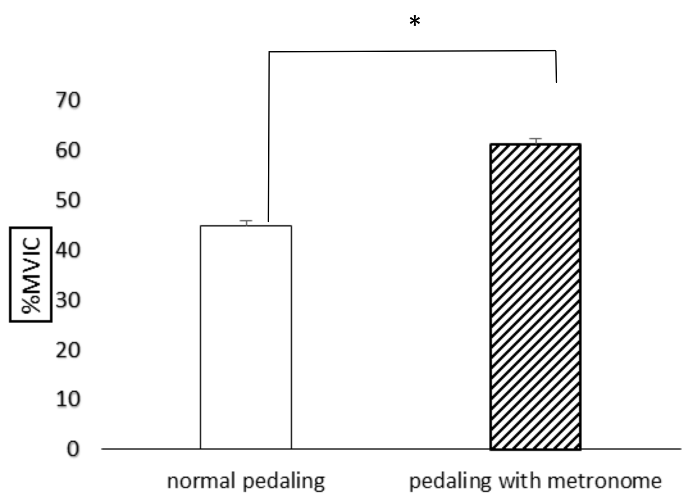

Figure 1. Normalized muscle activity in pedaling with and without auditory cue

Also, results showed that during pedaling, the effect of the auditory cue on the activity of RF, BF and TA muscles was similar and there was no significant interaction between the auditory cue and muscle factors ($p=0.97$). Figure 2 shows this result.

In addition, as can be seen in figure 3, the interaction between auditory cue, side and muscle factors was not significant (p=0.84).

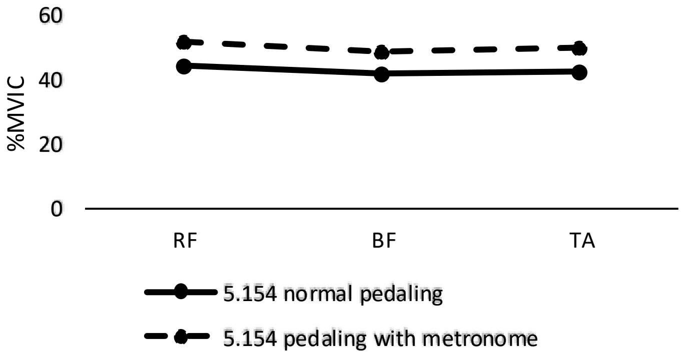

Figure 2: Interaction between the auditory cue and muscle factors

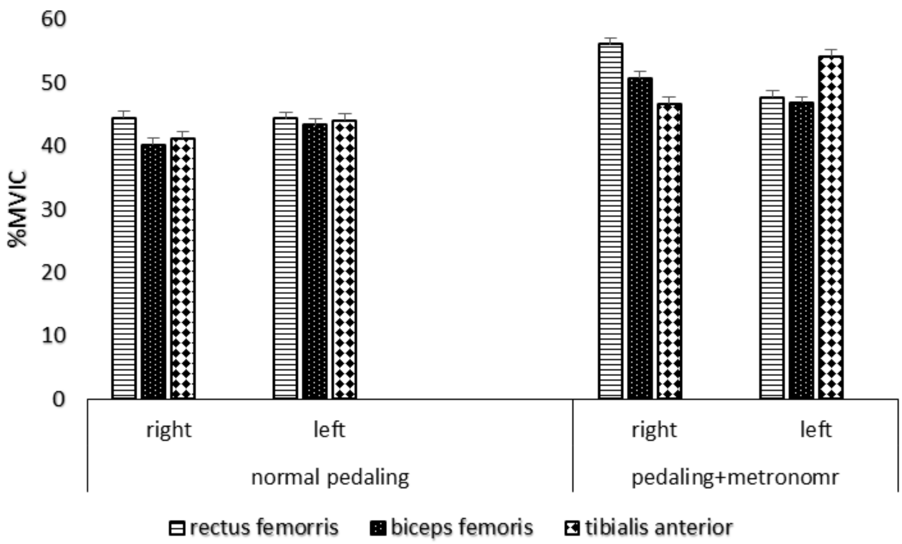

Figure 3: Interaction between the auditory cue, side and muscle factors

Discussion

The aim of this study was to determine the effect of the auditory cue on the electromyographic activity of rectus femoris, biceps femoris and tibilais anterior muscles while pedaling in the healthy elderly group.

The results showed that pedaling while auditory cue leads to higher activity of the rectus femoris and tibilis anterior muscles than un-cued pedaling. By reviewing the literature, there was no study which investigates the effect of the auditory cue on the EMG of the elderly while pedaling and the results of the current study are reporting for the first time. In the previous study by Fernández-del-Olmo (2003), (37) the burst of EMG in tibialis anterior and gastrocnemius muscles, slope of each burst and the its duration were studied in Parkinson disease during gait with and without external rhythm (click tone). In agreement with our results, they found that with stimulation, the slope of the EMG activation increased. Also, in their study the duration of EMG activation and the interval between EMG responses decreased. Furthermore, in support of the results of this study, Rinaldi et al (2014) reported higher TA muscular activity in the terminal swing phase of gait with auditory cue in association with drug intake in Parkinson patients (23). But the result of this study did not confirm our results about the BF muscle activity. They reported higher BF muscle activity during auditory cues but, in the current study, the activity of BF muscle did not differ between two cued and un-cued conditions. This can be for many reasons including: the studied subjects, the medical condition and the task. As mentioned above, they studied Parkinson subjects who intake, medication while walking with auditory cue.

The increased EMG activity of biceps femoris and tibialis anterior in this study can be explained as below. Performing two tasks concurrently (pedaling and hearing metronome beats) may provide an interference between the motor (pedaling) and cognitive (auditory cue) tasks. Due to the competition between cognition demands during pedaling, the need for attention may increase (38), which may reveal by increased muscle activity. In this regard, previous studies have shown that dual-task performance during walking predisposes the subject to gait instability and falls by increasing cognitive, motor interferences (39,40,41), so they increase their muscle activity for better motor performance and prevent falling.

Moreover, some evidence suggests that rhythmic sound patterns can increase the excitability of spinal motor neurons via the reticular spinal pathway, thereby reducing the amount of time required for the muscles to respond to a given motor command. Rossignol and Melvill Jones (25) investigated the audio-spinal influences by using an H-reflex technique. They reported that a sound burst increased the H-reflex amplitude prior to hopping movements synchronized with a musical rhythm. They also showed that enhanced gastrocnemius muscle activity during movement occurred while the H-reflex cue was not maintained during the combination cue condition (25).

Also, previous studies have shown kinematic changes such as longer stride length, higher speed and normalized cadence during walking with auditory cue due to altered joints kinematic (42,43,44). The alternation of joints kinematic during auditory cue may lead to increased muscle activity which has seen in this study. It is a hypothesis which needs further studies.

As during the cycling with rhythmic auditory cue, the person should pedal according to metronome beats, so it may change the timing of muscle recruitment and activity, but in the current study the RMS of signals was investigated. A survey on the timing of muscle activity during pedaling with auditory cue recommended strongly.

In this study, the effect of rhythmic auditory cue on the muscle activity of male elderly subjects was investigated during cycling, so the results cannot be generalized to functional activities and female subjects.

Conclusion

In conclusion, results showed that auditory cue increased muscle activity while pedaling in the elderly. So, in designing an appropriate training and rehabilitation program for the elderly subjects who have weaker lower limb muscles, the use of auditory cue while pedaling as an easy and low-cost training method is strongly recommended.

References

1. Bayatloo, A., Salavati, M., & Akhbari, B. The ability to selectively allocateattentional demands on walking during secondary cognitive and motor tasks in elderly people with and without a history of falls. Iranian Journal of Ageing, 2011. 5(4): p. 0-0.
2. Noroozian, M. The elderly population in iran: an ever growing concern in the health system. Iranian journal of psychiatry and behavioral sciences, 2012. 6(2): p. 1.
3. 3Barak, Y., Wagenaar, R. C., & Holt, K. G. Gait characteristics of elderly people with a history of falls: a dynamic approach. Physical therapy, 2006. 86(11): p. 1501-1510.
4. Tinetti, M. E., Speechley, M., & Ginter, S. F. Risk factors for falls among elderly persons living in the community. New England journal of medicine, 1988. 319(26): p. 1701-1707.
5. Ellmers, T. J., Paraskevopoulos, I. T., Williams, A. M., & Young, W. R. Recalibrating disparities in perceived and actual balance abilities in older adults: a mixed-methods evaluation of a novel exergaming intervention. Journal of neuro engineering and rehabilitation, 2018.15(1): p. 26.
6. James B. Robinson, Julie Loebach Wetherell. An Interdisciplinary Intervention for Fear of Falling: Lessons Learned from Two Case Studies. Clinical Gerontologist, 2018. 41(4): p. 366-373.
7. Wong, S. L., Gilmour, H. L., & Ramage-Morin, P. L. Parkinson's disease: Prevalence, diagnosis and impact. Statistics Canada. 2014
8. Ford, M. P., Malone, L. A., Nyikos, I., Yelisetty, R., & Bickel, C. S. Gait training with progressive external auditory cueing in persons with Parkinson's disease. Archives of Phys Medicine and Rehabilitation, 2010. 91(8): p. 1255-1261.
9. Willems, A. M., Nieuwboer, A., Chavret, F., Desloovere, K., Dom, R., Rochester, L., … Van Wegen, E. The use of rhythmic auditory cues to influence gait in patients with Parkinson’s

disease, the differential effect for freezers and non-freezers, an explorative study. Disability & Rehabilitation, 2006. 28(11): p. 721–728.

10. Zijlstra, W., Rutgers, A. W. F., & Van Weerden, T. W. Voluntary and involuntary adaptation of gait in Parkinson's disease. Gait & Posture, 1988. 7(1): p. 53-63.
11. Zhao Y, Nonnekes J, Storcken EJ, Janssen S, Wegen EE, Bloem BR, et al. Feasibility of external rhythmic cueing with the Google Glass for improving gait in people with Parkinson’s disease. J Neurol, 2016. 263: p. 1156-1165.
12. Espay AJ, Baram Y, Dwivedi AK, Shukla R, Gartner M, Gaines L, et al. At-home training with closed-loop augmented-reality cueing device for improving gait in patients with Parkinson disease. J Rehabil Res Dev, 2010. P. 47: 573
13. Pau M, Corona F, Pili R, Casula C, Sors F, Agostini T, et al. effects of Physical rehabilitation integrated with rhythmic auditory stimulation on spatioTemporal and Kinematic Parameters of gait in Parkinson’s Disease. Front Neurol, 2016. P. 7
14. Chen, J.L., Penhue, V.B., & Zatorre, R.J. The role of auditory and premotor cortex in sensorimotor transformations. The Neurosciences and Music III- Disorders and Plasticity, 2009. 1169: p. 15-34.
15. Ghai, S., Ghai, I., & Effenberg, A. O. Effect of rhythmic auditory cueing on aging gait: a systematic review and meta-analysis. Aging and disease, 2018. 9(5): p. 901.
16. Hausdorff, J. M., Lowenthal, J., Herman, T., Gruendlinger, L., Peretz, C., & Giladi, N. Rhythmic auditory stimulation modulates gait variability in Parkinson’s disease. European Journal of Neuroscience, 2007. 26(8): p. 2369–2375.
17. McIntosh, G. B., S., & Rice, R., Thaut, M. Rhythmic auditor-motor facilitation of gait patterns in patients with Parkinson’s disease. J of Neurology, Neurosurgery, and Psychiatry, (Journal Article), 1997. 62: p. 22–26.
18. Rochester, L., Baker, K., Hetherington, V., Jones, D., Willems, A. M., Kwakkel, G., ... & Nieuwboer, A. Evidence for motor learning in Parkinson's disease: acquisition, automaticity and retention of cued gait performance after training with external rhythmical cues. Brain Research, 2010. 1319: p. 103-111.
19. Baker, K., Rochester, L., & Nieuwboer, A. The effect of cues on gait variability-reducing the attentional cost of walking in people with Parkinson’s disease. Parkinsonism & Related Disorders, 2008. 14(4): p. 314–320
20. Thaut M, McIntosh G, Prassas S, Rice R. Effect of Rhythmic Auditory Cuing on Temporal Stride Parameters and EMG. Patterns in Hemi paretic Gait of Stroke Patients. J Neuro Rehab 1993. 7: p. 9-16
21. Kotz, S. A. & Schwartze, M. Differential input of the supplementary motor area to a dedicated temporal processing network: functional and clinical implications. Front Integr Neurosci 2011. 5: p. 86.

22. Schwartze, M. & Kotz, S. A. A dual-pathway neural architecture for specific temporal prediction. Neurosci Biobehav Rev 2013. 37: p. 2587–2596.
23. Rinaldi, N. M., Pereira, M. P., Formaggio, P. M., Morais, L. C., & Gobbi, L. T. B. Positive effects of auditory cue in locomotor pattern of people with Parkinson's disease (off and on medication). Revista Brasileira de Educação Física e Esporte, 2014. 28(4): p. 561-570.
24. Paltsev, E. I. change in the functional state of the segmental apparatus of the spinal cord under the influence of acoustic stimuli and its role in bringing about an arbitrary movement. Biofizika. 1967.
25. Rossignol, S., & Jones, G. M. Audio-spinal influence in man studied by the H-reflex and its possible role on rhythmic movements synchronized to sound. Electroencephalography and clinical neurophysiology, 1946. 41(1): p. 83-92.
26. Ridgel, A. L., Phillips, R. S., Walter, B. L., Discenzo, F. M., & Loparo, K. A. Dynamic high-cadence cycling improves motor symptoms in Parkinson's disease. Frontiers in neurology, 2015. 6: p. 194.
27. de Aguiar Greca JP, Ryan J, Baltzopoulos V, Korff T. Biomechanical evaluation of walking and cycling in children. Journal of biomechanics. 2019 Apr 18; 87:13-8.
28. Jafarnezhadgero A, Madadi-Shad M, Alavi-Mehr SM, Granacher U. The long-term use of foot orthoses affects walking kinematics and kinetics of children with flexible flat feet. 2018
29. Jafarnezhadgero AA, Majlesi M, Etemadi H, Robertson D. Rehabilitation improves walking kinematics in children with a knee varus: Randomized controlled trial. Annals of physical and rehabilitation medicine. 2018;61(3):125-34.
30. Gallagher, R., Damodaran, H., Werner, W. G., Powell, W., & Deutsch, J. E. Auditory and visual cueing modulate cycling speed of older adults and persons with Parkinson's disease in a Virtual Cycling (V-Cycle) system. Journal of neuroengineering and rehabilitation, 2016. 13(1): p. 77.
31. Contreras, B., Vigotsky, A. D., Schoenfeld, B. J., Beardsley, C., & Cronin, J. A comparison of gluteus maximus, biceps femoris, and vastus lateralis electromyography amplitude in the parallel, full, and front squat variations in resistance-trained females. Journal of applied biomechanics, 2016. 32(1): p. 16-22.
32. Merletti, R., Rainoldi, A., & Farina, D. Surface electromyography for noninvasive characterization of muscle. Exercise and sport sciences reviews, 2001. 29(1), p. 20-25.
33. Lin, H. T., Hsu, A. T., Chang, J. H., Chien, C. S., & Chang, G. L. Comparison of EMG activity between maximal manual muscle testing and cybex maximal isometric testing of the quadriceps femoris. Journal of the Formosan Medical Association, 2008. 107(2) p. 175-180.
34. Lee, S. Y., & Jo, M. E. Comparison of maximum voluntary isometric contraction of the biceps on various posture and respiration conditions for normalization of electromyography data. Journal of physical therapy science, 2016. 28(11), p. 3007-3010.

35. Tabard-Fougère, A., Rose-Dulcina, K., Pittet, V., Dayer, R., Vuillerme, N., & Armand, S. EMG normalization method based on grade 3 of manual muscle testing: Within-and between-day reliability of normalization tasks and application to gait analysis. Gait & posture, 2018. 60, p. 6-12.
36. Zadeh, M. A., & Moghadam, J. B. The effects of balance training on depression and quality of life in Parkinson's patients.
37. Fernández-del-Olmo, M., & Cudeiro Mazaira, F. J. A simple procedure using auditory stimuli to improve movement in Parkinson s disease: a pilot study. 2003.
38. Azadian, E., Taheri, H. R., Saberi Kakhki, A., & Farahpour, N. Effects of dual-tasks on spatial-temporal parameters of gait in older adults with impaired balance. Iranian Journal of Ageing, 2016. 11(4): p. 100-109.
39. Snijders A, Verstappen C, Munneke M, Bloem B. Assessing the interplay between cognition and gait in the clinical setting. J Neural Transm, 2007. 114: p. 13151321.
40. Muir-Hunter SW, Wittwer JE. Dual-task testing to predict falls in community-dwelling older adults: a systematic review. Physiotherapy, 2016. 102: p. 29-40
41. Ghai S, Ghai I, Effenberg AO Effects of dual tasks and dual-task training on postural stability: a systematic review and meta-analysis. Clin Interv Aging, 2017. 12: p. 557-577.
42. Freedland, R. L., Festa, C., Sealy, M., McBean, A., Elghazaly, P., Capan, A., ... & Rothman, J. The effects of pulsed auditory stimulation on various gait measurements in persons with Parkinson's disease. NeuroRehabilitation, 2002. 17(1) p. 81-87.
43. Arias P, Cudeiro J Effects of rhythmic sensory stimulation (auditory, visual) on gait in Parkinson’s disease patients. Exp Brain Res, 2008.186: p. 589-601
44. Arias, P., & Cudeiro, J. Effect of rhythmic auditory stimulation on gait in Parkinsonian patients with and without freezing of gait. PloS one, 2010. 5(3).

چکیده فارسی

تاثیر نشانه های شنیداری بر فعالیت الکتریکی عضلات پایین تنه حین پدال زدن در سالمندان

شیرین یزدانی*[1]، محمدتقی اقدسی[1]، صبا محمدعلی نژاد[1]

۱= گروه تربیت بدنی علوم ورزشی، دانشگاه تبریز ،تبریز ، ایران

نشانه های شنیداری یکی از تکنیک‌های مقبول در توانبخشی و بهبود کنترل حرکتی سالمندان و افراد دارای مشکل حرکتی می-باشد. هدف از مطالعه حاضر بررسی اثر نشانه‌های شنیداری بر فعالیت الکتریکی عضلات سالمندان در حین دوچرخه سواری می-باشد.

تعداد ۱۰ سالمند سالم مرد در این تحقیق شرکت کردند. با استفاده از دستگاه الکترومیوگرافی ۸۰ کاناله مدل +USB2 ساخت کشور ایتالیا با فرکانس نمونه برداری ۱۰۰۰ هرتز و الکترودهای سطحی ژله‌ای دو قطبی، فعالیت الکتریکی عضلات راست رانی (RF)، دوسر رانی (BF) و ساقی قدامی (TA) پای راست و چپ ثبت گردید. جهت نرمال سازی داده ها از روش MVIC استفاده شد. سیگنالهای به دست آمده با استفاده از نرم افزار OT Biolab پردازش شدند. برای این کار، از آزمودنی ها خواسته شد تا با سرعت ترجیحی خود در دو شرایط با و بدون نشانه ریتمیک شنیداری پدال بزنند. هر شرایط سه بار تکرار و هرکدام به مدت ۱ دقیقه اجرا شد. ۳ دقیقه استراحت بین تکرار ها وجود داشت. داده ها با استفاده از نرم افزار SPSS۲۴ و روش تحلیل واریانس ویژه داده‌های تکراری (Repeated measure) و t وابسته درسطح معنی‌داری ۰/۰۵ پردازش شدند. نتایج نشان داد که شدت فعالیت عضلات در پدال زدن با نشانه های شنیداری به طور معنی داری بیشتر از پدال زدن بدون نشانه های شنیداری بود (p=۰/۰۵). همچنین هنگام پدال زدن با نشانه شنیداری، شدت فعالیت عضلات راست رانی سمت راست و عضله ساقی قدامی چپ به طور معنی داری به ترتیب در حدود ۱/۲۵ (p=۰/۰۰۳) و ۱/۲۲ (p=۰/۰۴) برابر بیشتر از پدال زدن بدون نشانه شنیداری بود.

نشانه‌های شنیداری فعالیت الکتریکی فعالیت عضلات پایین تنه در سالمندان را افزایش میدهد. بنابراین در طراحی تمرینات مناسب و برنامه های توانبخشی برای اندام تحتانی سالمندان نشانه‌های شنیداری در حین پدال زدن بعنوان یک روش کم هزینه توصیه می‌شود.

واژه‌های کلیدی: پدال زدن، نشانه‌های شنیداری، الکترومایوگرافی، سالمندان