Journal of Associated Medical Sciences 2018; 51(1): 1-5

JAMS
Journal of Associated Medical Sciences

Thai-Journal Citation Index Centre (TCI) & ASEAN Citation Index (ACI)

Journal of Associated Medical Sciences

Journal homepage: https://www.tci-thaijo.org/index.php/bulletinAMS/index

Change in gait speed using the timed 10 meter walk test in individuals with neck pain

Nipaporn Wannaprom Somporn Sungkarat Sureeporn Uthaikhup*

Department of Physical Therapy, Faculty of Associated Medical Sciences, Chiang Mai University, Thailand

ARTICLE INFO

Article history:
Received September 2017
Received in revised form December 2017
Accepted as revised December 2017
Available online January 2018

Keywords:
Cervical pain, gait speed, neck pain, timed 10 meter walk test, walking speed

ABSTRACT

Background: Gait speed is an informative marker of individual's functional capacity and health status. Neck pain is suggested to be associated with impaired gait speed. However, there is limited evidence for a clinical assessment of gait speed in patients with neck pain.

Objectives: To investigate maximum gait speed using the timed 10 meter walk test in individuals with and without neck pain. Relationships between gait speed and characteristics of neck pain were also determined.

Materials and methods: Twenty six men and women aged between 18 and 59 years with chronic neck pain and 26 healthy controls of similar age and gender were recruited into the study. Participants were instructed to walk barefoot at their maximum speed along a 10 meter walk way. Time was recorded for the intermediate 6 meters. Test was performed twice and mean maximum gait speed was calculated for analysis.

Results: Participants with neck pain demonstrated a slower gait speed during walking at maximum speed compared to the control group ($p<0.001$). Maximum gait speed was moderately correlated with neck pain intensity ($p<0.001$) and disability ($p<0.01$).

Conclusions: Individuals with neck pain walked slower than those without neck pain at maximum speed, indicating that gait is compromised in individuals with neck pain. Gait assessment should be considered in patients with neck pain and the timed 10 meter walk test can be used as a clinical test.

Introduction

Control of balance and gait is complex and depends on sensory inputs from visual, vestibular and somatosensory systems including cervical proprioception.[1,2] It is well documented that abnormal cervical afferent input contributes to postural instability.[2,3] Several studies demonstrated that patients with neck pain had decreased stability during both static and dynamic standing balance.[4-6] There is also a growing body of research suggesting that patients with neck pain had altered gait characteristics.[7-9] Poole *et al.* investigating gait parameters during walking with and without head turns using a stride analyzer found that elders with neck pain had a decrease in self-selected gait speed and cadence when walking with head turns.[8] Likewise, Uthaikhup *et al.* using GAITRite instrumentation demonstrated that patients with chronic neck pain had slower gait speed, shorter step length, and narrower step width during walking with head movements and at maximum speed compared to healthy controls.[9] These findings indicate that patients with neck pain have gait disturbances. However, implementing such research results in clinical practice is still limited as only sophisticated equipment like GAITRite and stride analyzer was used.[8,9]

A timed 10 meter walk test is a frequently used measurement for gait speed. It has been recommended as an important indicator of physical performance and associated

* **Corresponding author.**
Author's Address: *Department of Physical Therapy, Faculty of Associated Medical Sciences, Chiang Mai University, Thailand*
** **E-mail address:** sureeporn.uthaikhup@cmu.ac.th
doi:
E-ISSN: 2539-6056

with risk for falls.[10-12] It is a simple, quick, and inexpensive gait evaluation.[13] It was also shown to have good validity and reliability.[14] Timed 10 meter walk test has been widely used to measure gait speed in various populations such as elderly,[15] and patients with neuromuscular,[16] neurological,[17] and orthopedic conditions.[18] It can be performed at preferred walking speed or fastest speed possible. However, evidence suggests that the fastest gait speed provide a better assessment when compared to self-selected speed as it measures the ability to adapt gait speed to environmental demands.[19]

As there is a limited evidence for a clinical assessment of gait speed in persons with neck pain, this study aimed to investigate gait speed in individuals with neck pain compared to healthy controls using timed 10 meter walk test. Gait disturbances associated with neck pain are frequently observed during challenging gait tasks.[7,20] Thus, maximum gait speed was chosen to be measured in this study. The relationships between maximum gait speed and characteristics of neck pain (intensity, duration and disability) were also determined as a previous study found a significant relationship between postural sway and pain intensity in patients with non-specific neck pain.[21] The findings of this study would support the contribution of cervical afferent input to postural control system and have a direct application to patients with neck pain.

Materials and methods

Participants

Twenty six participants (age range 18-59 years) with idiopathic neck pain and 26 healthy controls of a similar age and gender participated in the study. All participants were recruited from local hospitals, physical therapy clinics, universities and communities. To be included in the neck pain group, participants had to have neck pain for morer than 3 months with a score of at least 10 out of 100 on Thai version of the Neck Disability Index (NDI-TH).[22] They might have either dizziness or headache associated with neck pain. The control group had no history of neck pain, headache or dizziness in the past 6 months. Participants were excluded if they had a previous history of neck injury, known or suspected vestibular pathology, neurological and musculoskeletal conditions that could affect postural control, and taking more than four medications.[23] All eligible participants were asked to refrain from consuming alcohol and taking analgesic/muscle relaxant medications for at least 24 hours prior to testing.

Ethical approval for the study was obtained from the ethical review committee for research in humans, Faculty of Associated Medical Sciences, Chiang Mai University (Ref. no AMSEC-60EX-023). All participants signed a written informed consent before the commencement of the study.

Questionnaires

All participants completed a general questionnaire designed to collect demographic data, characteristics of neck pain, dizziness symptoms and treatment, if relevant. Participants with neck pain also completed a 10 cm Visual Analogue Scale (VAS) and the NDI-TH. VAS was used to measure intensity of neck pain[24] while NDI-TH was used to determine how neck pain affects an individual's daily life.[25] NDI-TH consists of 10 items including pain intensity, personal care, lifting, reading, headaches, concentration, work, driving, sleeping, and recreation.[25] Total possible score ranges from 0 to 50 and can be expressed as percentage. A higher score indicates greater disability.[25] NDI-TH was shown to be a reliable measure of functional limitation and disability in Thai persons with neck pain.[22]

Gait speed measure

The timed 10 meter walk test (TMW) was used to measure gait speed. Color tape was placed on the floor to mark the beginning and end of a 10 meter distance, with additional marking line at 2 and 8 meters. Participants were asked to walk barefoot with their maximum speed. Specific verbal instructions were given prior to the test: "I will say: ready, set, go. When I say 'Go', walk as fast as you safely can until I say stop".[26] Time for the intermediate 6 meters was measured to allow for acceleration and deceleration by a digital stopwatch.[27] Each participant performed the test twice.[28] Maximum gait speed (m/s) was calculated by dividing distance walked (6 m) by time (s) required to complete the trial. Maximum gait speed was computed for each trial and mean value was used for analysis.

Statistical Analysis

Sample size calculation was based on our pilot study (5 participants with neck pain and 5 controls). The means of maximum gait speed were 1.93±0.59 m/s for the neck pain group and 2.53±0.81 m/s for the control group. The sample size required for each group was 26 (effect size =0.80, power =0.80 and significant level =0.05).

All data were presented by descriptive statistics. Kolmogorov-Smirnov test was used to test a normal distribution of gait speed data. Independent t-tests were used to analyze differences in demographics and maximum gait speed between the neck pain and control groups. Pearson's correlation coefficients were used to determine the relationships between maximum gait speed and pain intensity (VAS score), disability (NDI-TH score) and pain duration. Significance was set at 0.05. All statistical analyses were conducted using SPSS statistical package.

Results

Demographic characteristics of the participants are presented in Table 1. There were no significant differences between the groups with respect to age, gender, weight, height, and body mass index (all $p>0.05$). Thirteen (50.00%) participants with neck pain received treatment (i.e. medicine, modalities, massage and acupuncture) to relieve their pain.

Mean and standard deviation (SD) values of maximum gait speed for the neck pain and control groups were 1.49±0.17 m/s and 1.79±0.17 m/s, respectively. Independent t-test revealed that the neck pain group had significantly slower gait speed than controls ($p<0.001$).

Results of Pearson's correlation coefficients revealed that maximum gait speed was moderately negatively correlated with VAS and NDI-TH scores ($p<0.001$ and $p<0.01$, respectively) (Table 2). There was no correlation between maximum gait speed and pain duration ($p>0.05$).

Table 1 Demographic data for the neck pain and control groups.

	Neck pain (n=26)	Controls (n=26)
Age (years)	31.80±11.10	29.54±10.26
Gender (% female)	57.69	57.69
Weight (kg)	63.77±14.83	59.23±12.35
Height (cm)	163.31±8.10	162.42±9.13
Body mass index (kg/m^2)	23.87±5.28	22.42±4.12
Neck pain and disability (% NDI)	22.00±13.30	-
Neck pain intensity (0-10 VAS)	4.90±1.97	-
Neck pain duration (months)	26.46±26.36	-
Pain on the testing day (%)	84.62	-
Dizziness (%)	26.92	0

Note: *Data are presented as mean±SD unless otherwise indicated. VAS: Visual analogue scale. NDI: Neck disability index.*

Table 2 Correlations between neck pain characteristics and gait speed .

	Gait speed
Pain intensity (VAS score)	- 0.67**
Neck pain and disability (NDI score)	- 0.59*
Pain duration	- 0.22

*Note: *p<0.01, **p<0.001, VAS: Visual analogue scale, NDI: Neck disability index.*

Discussion

The study demonstrated that participants with neck pain had slower gait speed during walking at their maximum speed compared to healthy controls. There were also relationships between higher levels of pain intensity and disability and slower gait speed. Our results support the notion that patients with neck pain have altered gait characteristics which may be resulted from abnormal cervical affferent inputs.[2]

A slower gait speed in individuals with neck pain in this study is consistent with previous findings which gait speed was measured with sophicated equipments.[8,9] This may imply that timed 10 meter walk test as a clinical assessment is useful for assessing gait speed in individuals with neck pain. The mean of maximum gait speed in our neck pain participants was relatively similar to that reported in patients with neck pain in Uthaikhup et al' s study[9] (1.49±0.17 m/s in this study and 1.55±0.18 m/s in Uthaikhup et al's study). However, our participants with neck pain tend to walk slower at maximum speed compared to caucasian people with a similar age (2.34±0.34 m/s).[28] Evidence suggests that slower gait is associated with increased risk of falls.[29,30] Although the prevalence of falls in people with neck pain is unknown, decreased maximum gait speed may be associated with falls in this population, especially in more challenging enviroment.

Altered cervical afferent input may contribute to decrease in maximum gait speed in our participants with neck pain.[1,2] It is well known that afferent information from vestibular, visual, and proprioceptive systems is important for control of postural stability and locomotion.[1,31] If one source of information is disrupted, it can cause declines in the maintainance of postural stability and locomotion.[1,2] Cervical spine has a high percentage of muscle spindles providing proprioceptive information.[32,33] Previous studies suggested that pain originating in the neck could alter muscle spindle sensitivity and cervical afferent input.[2,34] Thus, decreased maximum gait speed may be due to a mismatch between aberrant cervical proprioception and other normal sensory afferent inputs, or changes in sensorimotor integration.[1,2] Alternatively, maintaining dynamic balance is suggested to be an important component of walking function.[31] A previous study demonstrated that patients with neck pain had an impaired dynamic balance when compared with healthy controls.[6] While maximum gait speed is progressively more challenged and requires greater dynamic stability,[9] a slower gait speed may be a compensation related to postural instability during walking in participants with neck pain. However, it was noted that about 27% of our individuals with neck pain reported dizziness associated with neck pain. Dizziness symptom may influence slower gait speed in our participants with neck pain. Further research in this area is warranted.

In this study, decreased gait speed was moderately correlated to pain intensity and disability. Participants with highers level of neck pain and disability tended to walk slower than controls at their maximum speed. This result is in accordance with a previous study which demonstrated a moderate correlation between maximum gait speed and pain intensity and disability using GAITRite instrumentation.[9] No correlation between maximum gait speed and neck pain duration was found in this study. Likewise, decrease in postural stability was found to be related to a higher level of pain intensity but not pain duration in patients with neck pain.[21]

There are some limitations of this study. A few participants had dizziness associated with their neck pain. However, previous studies found impaired postural stability in neck pain patients either with or without dizziness but to a different extent.[4,35] Additionally, individuals may adjust their gait speed based on their strength. Lower extremity muscle strength was not measured in this study but our participants were relatively young and active and had no other musculoskeletal problems. Further investigation is required to clarify influence of dizziness on gait speed in patients with neck pain. A relationship between gait speed and falls in patients with neck pain should also be addressed in future research.

Conclusions

This study suggests that timed 10 meter walk test is a clinically useful measurement for assessing gait speed in individuals with neck pain. Individuals with neck pain had decreased gait speed during walking at maximum speed. Additionally, decrease in maximum gait speed was moderately correlated with higher levels of neck pain intensity and disability. Maximum gait speed should be considered in clinical assessment and mangement of neck pain.

Acknowledments

This study was funded by the Faculty of Associated Medical Sciences, Chiang Mai University, Chiang Mai, Thailand.

References

[1] Kristjansson E, Treleaven J. Sensorimotor function and dizziness in neck pain: implications for assessment and management. J Orthop Sports Phys Ther 2009; 39: 364-77. doi: 10.2519/jospt.2009.2834.

[2] Treleaven J. Sensorimotor disturbances in neck disorders affecting postural stability, head and eye movement control. Man Ther 2008; 13: 2-11. doi: 10.1016/j.math.2007.06.003.

[3] Bove M, Courtine G, Schieppati M. Neck muscle vibration and spatial orientation during stepping in place in humans. J Neurophysiol 2002; 88: 2232-41. doi: 10.1152/jn.00198.2002.

[4] Field S, Treleaven J, Jull G. Standing balance: a comparison between idiopathic and whiplash-induced neck pain. Man Ther 2008; 13: 183-91. doi: 10.1016/j.math.2006.12.005.

[5] Silva AG, Cruz AL. Standing balance in patients with whiplash-associated neck pain and idiopathic neck pain when compared with asymptomatic participants: A systematic review. Physiother Theory Pract 2013; 29: 1-18. doi:10.3109/09593985.2012.677111.

[6] Stokell R, Yu A, Williams K, Treleaven J. Dynamic and functional balance tasks in subjects with persistent whiplash: A pilot trial. Man Ther 2011; 16: 394-8. doi: 10.1016/j.math.2011.01.012.

[7] Sjostrom H, Allum JH, Carpenter MG, Adkin AL, Honegger F, Ettlin T. Trunk sway measures of postural stability during clinical balance tests in patients with chronic whiplash injury symptoms. Spine J 2003; 28: 1725-34. doi: 10.1097/01.brs.0000083170.34304.a3.

[8] Poole E, Treleaven J, Jull G. The influence of neck pain on balance and gait parameters in community -dwelling elders. Man Ther 2008; 13: 317-24. doi: 10.1016/j.math.2007.02.002.

[9] Uthaikhup S, Sunkarat S, Khamsaen K, Meeyan K, Treleaven J. The effects of head movement and walking speed on gait parameters in patients with chronic neck pain. Man Ther 2014; 19: 137-41. doi: 10.1016/j.math.2013.09.004.

[10] Cesari M, Kritchevsky SB, Penninx BW, Nicklas BJ, Simonsick EM, Newman AB, et al. Prognostic value of usual gait speed in well-functioning older people--results from the health, aging and body composition study. J Am Geriatr Soc 2005; 53: 1675-80. doi: 10.1111/j.1532-5415.2005.53501.x.

[11] Abellan van Kan G, Rolland Y, Andrieu S, Bauer J, Beauchet O, Bonnefoy M, et al. Gait speed at usual pace as a predictor of adverse outcomes in community-dwelling older people an International Academy on Nutrition and Aging (IANA) Task Force. J Nutr Health Aging 2009; 13: 881-9.

[12] Quach L, Galica AM, Jones RN, Procter-Gray E, Manor B, Hannan MT, et al. The non-linear relationship between gait speed and falls: The mobilize boston study. J Am Geriatr Soc 2011; 59: 1069-73. doi: 10.1111/j.1532-5415.2011.03408.x.

[13] Graham JE, Ostir GV, Fisher SR, Ottenbacher KJ. Assessing walking speed in clinical research: a systematic review. J Eval Clin Pract 2008; 14: 552-62. doi: 10.1111/j.1365-2753.2007.00917.x.

[14] Peters DM, Fritz SL, Krotish DE. Assessing the reliability and validity of a shorter walk test compared with the 10-Meter Walk Test for measurements of gait speed in healthy, older adults. J Geriatr Phys Ther 2013; 36: 24-30. doi: 10.1519/JPT.0b013e318248e20d.

[15] Kim H-j, Park I, Lee Hj, Lee O. The reliability and validity of gait speed with different walking pace and distances against general health, physical function, and chronic disease in aged adults. J Exerc Nutrition Biochem 2016; 20: 46-50. doi: 10.20463/jenb.2016.09.20.3.7.

[16] Pirpiris M, Wilkinson AJ, Rodda J, Nguyen TC, Baker RJ, Nattrass GR, et al. Walking speed in children and young adults with neuromuscular disease: comparison between two assessment methods. J Pediatr Orthop 2003; 23: 302-7.

[17] Nagano K, Hori H, Muramatsu K. A comparison of at-home walking and 10-meter walking test parameters of individuals with post-stroke hemiparesis. J Phys Ther Sci 2015; 27: 357-9. doi: 10.1589/jpts.27.357.

[18] Unver B, Baris RH, Yuksel E, Cekmece S, Kalkan S, Karatosun V. Reliability of 4-meter and 10-meter walk tests after lower extremity surgery. Disabil Rehabil 2017; 39: 2572-6. doi:10.1080/09638288.2016.1236153.

[19] Beaman CB, Peterson CL, Neptune RR, Kautz SA. Differences in self-selected and fastest comfortable walking in post-stroke hemiparetic persons. Gait Posture 2010; 31: 311-6. doi:10.1016/j.gaitpost.2009.11.011.

[20] Findling O, Schuster C, Sellner J, Ettlin T, Allum JH. Trunk sway in patients with and without, mild traumatic brain injury after whiplash injury. Gait Posture 2011; 34: 473-8. doi: 10.1016/j.gaitpost.2011.06.021.

[21] Ruhe A, Fejer R, Walker B. Altered postural sway in patients suffering from non-specific neck pain and whiplash associated disorder - A systematic review of the literature. Chiropr Man Ther 2011; 19: 13. doi: 10.1186/2045-709X-19-13.

[22] Uthaikhup S, Paungmali A, Pirunsan U. Validation of Thai versions of the Neck Disability Index and Neck Pain and Disability Scale in patients with neck pain. Spine (Phila Pa 1976) 2011; 36: 1415-21. doi: 10.1097/BRS.0b013e31820e68ac.

[23] Huang ES, Karter AJ, Danielson KK, Warton EM, Ahmed AT. The association between the number of prescription medications and incident falls in a multi-ethnic population of adult type-2 diabetes patients: the diabetes and aging study. J Gen Intern Med 2010; 25: 141-6. doi: 10.1007/s11606-009-1179-2.

[24] Ara T, Iizuka H, Sorimachi Y, Iizuka Y, Nakajima T, Nishinome M, et al. Evaluation of neck pain by using a visual analog scale before and after laminoplasty in patients with cervical myelopathy: relationship with clinical results. J Neurosurg Spine 2010; 12: 635-40. doi: 10.3171/2009.12.spine09181.

[25] Vernon H, Mior S. The Neck Disability Index: a study of reliability and validity. J Manipulative Physiol Ther 1991; 14: 409-15.

[26] Marques A, Cruz J, Quina S, Regencio M, Jacome C. Reliability, agreement and minimal detectable change of the Timed Up & Go and the 10-Meter Walk Tests in older patients with COPD. J Chronic Obstr Pulm Dis 2016; 13: 279-87. doi: 10.3109/15412555.2015.1079816.

[27] Lindemann U, Najafi B, Zijlstra W, Hauer K, Muche R, Becker C, et al. Distance to achieve steady state walking speed in frail elderly persons. Gait Posture 2008; 27: 91-6. doi: 10.1016/j.gaitpost.2007.02.005.

[28] Bohannon RW. Comfortable and maximum walking speed of adults aged 20-79 years: reference values and determinants. Age Ageing 1997; 26: 15-9.

[29] Luukinen H, Koski K, Laippala P, Kivela SL. Predictors for recurrent falls among the home-dwelling elderly. Scand J Prim Health Care 1995; 13: 294-9.

[30] Campbell AJ, Borrie MJ, Spears GF. Risk factors for falls in a community-based prospective study of people 70 years and older. J Gerontol 1989; 44: 112-7.

[31] Shumway-Cook A, Woollacott M. Motor control: translating research into clinical practice. Philadelphia: Lippincott Williams & Wilkins; 2012.

[32] Boyd-Clark LC, Briggs CA, Galea MP. Muscle spindle distribution, morphology, and density in longus colli and multifidus muscles of the cervical spine. Spine J 2002; 27: 694-701.

[33] Kulkarni V, Chandy MJ, Babu KS. Quantitative study of muscle spindles in suboccipital muscles of human foetuses. Neurol India 2001; 49: 355-9.

[34] Flor H. Cortical reorganisation and chronic pain: implications for rehabilitation. J Rehabil Med 2003; 41: 66-72.

[35] Treleaven J, Jull G, Lowchoy N. Standing balance in persistent whiplash: a comparison between subjects with and without dizziness. J Rehabil Med 2005; 37: 224-9. doi: 10.1080/16501970510027989.