



PREVENTION AND REHABILITATION: ORIGINAL RESEARCH

Perceptions of individuals with stroke regarding the use of a cane for walking: A qualitative study

Lucas R. Nascimento^{a, b, c, *}, Louise Ada^b, Gerdeany M. Rocha^a, Luci F. Teixeira-Salmela^a^a NeuroGroup, Discipline of Physiotherapy, Universidade Federal de Minas Gerais, Brazil^b Discipline of Physiotherapy, The University of Sydney, Australia^c Center of Health Sciences, Discipline of Physiotherapy, Universidade Federal do Espírito Santo, Brazil

A B S T R A C T

Keywords:

Stroke
Assistive technologies
Qualitative research
Rehabilitation

It is well known that clinical decisions, which include prescription of canes after stroke, should not only be based on biomechanical research. According to the principles of evidence-based medicine, patients' perceptions and preferences should also be investigated to help planning good clinical decisions. The purpose of this study was to comprehend how ambulatory people with stroke, naïve to the use of canes, perceive using a cane during walking. An exploratory, qualitative study was conducted. Twenty-four people, on average 6 years after a stroke, were included. Participants were categorized as slow (<0.4 m/s), intermediate (0.4–0.8 m/s), or fast walkers (>0.8 m/s), based on their baseline walking speed. Participants' spontaneous perceptions regarding the use of a cane were collected during a timed-walk test and analyzed, following standardized recommendations. The discourse of each participant was categorized into "positive perceptions" or "negative perceptions". Overall, the nature of the perceptions was both positive (i.e., improvements of mobility and/or independence, and improvement of safety/balance and/or reduced risk of falls) and negative (i.e., social stigmatism, and interference with use of the non-paretic upper limb). However, participants' perceptions were diverse, depending on their walking ability. Participants categorized as slow walkers perceived the use of a cane as positive, but this positive perception decreased, as walking ability increased. The most positive perceptions came from individuals with severe and moderate walking limitations, who tended to believe that using a cane may be helpful for improving walking, safety, and promoting independence. Fast walkers provided negative perceptions, and may not choose to use canes for walking due to social stigmatism or interference with use of the non-paretic upper limb.

© 2018 Elsevier Ltd. All rights reserved.

1. Introduction

Stroke is the second-leading global cause of death and the leading cause of disability worldwide (Mozaffarian et al., 2015). However, nowadays, a declining trend in mortality due to cerebrovascular diseases has been observed and many individuals are left with disabilities related to stroke (Uemura and Pisa, 1988). Recent data indicated that over 30 million people in the world have experienced and survived a stroke (Norving and Kissela, 2011). People after stroke, typically, demonstrate muscle weakness and loss of dexterity, which has long-lasting implications for their

walking ability (Dorsch et al., 2016; Alzahrani et al., 2011). Although most stroke survivors recover some walking ability, their walking speed, step length, and cadence remain significantly reduced (Polese et al., 2013; Nascimento et al., 2015). This poor walking performance, associated with fear of falling and lack of confidence for walking, limit community participation, and stroke survivors may become housebound and isolated from the society (Allet et al., 2009; Robinson et al., 2011). One of the main aims of rehabilitation of people with stroke is to improve their walking ability and their community ambulation skills, thereby, enhancing their social and occupational participation, and quality of life (Alzahrani et al., 2011; Schmid et al., 2007).

Walking aids, such as canes and walkers, are sometimes prescribed after stroke with the aim of improving safety and walking ability. These aids are not usually prescribed early after stroke, because it is believed that they will be detrimental to long-term

* Corresponding author. Universidade Federal do Espírito Santo, Center of Health Sciences, Marechal Campos Avenue, 1468, Maruípe, 29.043-900, Vitória, Brazil.
E-mail address: lrn@ufmg.br (L.R. Nascimento).

walking ability. Although the biomechanics of the use of walking aids have been examined in people with stroke after walking has stabilized, the findings are contradictory. Some studies indicated that the removal of walking aids in individuals, who had been habitually using a cane, reduces walking speed (Polese et al., 2012) or stride length (Kuan et al., 1999). Other studies did not show any changes (Buurke et al., 2005; Tyson, 1999). A recent study (Nascimento et al., 2016) indicated that the provision of a cane to individuals, naïve to the use of a cane, produced little or no effect on walking, as a group. However, when subgroups were analyzed separately, the provision of a cane produced clinical benefits regarding walking speed and step length to the slow and intermediate walkers (walking speed between 0.1 and 0.8 m/s).

There has been one study (Polese et al., 2011), which investigated the perceptions of individuals with stroke regarding the use of a cane. Participants answered a questionnaire with 80% reporting improved their confidence and safety, when using a cane during walking. However, this study only included individuals, who had been habitually using a cane and did not uncover factors that could influence their choice regarding the use or non-use of walking sticks in real life. In evidence-based practice (Herbert et al., 2005; Saragiotto et al., 2014), decisions about intervention should be based on patients' preferences, as well as on high-quality clinical research and experience. Therefore, it would be helpful to know how people after stroke, who are naïve to the use of a cane, perceive using a cane during walking, in order to understand factors that may influence patients' decision-making. The specific research questions were:

In individuals after stroke, whose walking has stabilized, but who are naïve to the use of a cane for walking,

1. What is the percentage of positive vs negative perceptions regarding the use of a single-point cane?
2. Are the perceptions related to walking ability?
3. What is the nature of the positive and negative perceptions?

2. Method

2.1. Design

An analysis of secondary outcomes of an experimental study investigating the effect of the provision of a cane on walking after stroke was performed (Nascimento et al., 2016). Individuals with diagnosis of stroke, naïve to the use of canes, were recruited from the general community of two metropolitan cities in Brazil, via advertisement and by screening public rehabilitation services and lists of previous research projects. Measures of walking were collected on one day in a research laboratory, under two experimental conditions: walking with and without a cane. Participants were asked to rate their perceptions regarding the use of a cane by two experienced physiotherapists. Responses were recorded as detailed notes (Bampton et al., 2012). The study was approved by the Universidade Federal de Minas Gerais Ethical Review Board (#ETIC 0538.0.203.000–09) and followed the Standards for Reporting Qualitative Research (O'Brien et al., 2014). All included participants provided written consent, prior to data collection.

2.2. Participants

People with stroke were included if they: were >18 years of age; had a mean time since the onset of stroke of at least six months (Nascimento et al., 2014); were able to walk at least 14 m independently; and were not regular users of walking sticks. They were excluded if they had cognitive deficits, identified on the Mini-

Mental State Examination (Brucki et al., 2003) or any other neurological or orthopedic disorders.

The characteristics of the participants, such as age, sex, side of weakness, time since stroke, dexterity (Lower Extremity Coordination Test scores) (Pinheiro et al., 2014; Menezes et al., 2017), tonus of the plantarflexor muscles (modified Ashworth scale) (Bohannon and Smith, 1987), motor recovery (Fugl-Meyer Scale – lower limb section) (Maki et al., 2006), and walking speed (10-Meter Walking Test) (Nascimento et al., 2012), were collected for characterization purposes. Efforts, such as provision of private transport, were made to recruit participants with different walking abilities: slow (<0.4 m/s), intermediate (0.4–0.8 m/s), and fast walkers (>0.8 m/s) [15,27,28]. These cut-off values were decided, prior to data collection (Jeong et al., 2015).

2.3. Data analyses

Descriptive statistics were used to present the characteristics of the participants. A qualitative method was employed to comprehend the participants' spontaneous perceptions regarding the use of a cane. First, the discourse of each participant was categorized into “positive perceptions” or “negative perceptions” by two reviewers, independently (LRN and GMR). Discourse was considered to include positive perceptions, when participants reported benefits regarding the use of the cane and/or manifested interest in using it. Discourse was considered to provide negative perceptions, when participants reported criticism regarding the use of the cane and/or showed no interest in using it. Disagreements or ambiguities were resolved by consensus after discussion with a third reviewer (LFT-S). Second, a content analysis was conducted, following previous recommendations: pre-analysis (transcription, reading, and re-reading of participants' speeches), discourse exploration (data organization and grouping of data, according to thematic units), and discourse interpretation (grouping of data, according to the emerged categories) (O'Brien et al., 2014; Bardin, 2009; Faria et al., 2015). Discourse from all the included participants were analyzed, until there were no new emerging categories.

In order to answer Question 1, the percentage of individuals with positive perceptions vs those with negative perceptions was calculated. In order to answer Question 2, the percentage of individuals with positive perceptions vs those with negative perceptions was calculated for the slow, intermediate, and fast walkers, separately. In order to answer Question 3, the categories describing the nature of the positive and negative perceptions were grouped, according to walking ability.

3. Results

3.1. Participants

The sample of this secondary analysis is comprised of 20 of the 24 original volunteers (10 men), since two volunteers did not provide any perceptions regarding the use of the cane, and two volunteers had motor aphasia. The mean age of these participants was 62 years (SD 10), with a mean time since the onset of stroke of 6 years (SD 5). Their mean comfortable speed was 0.66 m/s (range 0.1–1.3 m/s), and they were categorized as slow (<0.4 m/s; $n = 5$), intermediate (0.4–0.8 m/s; $n = 8$), and fast (>0.8 m/s; $n = 7$) walkers (see Table 1).

3.2. Percentage of positive vs negative perceptions regarding the use of a cane

When the discourse of the participants were analyzed all together, 55% ($n = 11$) of the participants reported positive

Table 1
Characteristics of participants.

Characteristic	n = 20
Age (yr), mean (SD)	62 (10)
Sex, number male (%)	10 (50)
Side of weakness, number right side (%)	10 (50)
Time since stroke (yr), mean (SD)	6 (5)
Cognition (MMSE, 0–30), mean (SD)	25 (2)
Dexterity – paretic (LEMOCT taps/s), mean (SD)	0.6 (0.6)
Dexterity – non-paretic (LEMOCT taps/s), mean (SD)	1.3 (0.5)
Hypertonia (Modified Ashworth Scale, 0–4), n (%)	
0	6 (30)
1	4 (20)
1+	5 (25)
2	3 (15)
3	1(5)
4	1(5)
Motor recovery (Fugl-Meyer LL, 0–34), mean (SD)	25 (7)
Comfortable walking speed (10MWT, m/s), mean (SD)	0.66 (0.33)

MMSE = Mini-mental state examination; LL = lower limb; LEMOCOT = Lower extremity motor coordination test; 10MWT = 10-m Walk Test.

perceptions regarding the use of a cane and 45% (n = 9) reported negative perceptions.

3.3. Percentage of positive vs negative perceptions according to walking ability

When the discourse of the participants were analyzed according to their walking ability, 100% (n = 5) of the slow walkers, 50% (n = 4) of the intermediate walkers, and 30% (n = 2) of the fast walkers reported positive perceptions.

3.4. Nature of the positive and negative perceptions

Four categories emerged from the content analysis of the discourse of the participants (Table 2). Two categories reflected positive perceptions regarding the use of a cane:

1. Acceptance based on improvement of mobility and/or independence;
2. Acceptance based on improvement of safety/balance and/or reduced risk of falls.

Two categories reflected negative perceptions regarding the use of a cane:

- 3 Rejection based on social stigmatism.
4. Rejection based on interference with use of the non-paretic upper limb.

4. Discussion

This qualitative study investigated the spontaneous perceptions regarding the use of a single-point cane for walking of individuals with stroke, who were naïve to using a cane. Perceptions were different, depending on their walking ability. Participants categorized as slow walkers perceived the use of a cane as positive, but this positive perception decreased, as walking ability increased. The nature of the perceptions was both positive (including perceptions of increase in walking performance) and negative (including perceptions of an interference with use of the upper limb).

In the current study, participants were categorized into slow, intermediate, and fast walkers on the basis of Perry's findings (Perry et al., 1995) that people with stroke who walked <0.4 m/s (slow) were largely housebound, those who walked 0.4–0.8 m/s (intermediate) were limited community-ambulators, and those who walked >0.8 m/s (fast) were unlimited community-ambulators. All slow walkers perceived the use of a cane as positive. Slow walkers typically demonstrate profound weakness and lack of dexterity, which significantly limit their mobility (Dorsch et al., 2016; Alzahrani et al., 2011). The cane may have represented an apparent opportunity for immediate recover of their walking ability and social participation, since those individuals are housebound and isolated from society. Although slow walkers liked the cane, research shows that the provision of a cane does not make much biomechanical difference to their walking (Nascimento et al.,

Table 2
Perceptions regarding the use of a cane during walking.

Category	Walking ability	Discourse
Acceptance based on improvement of mobility and/or independence	Slow walkers	"Good, I want a cane. This is exactly what I need, this will help me to walk better. Without it, I am housebound and I cannot go out." (P18). "We should buy a cane [speaking to the caregivers]. Look at them, they are afraid of giving me something to help me walk, concerned about falls [speaking to the therapist]. Maybe using this [the cane], it will let me walk by myself." (P13).
	Intermediate walker	"I am walking faster with this cane. This might help me with my daily activities." (P05).
Acceptance based on improvement of safety/balance and/or reduces risk of falls	Slow walker	"The cane gives me more confidence. I feel I will be able to walk at home without falling down. I have been very quiet, since I had this thing [stroke]" (P21).
	Intermediate walkers	"To walk faster, this is better. This arm [paretic] does not swing too much. This is good. At home, to walk in some unsafe places, I used to use a broomstick." (P2). "This one [the cane] is really good at improving my balance. So, this must be used to improve balance and strength, am I right?" (P9).
	Fast walker	"Can I take this [the cane] home? It will be useful during bus trips. In bus trips, I almost fall down sometimes." (P3).
Rejection based on social stigmatism	Intermediate walkers	"This cane really improves my confidence on walking, but I am definitely not using it. I will never go out on streets using it." (P20). "Well, I have a similar cane at home, but my husband does not like it. He keeps saying that I look like a blind woman walking." (P9).
Rejection based on interference with use of the non-paretic upper limb	Fast walker	"It [cane] might be helpful to someone who really needs. I already walk fine without this, this thing." (P22).
	Intermediate walkers	"Streets on my suburb are too bumpy. I cannot use it [the cane]. I just go out to buy things on the market. So, I always have two or three shopping bags on my hand, I need this hand [non-paretic upper limb] free." (P10). "This makes me walk faster, but I don't want it. It is just one more thing to carry." (P17).
	Fast walker	"[With the cane] I feel that I will not be able to protect myself. This arm [non-paretic upper limb] must be free, because the other one is weak." (P4).

2016). On the other hand, slow walkers perceived that a cane added safety to their walking, and this is in accordance with biomechanical studies (Polese et al., 2012; Nascimento et al., 2016), which suggest that canes has the potential to increase stability during the single limb support phase, allowing sufficient time for the contralateral limb to swing, which may explain the improved balance and safety sensation. Therefore, provision of a cane to slow walkers may be beneficial, not because it improves their walking *per se*, but because it increases their confidence.

Only half of the intermediate walkers perceived the use of a cane as positive. They perceived that it improved their walking and increased safety. This is in line with research that showed that the provision of a cane to this group makes a major biomechanical difference to their walking (Nascimento et al., 2016). Improved walking is associated with independence in daily activities and increased social participation, which has the potential to promote benefits, such as reducing physical inactivity (Alzahrani et al., 2011; Barclay et al., 2015). On the other hand, half of the participants perceived the use of a cane as negative. This was often based on the perception that using a cane would cause them to be socially stigmatized. A recent study (Horne et al., 2014) showed that people with stroke commonly report fear (eg., fear of falling, fear of stigma, and fear of going out) and loss of social confidence (eg., negative judgment from other people and being uncomfortable in social environments), that limit their community participation. Perhaps, individuals after stroke, who have the potential to improve walking (ie, intermediate walkers) and have chosen not to use a cane due to social or cultural stigmas, should be progressively encouraged. Once individuals begin to succeed and improve by practicing small achievable tasks, their belief and confidence in themselves tend to improve, enabling them to move on and to attempt other activities (Horne et al., 2014). In addition, they felt that the cane limited the use of their non-paretic arm, which they currently used for holding things. Clinically, this suggests the need to evaluate not only walking speed, but also paretic upper limb function when prescribing a cane, and weigh up the potential improvements in walking with the possible detriment in carrying and holding objects.

Most of the fast walkers, on the other hand, perceived the use of a cane as negative. They did not think that they needed it. This is in line with research that showed that the provision of a cane to this group makes their walking worse (Nascimento et al., 2016). In addition, the need to use the non-paretic upper limb was perceived by the fast walkers, who are already involved in community participation and do not get benefits from using a cane.

This study has some limitations. First, the spontaneous perceptions of the participants regarding the use of a cane were collected during the use of the cane. Future studies, capable of guiding participants through the process of revealing their perceptions using semi-structured interviews, may identify new aspects of using a cane. Second, this study investigated the immediate perceptions of using a cane during walking and this does not necessarily mean that these will translate into the long-term. Given that intermediate walkers gain the most biomechanical benefits from using a cane (Nascimento et al., 2016), a randomized clinical trial investigating the effect of a long-term use on actual and perceived walking in this subgroup is warranted. Furthermore, the participants' ability to use their arms were not investigated, which could have interfered with the results, as individuals without upper limb limitations may feel more confident for holding a cane.

5. Conclusions

The most positive perceptions about using a cane during walking came from individuals with severe and moderate walking

limitations. The benefits were associated with improvements in mobility and functional independence, as well, as in safety and balance during walking. Clinically, these perspectives should be analyzed together with results from biomechanical researches, in order to help clinicians plan cane prescriptions for moderately disabled people with stroke. Negative perceptions were associated with lack of social confidence and/or limitations regarding the use of the non-paretic upper limb during daily activities, and were predominantly reported by individuals with mild walking limitations.

Competing interests

None.

Acknowledgements

Brazilian Government Funding Agencies (CAPES, CNPq, and FAPEMIG) for the financial support.

References

- Allet, L., Leeman, B., Guyen, E., Murphy, L., Monnin, D., Herrmann, F., Schnider, A., 2009. Effect of different walking aids on walking capacity of patients with poststroke hemiparesis. *Arch. Phys. Med. Rehabil.* 90, 1408–1413.
- Alzahrani, M., Dean, C., Ada, L., 2011. Relationship between walking performance and types of community-based activities in people with stroke: an observational study. *Braz. J. Phys. Ther.* 15 (1), 45–51.
- Bampton, J., Vargas, J., Wu, R., Potts, S., Lance, A., Scrivener, A., Ada, L., Dean, C., 2012. Clinical physiotherapists had both positive and negative perceptions about delivering two different interventions in a clinical trial: a mixed methods study. *J. Physiother.* 58, 255–260.
- Barclay, R., Ripat, J., Mayo, N., 2015. Factors describing community ambulation after stroke: a mixed-methods study. *Clin. Rehabil.* 29 (5), 509–521.
- Bardin, L., 2009. *Análise de Conteúdo*. Edições, Lisboa, p. 70.
- Bohannon, R.W., Smith, M.B., 1987. Inter-rater reliability of a modified Ashworth scale muscle spasticity. *Phys. Ther.* 67, 206–207.
- Brucki, S.M.D., Nitrini, R., Caramelli, P., Bertolucci, P.H.F., Okamoto, I.H., 2003. Suggestions for utilization of the mini-mental state examination in Brazil. *Arq. Neuropsiquiatr.* 61, 777–781.
- Buurke, J.H., Hermens, H.J., Erren-Wolters, C.V., Nene, A.V., 2005. The effect of walking aids on muscle activation patterns during walking in stroke patients. *Gait Posture* 22, 154–170.
- Dorsch, S., Ada, L., Canning, C.G., 2016. Lower limb strength is significantly impaired in all muscle groups in ambulatory people with chronic stroke: a cross-sectional study. *Arch. Phys. Med. Rehabil.* 97 (4), 522–527.
- Faria, C.D.C.M., Teixeira-Salmela, L.F., Araújo, P.A., Polese, J.C., Nascimento, L.R., Nadeau, S., 2015. TUG-ABS Português-Brasil: instrumento para avaliação clínica da mobilidade de hemiparéticos pós-AVC. *Rev. Neurocienc.* 23 (3), 357–367.
- Herbert, R., Jamtvedt, G., Mead, J., Hagen, K., 2005. *Practical Evidence-based Physiotherapy*. Butterworth-Heinemann, Eddinburg; New York.
- Horne, J., Lincoln, N.B., Preston, J., Logan, P., 2014. What does confidence mean to people who have had a stroke? A qualitative interview study. *Clin. Rehabil.* 28 (11), 1125–1135.
- Jeong, Y., Jeong, Y.J., Kim, T., Han, S.H., Jang, S.H., Kim, Y.S., Lee, K.H., 2015. A randomized comparison of energy consumption when using different canes, inpatients after stroke. *Clin. Rehabil.* 29 (2), 129–134.
- Kuan, T., Tsou, J., Su, F., 1999. Hemiplegic gait of stroke patients: the effect of using a cane. *Arch. Phys. Med. Rehabil.* 80, 777–784.
- Maki, T., Quagliato, E.M.A.B., Cacho, E.V.A., Paz, L.P.S., Nascimento, N.H., Inoue, M.M.E.A., Viana, M.A., 2006. Reliability study on the application of the Fugl-Meyer scale in Brazil. *Braz. J. Phys. Ther.* 10, 177–183.
- Menezes, K.P., Nascimento, L.R., Pinheiro, M.B., Scianni, A.A., Faria, C.D.C.M., Avelino, P., Faria-Fortini, I., Teixeira-Salmela, L.F., 2017. Lower limb motor co-ordination is significantly impaired in ambulatory people with chronic stroke: a cross-sectional study. *J. Rehabil. Med.* 49, 322–326.
- Mozaffarian, D., Benjamin, E.J., Go, A.S., Arnett, D.K., Blaha, M.J., Cushman, M., de Ferranti, S., Després, J.P., Fullerton, H.J., Howard, V.J., Huffman, M.D., Judd, S.E., Kissela, B.M., Lackland, D.T., Lichtman, J.H., Lisabeth, L.D., Liu, S., Mackey, R.H., Matchar, D.B., McGuire, D.K., Mohler 3rd, E.R., Moy, C.S., Muntner, P., Mussolino, M.E., Nasir, K., Neumar, R.W., Nichol, G., Palaniappan, L., Pandey, D.K., Reeves, M.J., Rodriguez, C.J., Sorlie, P.D., Stein, J., Towfighi, A., Turan, T.N., Virani, S.S., Willey, J.Z., Woo, D., Yeh, R.W., Turner, M.B., American Heart Association Statistics Committee and Stroke Statistics Subcommittee, 2015. Heart disease and stroke statistics-2015 update: a report from the American Heart Association. *Circulation* 131 (4), e29–322, 27.
- Nascimento, L.R., Ada, L., Teixeira-Salmela, L.F., 2016. The provision of a cane provides greater benefit to community-dwelling people after stroke with a

- baseline walking speed between 0.4 and 0.8 m/s: an experimental study. *Physiotherapy* 102 (4), 351–356.
- Nascimento, L.R., Oliveira, C.Q., Ada, L., Michaelsen, S.M., Teixeira-Salmela, L.F., 2015. Walking training with cueing of cadence improves speed and stride length after stroke more than walking training alone: a systematic review. *J. Physiother.* 61, 10–15.
- Nascimento, L.R., Michaelsen, S.M., Ada, L., Polese, J.C., Teixeira-Salmela, L.F., 2014. Cyclical electrical stimulation increases strength and improves activity after a stroke: a systematic review. *J. Physiother.* 60 (1), 22–30.
- Nascimento, L.R., Caetano, L.C., Freitas, D.C., Morais, T.M., Polese, J.C., Teixeira-Salmela, L.F., 2012. Different instructions during the tem-meter walking test determined significant increases in maximum gait speed in individuals with chronic hemiparesis. *Braz. J. Phys. Ther.* 16 (2), 122–127.
- Norrving, B., Kissela, B., 2011. The global burden of stroke and need for a continuum of care. *Neurology* 80, S5–S12, 3 Suppl 2.
- O'Brien, B.C., Harris, I.B., Beckman, T.J., Reed, D.A., Cook, D.A., 2014. Standards for reporting qualitative research: a synthesis of recommendations. *Acad. Med.* 89 (9), 1245–1251.
- Perry, J., Garrett, M., Gronley, J.A.K., Mulroy, S.J., 1995. Classification of walking handicap in the stroke population. *Stroke* 26, 982–989.
- Pinheiro, M.B., Scianni, A.A., Ada, L., Faria, C.D., Teixeira-Salmela, L.F., 2014. Reference values and psychometric properties of the lower extremity motor coordination test. *Arch. Phys. Med. Rehabil.* 95 (8), 1490–1497.
- Polese, J.C., Ada, L., Dean, C.M., Nascimento, L.R., Teixeira-Salmela, L.F., 2013. Treadmill training is effective for ambulatory adults with stroke: a systematic review. *J. Physiother.* 59, 73–80.
- Polese, J.C., Teixeira-Salmela, L.F., Nascimento, L.R., Faria, C.D.C.M., Kirkwood, R.N., Laurentino, G.C., Ada, L., 2012. The effects of walking sticks on gait kinematics and kinetics with chronic stroke survivors. *Clin. Biomech.* 27, 131–137.
- Polese, J.C., Nascimento, L.R., Faria, C.D., Laurentino, G.E., Rodrigues-de-Paula, F., Ada, L., Teixeira-Salmela, L.F., 2011. Percepção de hemiplégicos crônicos sobre o uso de dispositivos auxiliares na marcha. *Rev Panam Salud Publica* 30 (3), 204–208.
- Robinson, C.A., Shumway-Cook, A., Matsuda, P.N., Ciol, M.A., 2011. Understanding physical factors associated with participation in community ambulation following stroke. *Disabil. Rehabil.* 33 (12), 1033–1042.
- Saragiotto, B.T., Costa, L.C., Oliveira, R.F., Lopes, A.D., Moseley, A.M., Costa, L.O., 2014. Description of research design of articles published in four Brazilian physical therapy journals. *Braz. J. Phys. Ther.* 18 (1), 56–62.
- Schmid, A., Duncan, P.W., Studenski, S., Lai, S.M., Richards, L., Perera, S., Wu, S.S., 2007. Improvements in speed-based gait classifications are meaningful. *Stroke* 38 (7), 2096–2100.
- Tyson, S., 1999. Trunk kinematics in hemiplegic gait and effect of walking aids. *Clin. Rehabil.* 13, 295–300.
- Uemura, K., Pisa, Z., 1988. Trends in cardiovascular disease mortality in industrialized countries since 1950. *World Health Stat. Q.* 41 (3–4), 155–178.