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Original Article

SHORT-TERM CHANGES IN SPINAL CORD EXCITABILITY AFTER BACKWARD WALKING WITH AND WITHOUT BODY WEIGHT SUPPORT

ALTERAÇÕES DE CURTO PRAZO NA EXCITABILIDADE MEDULAR APÓS MARCHA REVERSA COM E SEM ALÍVIO DE PESO CORPORAL

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RESUMO

A marcha é uma ferramenta simples e econômica para reabilitação. Diminui a excitabilidade reflexa da medula espinhal e pode ser útil para minimizar os sintomas associados à espasticidade, que é comum em certas doenças como a esclerose múltipla. Particularmente, caminhar em condições relativamente desafiadoras induz efeitos mais consistentes em comparação à típica caminhada para frente. Além disso, o suporte do peso corporal durante a marcha pode ser interessante para pacientes com dificuldade de locomoção. No entanto, não há dados disponíveis sobre a neuroplasticidade de curto prazo na medula espinhal após marcha para trás (BW) com ou sem alívio de peso. O presente estudo mostrou redução significativa na amplitude do reflexo H (análogo elétrico do reflexo de estiramento) após 20 minutos de BW em esteira, com ou sem suporte de 20% do peso corporal ($p<0,05$). Também foi detectado um deslocamento significativo da curva de recrutamento (RC) para a direita em ambas as condições, indicando que é necessário aumento da intensidade do estímulo para a evocar o reflexo ($p<0,05$). Nenhuma diferença significativa foi detectada na amplitude do reflexo H e nas intensidades do estímulo após 45 minutos do término da tarefa de caminhada. Os efeitos de curto prazo não foram associados à inibição pré-sináptica dos terminais Ia, sugerindo que o mecanismo pré-sináptico que atua nos terminais das aferentes Ia pode não ser responsável pela redução na excitabilidade reflexa.

Palavras-chave: Eletrofisiologia; Neuroplasticidade, Fisioterapia; Reabilitação neurológica.

ABSTRACT

Walking is a simple and cost-effective tool for rehabilitation. It decreases spinal cord reflex excitability and might be useful for minimizing symptoms associated with spasticity, which is common in certain diseases such as multiple sclerosis. Particularly, walking in relatively challenging condition presents stronger effects than a typical forward walking. Additionally, body weight support during gait might be suitable for patients with impaired locomotion. However, there is no available data of short-term spinal cord neuroplasticity after backward walking (BW) with or without weight relief. The present study showed a significant reduction in H-reflex amplitude (the electrical analog of the stretch reflex) after 20 min of BW over a treadmill, with or without 20% of body weight support ($p<0.05$). It was also detected a significant shift of the recruitment curve (RC) to the right in both conditions, indicating that increased stimulus intensity is needed for reflex activation ($p<0.05$). No significant difference was detected in both H-reflex amplitude and stimulus intensities after 45 min from the ending of the walking task. The short-term after-effects were not associated with presynaptic inhibition of Ia terminals, suggesting that the presynaptic mechanism acting on Ia afferent terminals might not mediate the reduction in reflex excitability.

Keywords: Electrophysiology; Neuroplasticity; Physiotherapy; Neurological rehabilitation

Introduction

Challenging motor performance favors neuroplasticity, which is associated with both the acquisition of new motor skills and the restoration of the lost basic abilities (such as walking)[1,2]. Walking on a treadmill in different conditions has been adopted as adjunct in rehabilitative interventions. For instance, backward walking (BW) provided significant functional benefits (increased muscle strength, better control of gait, improved balance, etc) in stroke[3], osteoarthritis[4], Parkinson[5], low-back pain[6], cerebral palsy[7] and diabetic peripheral neuropathy[8]. Compared to forward walking, BW requires greater effort for suitable control of foot positioning, sensory reweighting due to increased reliance on the available sensory inputs other than the visual system, increased mechanical work and increased metabolic cost[3].

Investigations on locomotor-related plastic changes in able-bodied individuals have been carried out to gain insight into the neurophysiological adaptations with potential contribution to rehabilitation[9-11]. This is fostered by the fact that the short-term changes can be reverted into a long-lasting reduction in spinal cord excitability after a training program[12]. For instance, the resulted reflex suppression might be desirable to mitigate symptoms of spasticity, such as hyperreflexia[11].

The H-reflex (the "electrical analog" of the stretch reflex) has been widely used as a probe for neuroplasticity. Previous studies on healthy participants showed a consistent H-reflex suppression after a single bout of downhill walking (DW), that was more prominent than walking forward on a level surface (FW) [10,13]. The short-term changes in synaptic transmission were ascribed to the strong eccentric muscular activity in DW rendering increased muscle spindle sensory activation as compared to a level walking[10]. Similarly, BW is marked by increased dependence on somatosensory input due to the impossibility to rely on visual cues[3]. However, the short-term changes in transmission of the sensorimotor pathways after BW remains to be determined.

During walking with a body weight support, the afferent inflow from the moving limbs also plays a significant role in the modulation of spinal cord excitability[14]. Therefore, we hypothesized that the partially unloaded locomotor rhythmic movement (e.g, walking with weight relief of 20%)[15] prompts comparable short-term alterations across synaptic transmission. Since there is a number of studies showing positive rehabilitative results using body weight support in individuals with limited gait function[16,17], we believe it is worth evaluating whether the short-term reflex modulation is equivalent after BW with weight-bearing support. This last intervention presented better results in an individual with spinal cord injury, since it is more difficult to perform as compared to FW with body weight support[18], as well as improves walking speed in children with spastic diplegia[19].

The neurophysiological mechanisms underlying reflex modulation after locomotor related movements are not well understood. Presynaptic inhibition of Ia afferent terminals (PSI) has suggested to be responsible for the short-term changes in the soleus H-reflex after leg cycling[9], arm cycling[20], and the combination of arm and leg cycling[11]. However, no evidence on the excitability of the inhibitory presynaptic pathway after a walking task has yet been provided. Therefore, based on previous evidence of PSI modulation after rhythmic movements, we conjecture that PSI accounts for by the attenuation of the reflex response after BW either with or without body weight support.

The aim of the present work is to investigate spinal cord reflex excitability (through the H-reflex method) after BW, and to assess whether the reflex modulation is retained after walking with body weight relief, a procedure frequently adopted in rehabilitative interventions. We also sought to disclose if PSI is one of the neurophysiological mechanisms responsible for reflex modulation after each walking task. We hope that the results on the short-term neuronal adaptations, following a single bout of BW training with or without weight support in able-bodied individuals, will contribute to refine the understanding of the neurophysiological adaptations after locomotor activity.

Methods

Sample

Fifteen healthy adults (9 men; 26.2 ± 5.8 years; 76.15 ± 17.98 kg; 172 ±10 cm), were recruited for the present study. As an inclusion criterion, volunteers should have practiced resistance training for at least 6 months before enrolling in the study. Moreover, participants with either history of neurological diseases or lower limb injuries in the last 6 months prior to the tests were discarded. Volunteers signed an informed written consent form approved by the Research Ethics Committee of the Faculty of Health Sciences of the University of Brasília (CAAE: 31073020.8.0000.0030), in accordance with the Declaration of Helsinki. They were instructed to refrain from vigorous physical activity and consumption of any type of stimulant or psychotropic substances during the study.

Data acquisition

An acquisition system MEB 2300 (Nihon-Kohden, Japan) was used to record the electromyogram (EMG) of the soleus (SO) and tibialis anterior (TA) muscles. The EMG of the SO muscle was recorded using surface electrodes positioned 4 cm below the junction of the two gastrocnemius heads, above the SO muscle aponeurosis. The electrodes for the TA muscle were located on the middle line of the belly of the muscle. A ground electrode was placed over the ulnar styloid process. The EMG sampling rate was 2kHz with a band-pass filter of 10Hz to 1kHz. The H-reflex was evoked in the SO with the participants seated in a semi-inclined position with hip and knee at 120° and ankle at 90°.

Stimulation protocol

The H-reflex was evoked by a rectangular pulse of current with 1 ms duration (stimulation channel 1 from the MEB 2300) applied to the tibial nerve through a bipolar electrode located at the popliteal fossa. The intensity of stimulation was manually increased going from the threshold to the maximum H-reflex amplitude (Hmax). The interval between the intensities to elicit the threshold H-reflex and Hmax was divided into 10 to 15 equally spaced values of current to obtain the ascending limb of the recruitment curve (RC) (Figure 1A). As the H-reflex amplitudes vary even with constant stimulus intensity, the stimuli were delivered 5 times for each intensity, so each point of the ascending limb of the RC in Figure 1A represents the averaged H-reflex for the respective stimulus. The stimulus intensities were progressively increased until reaching the supramaximal stimulus to evoke the M-wave with maximal amplitude (Mmax), which represents the activation of 100% of the motoneurons within the pool.

To assess the level of PSI, the H-reflex was conditioned by a rectangular electrical pulse (1 ms) (stimulation channel 2 from the MEB 2300) applied to the common peroneal (CP) nerve with the electrode positioned over the fibular neck. The stimulus on CP nerve was applied 15 ms before the test stimulus to the tibial nerve[21]. A total of 20 stimuli were randomly applied in each condition, to obtain 10 control (CONT) and 10 conditioned (COND) H-reflexes. However, 4 out of 15 participants did not present a measurable PSI. The amplitude of the test H-reflex ranged between 20 and 30% of the Mmax[22]. The presence of a constant M wave was monitored in TA muscle with amplitude at around 100 µV, consistent with stimulation of 1.5 x motor threshold throughout the experiment[23].

Procedures

A system consisted of a harness coupled to a load cell fixed to an overhead horizontal beam, where lays an electric motor to lift the participant, was used for the partial (20%) body weight support. The 20 min walking session was then performed on a computerized treadmill (TK35, CEFISE, Brazil) with and without weight support. The participant was instructed to walk for 2 min to adjust the speed of the treadmill in order to achieve a moderate level of effort, i.e., subjective perceived exertion (SPE) of 3 to 4, in a scale between 0 (very easy) to 10 (exhaustive) [24]. The walking interventions were randomly selected and performed across 2 days, with an interval of 1 week: 1) backward walking (BW); 2) BW with 20% of body weight support (BW-20).

Walking duration and the percent of weight support were selected based on previous studies that reported short-term changes in H-reflex responses[10,13,15]. The independent variables (see next section) were assessed in three moments: 1) before walking (PRE), 2) ten min after walking (POS-1), 3) forty-five min after walking (POS-2). During each walking intervention the heart rate (HR) and the SPE were estimated every 5 min (5, 10, 15 and 20 min). The monitor HEM-7113INT (OMRON, Japan) was used to measure the HR and the blood pressure (BP).

Data processing

The peak-to-peak amplitude values of the H-reflexes and M-waves were calculated offline using a custom-made routine written in MATLAB environment (MathWorks, Inc.). The amplitudes and the current values were normalized, respectively, by the Mmax and the current required to evoke a M-wave with amplitude equivalent to 50% of Mmax. The parameters associated with the ascending limb of the RC of the H-reflex were estimated by means of a general least square model to fit a sigmoid (logistic curve) to the peak-to-peak amplitude values as suggested elsewhere[25]. The Hmax was defined as the average of the 5 highest H-reflex amplitudes.

Figure 1A depicts the H-reflex and M-wave RCs and respective sigmoid curves from one representative participant. The intercept on the x-axis that represents the threshold current for the H-reflex (C_Hth, indicated as a filled square on the abscissa of the Figure 1B) at a given moment (PRE, POS-1 or POS-2) (Figure 1C) was mapped using the linear regression estimated from the ascending limb of the RC (inclined dashed lines in Figure 1D). The current parameter C_H50 is the intensity of stimulus necessary to elicit an H-reflex related to Hmax/2, which corresponds to the point where the regression line intersects the inflection of the sigmoid (50%Hmax, indicated as a filled circle on the sigmoid of the Figure 1B). Both C_Hth and C_H50 provide an estimate of the RC shifting along the abscissa.

The PSI level (%PSI) was calculated as a percentage change according to the equation: %PSI = [(CONT- COND) / CONT] x 100

The mean arterial pressure (MAP) was calculated as the weighted average (weight 1.0 to systolic BP and 2.0 to diastolic BP) according to the following equation [26]: MAP= (systolic BP + 2x diastolic BP) / 3

Statistical analysis

The Shapiro-Wilk test was conducted to verify the normality of the data. A two-way repeated measures ANOVA was used to detect differences among the moments (PRE x POS-1 x POS-2) and weight support (BW x BW-20). When necessary, a post-hoc Bonferroni test was performed to detect significant differences. The independent variables were the Hmax, Mmax, %PSI, normalized current intensities (C_Hth and C_H50) and MAP. The Pearson correlation coefficient was evaluated for the variation from PRE to POS-1 moments (Δ%) between %PSI and Hmax in both conditions (BW and BW-20).

A paired t-test was applied to detect differences between the two weight supported conditions (BW and BW-20) for the variables SPE, HR and treadmill speed. Both the SPE and HR consisted of the mean collapsed across the minutes 5, 10, 15 and 20 during the walking task. The SPSS software (Statistical Package for Social Sciences, USA) was used for all analysis. The significance level was set at $p<0.05$ for all tests.

Results

Figure 1C depicts the averaged H-reflex amplitudes on the ascending limb of the RC from a representative participant and the respective sigmoidal fit estimated in PRE, POS-1 and POS-2 moments. There is an evident shift of the RC to the right along with a reduction in the highest amplitude H-reflexes (Hmax) (Figure 1D).

The two-way ANOVA of repeated measures revealed significant main effects on Hmax amplitude across the moments (PRE, POS-1 and POS-2) ($F(2,28) = 8.004$; $p=0.006$; $\eta^2 = 0.364$) (Figure 2A), with no main effect for the support condition (BW and BW-20). A significant reduction was detected in Hmax at the moment POS-1 as compared to PRE ($p<0.002$) (Figure

2A). However, no significant difference was detected between PRE and POS-2, indicating that Hmax did not differ from the control (PRE) after 45 min from the ending of either BW or BW-20 tasks.

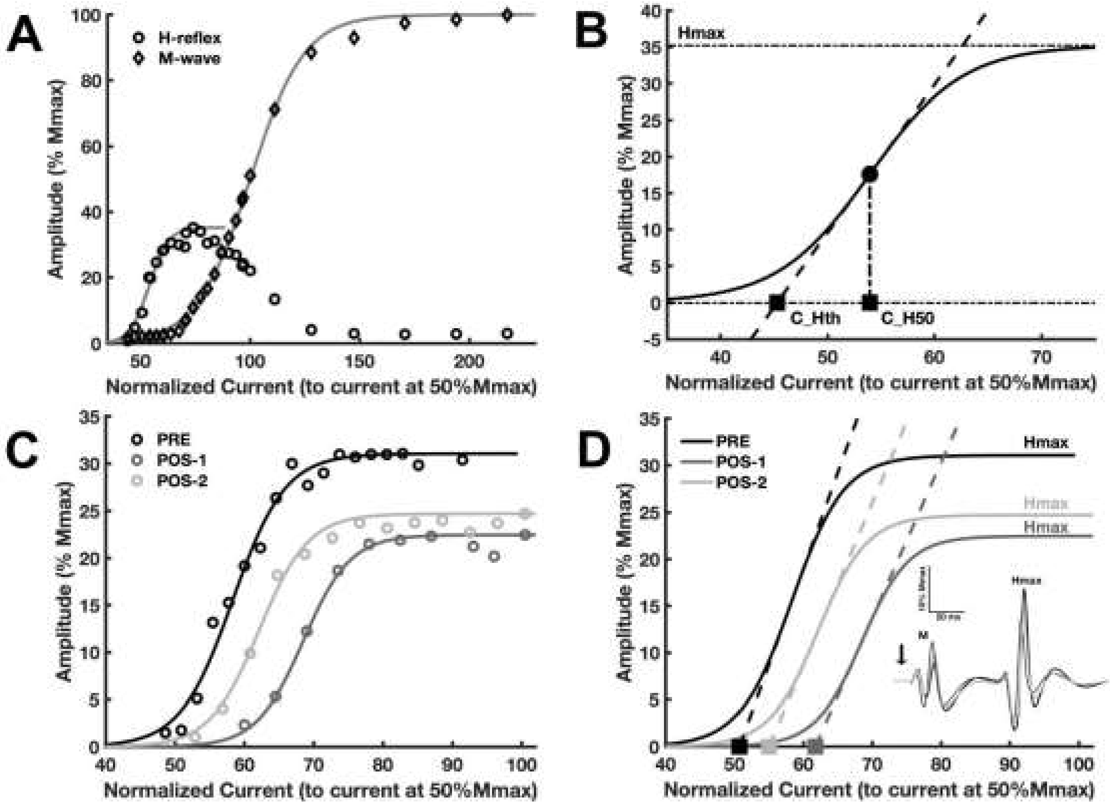

Figure 1: A) Recruitment curve (RC) of both the H-reflex (circles) and M-wave (diamonds) of a representative participant with the respective sigmoidal fit (continuous line). Each point in the ascending limb of the RC is the peak-to-peak amplitude averaged from 5 H-reflexes (or M-waves) normalized by Mmax; **B)** A zoom from **A** highlighting the sigmoid fit of the H-reflex RC (both H-wave and M-wave amplitudes, as well as the M-wave sigmoid, are omitted for clarification). The dashed inclined line represents the regression line of the ascending limb of the RC, that intersects the sigmoid at 50%Hmax (filled circle on the sigmoid), corresponding to the intensity of C_H50. The regression line also crosses the abscissa at C_Hth; **C)** Each circle represents the average of 5 H-reflexes obtained in all moments (PRE, POS-1 and POS-2). The respective sigmoids are also displayed; **D)** The same as in **C**, showing the regression lines that crosses the abscissa at C_Hth in each moment (filled squares). Note the displacement of the curve to the right, with the progressive return of the C_Hth to the original value (the C_Hth in POS-1 is higher than both PRE and POS-2). It is also noticed a reduction in Hmax from PRE to POS-1. The inset shows a sweep of the maximum H-reflex (Hmax) in each moment. The arrow indicates the stimulus artifact (omitted for clarification). M = M-wave.
Note: Recruitment curves and the respective sigmoidal fit.
Source: authors.

There were no significant interactions between factors moment and support condition, suggesting that the amount of H-reflex modulation was similar for both walking tasks (BW and BW-20). There were no main effects for Mmax considering all factors and walking tasks, as well as no interactions (Table 1).

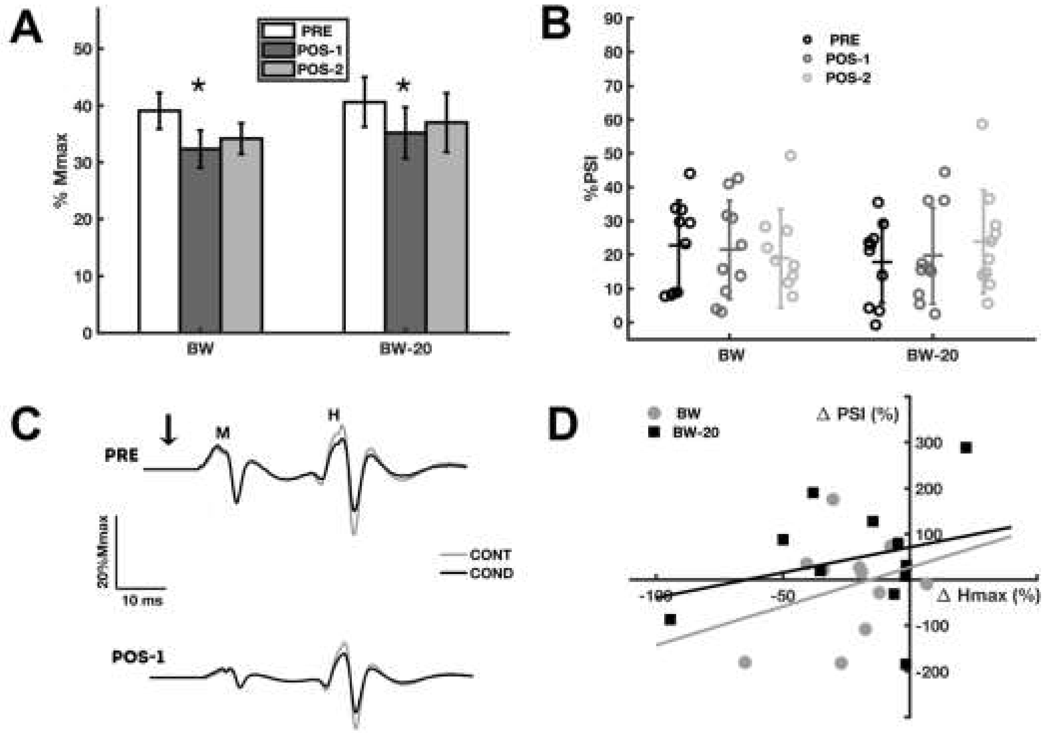

Figure 2: A) Mean values of Hmax calculated form the data of all participants across the moments (PRE, POS-1 and POS-2) and conditions (BW and BW-20). There was a significant reduction in Hmax at the moment POS-1 as compared to PRE. The vertical line is the standard deviation. Asterisk represents $p<0.05$ (different from PRE); **B)** Averaged values of %PSI (horizontal lines) from all participants. The vertical lines represent the standard deviation; **C)** EMG recordings from a representative participant showing the control (CONT) and the conditioned (COND) H-reflexes in both moments PRE and POS-1. Each trace is the average of 10 sweeps. The M-wave remained constant for both CONT and COND irrespective of the moments. The arrow indicates the stimulus artifact (omitted for clarification). M = M-wave; H = H-reflex; **D)** Correlation between the variation from PRE to POS-1 of %PSI and Hmax. No significant correlation was found (BW x Hmax: R= 0.299; p=0.371; BW-20 x Hmax: R=0.273; p=0.416).
Note: Grand average of Hmax and %PSI, as well as representative data.
Source: authors.

The results from the stimulus intensities to elicit the H-reflexes with different amplitudes in the ascending limb of the RC showed significant main effect throughout the moments after both tasks for C_Hth ($F(2,28) = 4.356$; $p = 0.023$; $\eta^2 = 0.237$) and C_H50 ($F(2,28) = 7.555$; $p < 0.008$; $\eta^2 = 0.350$) (Table 1). There was a significant increase in C_Hth ($p = 0.005$) and C_H50 ($p=0.015$) at POS-1 as compared to PRE. These results indicate a significant shift of the H-reflex RC to the right (see Figure 1D). There was a significant decrease in the parameters C_H50 at the moment POS-2 as compared to POS-1 ($p < 0.001$) indicating a tendency to return to the control value after 45 min. The current parameters did not show main effects for the factor support condition, as well as no interaction of the two factors presently explored (support condition and moment).

Table 1. Normalized averaged values for Mmax and Currents. The standard deviations are between parenthesis.

	PRE		POS-1		POS-2	
	BW	**BW-20**	**BW**	**BW-20**	**BW**	**BW-20**
Mmax (mV)	7.41 (2.85)	7.46 (3.17)	7.59 (3.03)	7.42 (2.90)	7.61 (2.83)	6.90 (2.73)
Curr-Hth (%)	48.95 (7.40)	47.96 (5.78)	50.87 (6.06)*	51.43 (8.18)*	47.57 (7.12)	42.70 (19.51)
Curr-H50 (%)	58.56 (8.10)	57.52 (7.40)	60.42 (7.45)*	62.01 (10.53)*	58.47 (8.97)†	51.31 (10.98)†

Note: (*): significant difference (p <0.05) from PRE; (†): significant difference (p <0.05) from POS-1; BW: backward walking; BW-20: backward walking with 20% of body weight support.
Source: authors.

It was not possible to detect a significant main effect in the %PSI for both factors moment and support condition. The overall results for %PSI are presented in Figure 2B. Examples from a representative participant are in Figure 2C depicting superimposed sweeps with test and conditioned H-reflexes (CONT and COND, respectively) recorded at PRE and POS-1 moments. The amount of inhibition did not change at both moments and the test H-reflex had very similar amplitudes (between 20 and 30%Mmax). No significant correlation was detected for the variation from PRE to POS-1 moments (Δ%) between the %PSI and Hmax for all conditions. Figure 2D shows the correlation between ΔHmax and ΔPSI.

There were no main effects for the variable MAP considering all factors and walking tasks, as well as no interactions (Table 2). The paired t-test did not detect significant differences for the variables SPE, HR, and speed of the treadmill between weight-supported conditions (BW and BW-20). These results are presented in Table 2.

Table 2. Values of subjective perceived exertion (SPE), treadmill speed, heart rate (HR) and mean arterial pressure (MAP).

	BW	BW-20
	Mean (std)	**Mean (std)**
SPE	4.31 (1.48)	4.08 (1.50)
Speed (km/h)	3.20 (0.62)	3.42 (0.44)
HR (bpm)	112.21 (12.95)	104.92 (8.50)
MAP (mmHg)		
PRE	90.77 (9.01)	90.33 (11.01)
POS-1	89.69 (7.76)	87.08 (8.55)
POS-2	89.90 (7.48)	88.18 (9.95)

Note: BW: backward walking; BW-20: backward walking with 20% of body weight support; std = standard deviation.
Source: authors.

Discussion

The present study corroborates previous work with DW and FW[10,13] and extends the results to BW with and without weight support. Notably, the weight-bearing walking did not interfere with the pattern of reflex modulation. The reduction in Hmax observed at POS-2 following BW did not reach statistical significance. This suggests that the recovery to the control values (H-reflex amplitude in PRE moment) is gradual and might take several minutes. The right shift of the RC after BW was significant, indicating the increased threshold to elicit H-reflexes at the ascending limb of the RC. However, the mechanisms behind these short-term effects seem not to be mediated by presynaptic inhibition of Ia terminals, as %PSI was not significantly different following both walking tasks.

Backward walking has distinct biomechanical characteristics and patterns of muscle activation and might be deemed as a challenging locomotor activity when compared to the most usual walking task (FW), becoming very useful as a rehabilitative adjunct. Despite the view that BW and FW probably share the same locomotor neural program (but working in reverse)[27], BW is somewhat unnatural and seldom is it used in daily functional tasks. It is not possible to rely on visual input to guide the movement during BW and, in terms of mechanics, the plantar flexion in BW is not used for propulsion as compared to FW[28].

It has been shown that the co-contraction, as observed in muscles around the ankle joint during the stance phase of BW, lead to long-lasting reduction in the excitability of the stretch reflex pathway along with changes in the excitability of the corticospinal pathway[12]. Therefore, challenging motor tasks, such as BW, might promote neuronal reorganization in different levels of the central nervous system (e.g., spinal cord and cortex)[29,30,12], also reflected by the significant cortical involvement during BW[31]. Indeed, motor tasks characterized by skilled movements, that demands increased cortical involvement, induced short-term plasticity probably mediated by the corticospinal tract[2,12,29,30]. These adaptations might help explain the short-term effects on spinal cord excitability currently observed.

Partial body weight support enhances the contribution of sensory inputs (very desirable for rehabilitation), that is integrated with descending commands within the spinal cord to produce a suitable coordination of locomotor movements[14,32]. This constantly modulated sensory feedback undergoes short and long-term plasticity[33,34]. During walking with weight support, there is a partial unload, hence, it would be expected a lesser contribution of load-related sensory feedback to muscle activation. Nevertheless, the ankle extensors activation as well as the knee and ankle joint trajectories with 20% of body weight support during FW, did not significantly differ from a full weight bearing FW[35,36]. From our knowledge, there is no data on muscle activation and gait kinematics during BW with reduced weight bearing. However, during backward running with 20%, 40%, 60% and 80% of body weight support, the magnitude of ankle extensor muscle activity did not differ from running forward with the same amounts of weight relief[37]. It is therefore unlikely that the muscle activation is determinant for possible changes in sensory input from the load receptors during BW-20. Finally, in the current investigation, the physiological variables HR, MAP, and SPE, were not significantly different between walking with and without support, indicating that the effort to perform the task did not influence the results.

The present results showed that the reflex down-modulation after BW was equivalent for BW-20, providing evidence that partial weight-bearing gait induced spinal cord plasticity to a similar extent as did the full body weight walking. We propose that, despite the possible changes in the load of the lower limbs due to a partial weight-bearing walking, similar mechanisms of spinal cord plasticity were triggered by the walking tasks. These mechanisms might encompass neuronal locomotor systems that are regulated by the afferent input from the moving limbs. [27]

As for the mechanism responsible for reflex attenuation, it is well known that the PSI gates the afferent inflow to the spinal cord and its control is probably part of a process that mediates neuroplastic changes[38]. This neurophysiological mechanism is generally proposed to mediate the short-term down regulation of spinal cord excitability after locomotor activity [11,20].

However, we were unable to find significant difference in %PSI following a single bout of BW in different conditions. Our findings are in agreement with a previous study that did not show significant difference in PSI after walking with functional electrical stimulation applied to the CP nerve during the swing phase of the gait cycle[39]. Additionally, there was no significant correlation between the variation (from PRE to POS-1 moments) of %PSI (ΔPSI) and the variation of the Hmax (ΔHmax) across conditions. These results suggest that an alternative mechanism of reflex modulation could account for by the observed down-modulation of the H-reflex.

Therefore, it is possible that a postsynaptic mechanism (e.g., mediated by Ia inhibitory interneuron within a reciprocal inhibition pathway) is involved in the currently observed reflex suppression. As cortical plasticity (that might occur after walking tasks) is normally associated with spinal cord changes in excitability, and a contingent of the corticomotoneuronal cells projects to reciprocal Ia inhibitory interneurons[30], the suppression of H-reflex after walking could be postsynaptic in origin. Additionally, there is evidence of reflex modulation related to this inhibitory pathway, since the level of reciprocal inhibition was increased after 30 min of robot-assisted passive stepping with therapeutic electrical stimulation to the CP nerve in healthy participants[40].

Assuming that a post synaptic mechanism underlies the after-effects from BW, the present results point to the hypothesis of an increased activation threshold of the motoneurons from the pool, which could explain the right shift of the RC. Further investigations considering short-term effects on motoneurons (e.g., through reciprocal inhibition) after walking without assistive devices in able-bodied participants are advised.

Conclusion

The current findings show that the short-term alterations in spinal cord excitability are induced after BW, and the amount of suppression did not differ from walking with 20% weight support. The Hmax showed a significant reduction 10 min after BW task performed during 20 min. Moreover, a significant shift of the RC to the right indicates increased activation threshold of the H-reflex. However, these short-term effects lasted for less than 45 min. No significant difference was noticed for the PSI of Ia terminal from muscle spindles among the conditions investigated, suggesting that a presynaptic inhibitory pathway might not have influence on the short-term reflex suppression. The present results add to the knowledge of short-term spinal cord neurophysiology adaptations after BW either with or without weight support, with potential application for the development and/or improvement of rehabilitative interventions.

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