

Ankle power generation has a greater influence on walking speed reserve than balance following traumatic brain injury



Epworth
Research

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Introduction

Following traumatic brain injury (TBI), individuals may have significant mobility limitations, including reduced walking speed. Walking speed is fundamental for function and independence. It is a strong predictor of disability and mortality and has been referred to as the “sixth vital sign”.

Walking speed reserve (WSR) refers to the difference between self-selected walking speed (SSWS) and fast walking speed (FWS). WSR is important for an individual’s mobility, adaptability to environmental demands and participation in community activities such as timely road crossing.

Ankle power generation (APG) or the force produced by the ankle plantarflexors for push-off, is the most important contributor to forward propulsion during walking. Balance, or stability, whilst walking is also important. Predictors of WSR following TBI are yet to be determined, but may assist clinicians to prioritise treatment planning and target specific therapeutic interventions. It is currently unclear whether APG or balance is a stronger predictor of WSR.

Aims

The primary aim of this study was to determine the relationship between balance, APG and WSR in TBI. It was hypothesised that: i) APG would be a stronger predictor of WSR than balance; ii) that individuals with more impaired APG would demonstrate a lower WSR.

Methodology

A cross-sectional study of 92 individuals receiving physiotherapy for mobility limitations following TBI were recruited. Walking speed (self-selected and fast), ankle power generation (APG) and a summed single-leg balance score were measured. Three-dimensional (3D) gait data were acquired using a motion analysis system (Vicon 512, Oxford Metrics, Oxford UK).

Participants were dichotomised into two groups; 1) those who had a WSR and 2) those with ‘no WSR’ (Table 1). WSR or the ability to increase speed on demand by defined as an increase in walking speed $\geq 0.20\text{m/s}$.

Correlations, logistic regression and receiver operating characteristic (ROC) analyses were performed to investigate independent relationships between WSR, APG and balance.

Table 1. Group characteristics for those with and without WSR

	WSR (n = 50)	No WSR (n = 42)	p
Age (years)	27.6 (8.9)	27.6 (8.9)	0.163
Height (cm)	177.3 (7.6)	171.9 (9.0)	0.058
Weight (kg)	73.1 (11.0)	72.5 (15.3)	0.825
Time post injury (months)	54.7 (64.4)	46.2 (70.4)	0.549
Post traumatic amnesia (days)	66.7 (62.3)	74.1 (38.7)	0.545
Self-selected walking speed (m/s)	1.20 (0.23)	0.80 (0.40)	< 0.001
Fast walking speed (m/s)	1.70 (0.34)	-	
Balance (sec)	42.5 (27.0)	20.0 (20.1)	< 0.001
Ankle power generation (W/kg)	1.60 (0.70)	0.90 (0.70)	< 0.001
HiMAT score (/54)	28.2 (9.1)	12.1 (7.9)	< 0.001

Results

Fifty participants were able to increase their walking speed beyond the 0.20m/s threshold. Those with WSR had significantly faster SSWS, better balance and greater APG than those without a WSR (Table 1). On average, these 50 participants were able to increase their walking speed by 0.50m/s between SSWS and FWS trials.

Overall, there was a strong correlation between SSWS and APG, $r = 0.78$ (<0.001) (Fig 1), and a moderate correlation between SSWS and balance, $r = 0.48$ (<0.001). The results of this study indicate that APG was a stronger predictor and better classifier of WSR than balance. Further, the inability to generate a WSR was strongly associated with reduced APG.

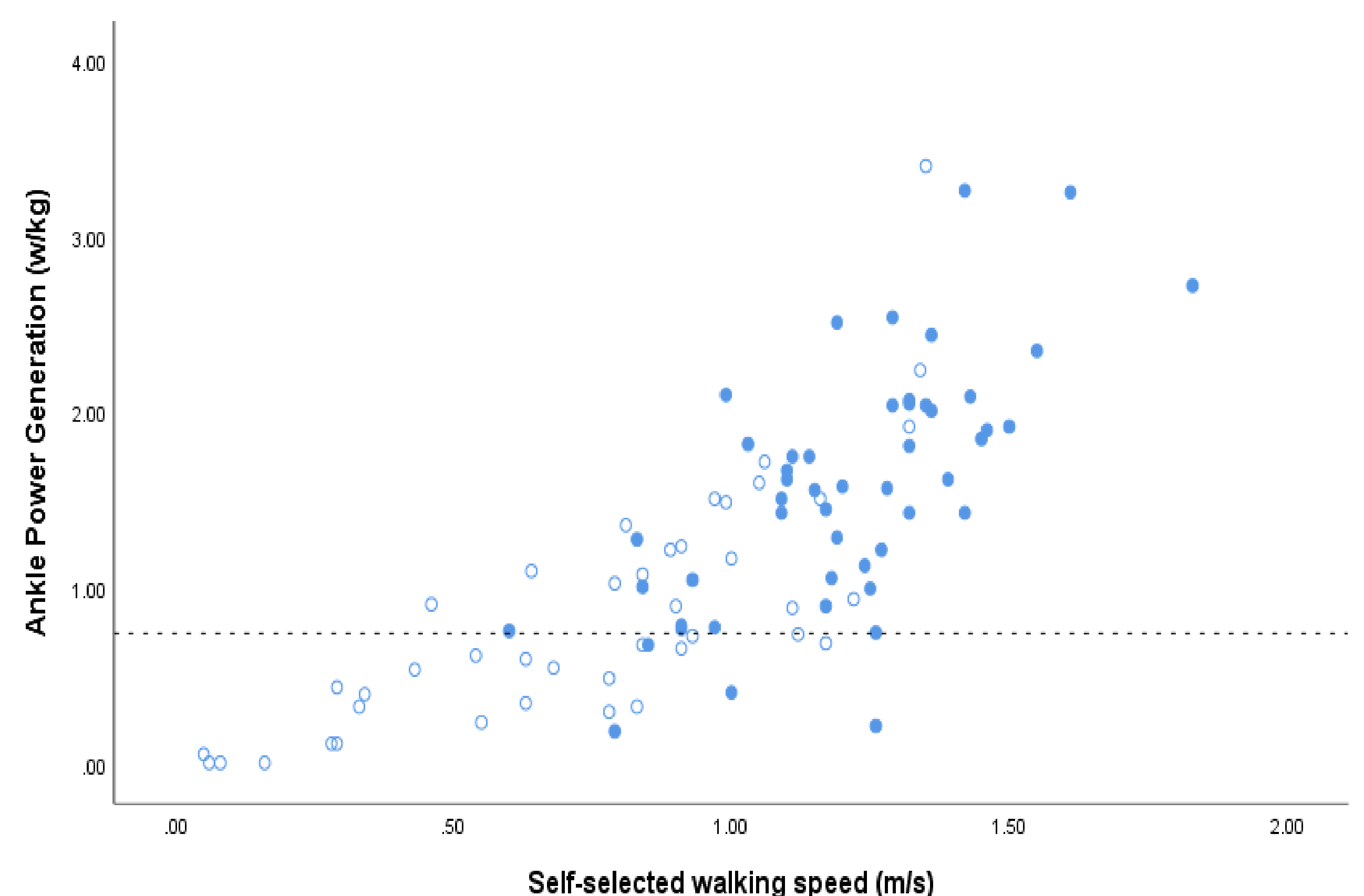


Figure 1. Distribution of participants who were able/unable to increase their walking speed based on APG.

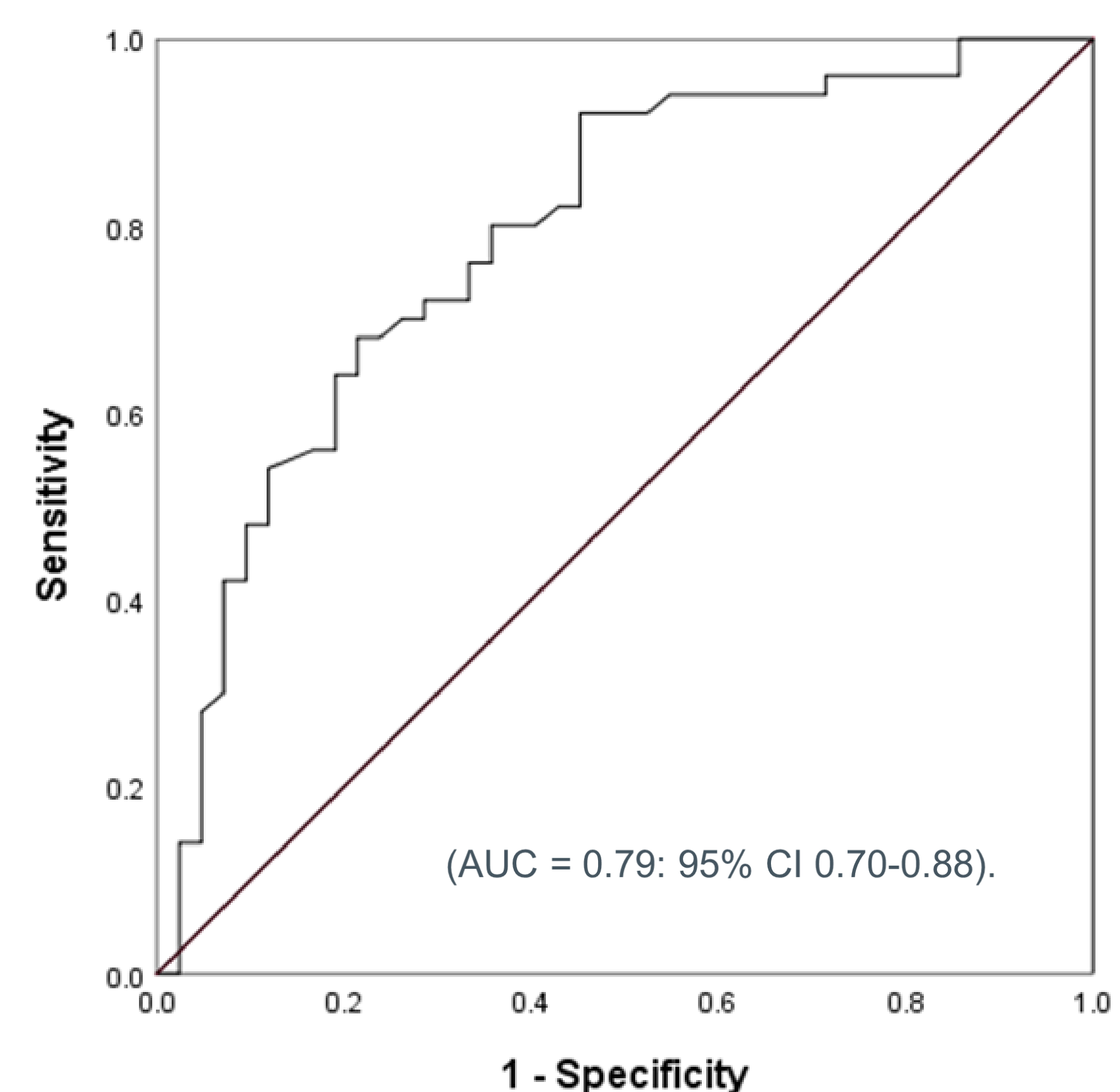


Figure 2: ROC Curve for Ankle Power Generation

Conclusions

Following a TBI, APG was a stronger predictor of WSR than balance. These findings are consistent with previous evidence in TBI, which suggests that the primary limiting physical impairment for walking is APG. Clinicians should consider interventions which target ankle power generation in order to increase walking speed reserve for adaptive community mobility.