Comparing forward (FW) and backward walking (BW) Speeds with Age and Disease Severity in Persons with Parkinson Disease (PwP).

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Background

- Postural stability is essential for fall prevention[1,2], is dysfunctional in the elderly[3] and people with moderate PD[4], and does not improve with medication[5]
- Up to 90% of PwP have fallen at least once[1] and 17% of newly diagnosed individuals have already fallen[2]
- Laboratory-based studies suggest kinematic measures for BW are more strongly associated with age than FW in healthy controls and more predictive of walking difficulties and falls in elderly controls[9,10,11]
- In PwP, BW deficits may surpass FW deficits, be correlated with disease severity, and be impacted earlier in the disease[6,12,13]
- Considering the multidirectional nature of negotiating complex environments while walking, there is a need to have a simple clinical test of BW that may capture deficits, detect fall risk, and be sensitive to improvements[1,6,8]
- Carter et al.[17], introduced a clinical outcome tool named the 3 meter BW test (3MBWT) which compared its' accuracy to other common clinical measures used to identify elderly fallers, including the 10 meter FW test (10MWT) and the Timed Up and Go (TUG reg) and provides fall predictability cut off times
- Outcome tools that represent the environmental complexity and cognitive resources required for everyday mobility which can be used to predict fall risk are greatly needed[1,6,8] so that interventions can be implemented before a fall occurs

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Purpose

- The purpose of this study is to summarize retrospective data from a physical therapy clinic that used the Carter et al. novel 3-meter BW test in a group of PWP of varying disease severity.

Aim 1. Characterize the response to first and second trial BW
Aim 2. Analyze the relationship between FW and BW and age
Aim 3. Analyze the relationship between FW and BW and disease severity
Aim 4. Characterize the relationship between FW and BW and fallers/non fallers

Methods

- The data presented in this study were part of a larger medical record review examining long-term adherence and benefits for participants who consistently attend a physical therapy clinic that offers access to research-based Parkinson-specific physical therapy and onsite group exercise programming.
- Evaluations were performed by physical therapists as part of a standard evaluation of all new clients
- No instructions on administration of PD medication were given
- The following data was included in this analysis
  - Demographics: age, sex, date of diagnosis, and 6-month fall history
    - (yes or no)
  - Clinical measures: three-meter BW test[17] and ten-meter walk test (FW)[7]
  - Two trials of BW were performed to determine its trial to trial consistency[18]
  - One trial of FW was collected for each of the two different speed conditions: normal speed (FW_NT) and fast and safe (FW_FS)
- Disease severity was determined by one PD-specialized physical therapist (BF) performing chart reviews to identify key criteria for assigning the appropriate Hoehn and Yahr Stage[19]

Subject Selection

Review Medical Record from July 2013 – July 2018 (n = 538)

Excluded (n = 384)
- Did not receive a 1-year consult that was completed before July 2018

Excluded (n = 20)
- Did not complete their 1-year consult ± 3 months of their initial consult

Included (n = 176)

Graphic 1: Subject Selections

Data Analysis

- Demographic characteristics of participants and clinical data were summarized with descriptive statistics and frequency distributions. For this and all other comparisons, a p-value of 0.05 was used
- For Aim 1, differences in gait speed between the first and second trial of BW was analyzed using paired samples t-test
- For Aims 2, 3 and 4, gait speeds across FW and BW were compared across decades (50-80 years), disease severity (H&Y Stages 1-4), and fall risk (reported fallers versus non-fallers) using one-way ANOVA

Results

Aim 1. Characterize First-trial BW Performance (Figure 1: A & B)
- First-trial (T1) is significantly different from second trial (T2), p=.002.

Backward Walking - Overall
Figure 1 A: Backward Walking Trials

Aim 2. Relationship to Age (Figure 2: A & B)
- FW and BW gait speed decreased across decades (trend did not reach significance)
  - FW_NT, p=.536; FW_FS, P=.929
  - BW_T1, p=.989; BW_T2, p=.900
- Gait speed relationship b/w FW and BW trials appears consistent
  - FS trial was 26.9% to 30.9% faster than NT
  - T2 was 14.12% to 23.1% faster than T1

Forward Walking Vs. Age

Backward Walking Vs. Age

Aim 3. Relationship to Disease Severity
Forward Walking
- Forward walking speed did not decrease significantly with greater disease severity
  - FW_NT, p=.066; nor FW_FS, p=.091
- Forward walking speed relationship between FW trials were consistent
  - FS was 27.3% to 31.1% faster than NT

Backward Walking
- Backward walking speed decreased significantly with greater disease severity (T1 and T2).
  - BW_T1, p=.002; BW_T2, P=.008
- Post hoc comparisons showed:
  - BW_T1 was significantly different between stages 1 and 2, p=.047; and between stages 2 and 4, p=.001
- Although T1 was always slower, the relationship between gait speed T1 and T2 was more variable with increased disease severity
  - T2 was 14.1% (H&Y 1) to 29.5% (H&Y 4) more variable than T1

Forward Walking Vs. Hoehn and Yahr Stage

Backward Walking Vs. Hoehn and Yahr Stage

Aim 4. Relationship between fallers and non fallers
- Gait speed was not significantly different between fallers & non fallers for FW or BW conditions
  - FW_NT, p=.616; FW_FS, p=.788
  - BW_T1, p=.765; BW_T2, P=.586
- There was a significant difference in age between fallers and non fallers, p=.01
- The % of fallers were similarly distributed across disease severity
- The highest probability of falls occurred for Stage 2

		Reported Falls last 6 months			
		No		Yes	
		Mean± S.D	Count	Mean± S.D	Count
Age		71.32±7.90		74.42±7.14	
Sex	Male		72		45
	Female		27		22
FW_NS_speed		1.09±.25		1.07±.31	
FW_FS_speed		1.51±.35		1.53±.33	
BW_T1_speed		.72±.33		.70±.33	
BW_T2_speed		.89±.38		.86±.34	

% Of Fallers in Each Hoehn & Yahr Stage				
	1	2	3	4
FW_NT	20.90%	34.33%	23.88%	20.90%
BW_T1	20%	33.85%	24.62%	21.54%

Results

Defining optimal cutoffs to identify fallers or non fallers in PwP

Comparison of previously reported dual cut-off times in elderly controls from Carter et al.[29] to our data in PwP

% Fallers captured at < 0.67 m/s

% Nonfallers captured at > 1 m/s

Carter et al. - 81% EC
PwP T1- 53% T2- 59%

Further assessment Needed in this range

Carter et al. - 75% EC
T1 - 77% PwP
T2 - 81%

Slower ← → Faster

| 0.5 | 0.6 | 0.75 | 1 | 3 | m/s |
| 6 | 5 | 4.5 | 4 | 3 | 1 | seconds |

Backward Gait Speed

Conclusions/Limitations

Conclusions
- BW T1 is significantly different from T2 as previously shown for first-trial protective stepping[18] and may reflect the instability that may occur from a single loss-of-balance event in daily life
- Neither BW nor FW speeds were significantly related to decade.
- Only BW was related significantly to HY Stage or disease severity
- There were no significant relationships found between BW or FW speeds and fallers and non fallers
- As previously reported[3] we showed as many as 21% of people with early PD (H&Y1) report falling in the last 6 months

Limitations
- Retrospective study design; a prospective study may provide more insight on the differences/relationships between these variables
- Distribution of age and disease severity was not equal across groups.
- Separating by decade may have limited our ability to detect differences in a study of this size
- Medication dosage and state was not specified during testing
- Other fall risk factors (obesity, level of fitness, arthritis, etc.) were not included

Future Directions

- Determine if there is a difference in sensitivity of BW T1 and T2 as shown for protective stepping trials[18].
  - to different different modes of practice (i.e, aerobics vs. skill learning)
  - to detect freezers and non freezers
- Establish reliability of the BW test in different populations
- Prospective studies needed to determine ability of BW to predict falls and to compare BW with other validated fall risk measures (TUG, 10 meter walk test, four square step test, five times sit to stand and pull or push tests)
- Include a broader and more equal distribution for age and disease severity to capture younger individuals (< 50) and those with greater disease severity
- Determine the sensitivity of BW to detect short and long-term improvements with rehabilitation or group exercise interventions that include multidirectional, complex cognitive/motor training

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