Fibromyalgia and Aging: The Role of Time-of-Day in Cognitive and Physical Performance

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Introduction

Fibromyalgia

- Fibromyalgia (FM) is a chronic condition characterized by widespread pain, fatigue, stiffness, and concentration problems (Wolfe et al., 1995).
- FM affects between 2-6% of Americans; approximately 90% of those affected are women (Lawrence et al., 2008; Wolfe et al., 1995).
- The prevalence of FM increases with age, reaching greater than 7% in women 60-79 years of age (Wolfe et al., 1995).
- FM has a high rate of co-morbidity with anxiety and depression (Aguglia et al., 2011).
- Common FM symptoms of depression and fatigue are related to higher levels of impaired cognition (Suhr, 2003) and physical functioning (Jones et al., 2010).
- But are cognitive and physical performance affected by time of day in FM?

Time of Day

- Generally, circadian patterns for older adults tend to favor morning as a time for peak performance (Roenneberg et al., 2003; Martin et al., 2008).
- Symptoms of FM, however, may disrupt typical circadian and performance patterns.
  - 80% of those diagnosed with fibromyalgia suffer from broken sleep (Scheuermann, 2009).
  - Poorer sleep appears to result in more pain the following day (Affleck et al., 1996)
- With FM, pain, stiffness, and fatigue tend to be greater in the morning, especially for those with low pain tolerance (Bellamy et al., 2004; Riva et al., 2010).
  - Fatigue is often worse early in the morning and again later in the afternoon (McIlwain & Bruce, 2003).
  - Pain tends to increase again later in the day (McLean et al., 2005)

Purpose of Study

- The current study compares the physical and cognitive functioning of older adults with FM to their same-aged healthy peers to determine whether time of day might moderate the relationship between FM status and performance.

Hypotheses

- An interaction between FM status and session is expected, with FM participants performing better on the cognitive and physical tests later in the day and non-FM participants doing better in the morning.

Method

Participants

- Community dwelling, functionally independent adults over 50
  - 70 individuals with FM
    - 5 males, 65 females
  - 76 healthy controls
    - 25 males, 51 females

Procedures

- Mailed information and consent documents, health history, activities/demographic survey, other questionnaires
- 2 days of testing (~2 hours/day); physical and cognitive testing took place on second day
  - Cognitive tests took 35 - 60 minutes
  - Physical tests took about 25 minutes

Measures

- Time of Day
  - 3 testing sessions, beginning at:
    - 9:00 a.m.
    - 11:00 a.m.
    - 1:00 p.m.
- Covariates
  - Age
  - Gender
- Cognitive Measures
  - Stroop Color (Stroop C) and Color/Word (Stroop CW) Tests (Trenerry et al., 1989); scores = seconds to complete
  - Trails A & B (Lezak, 1995); scores = seconds to complete
  - CERAD 10-item word list assessing immediate (3 trials) and (10-15 minute) delayed recall, plus a 20-item delayed recognition trial (Morris et al., 1989); score = total number correct across all trials
  - Digit Span Forward and Backward (Wechsler, 1997); scores = # correct
  - Digit Symbol Substitution (Wechsler, 1997); scores = number correct in 120s
  - Animal fluency; scores = number named in 60 seconds
- Physical Measures
  - Fullerton Advance Balance scale (FAB; Rose, Lucchese & Wiersma, 2006); score = 10-item total
  - Senior Fitness Test (Rikli & Jones, 2001):
    - 30-second chair stand (# of stands)
    - 8 Foot Up and Go (# seconds)
    - 6 Minute Walk (distance covered in 6 minutes)
  - Preferred Walk Velocity (30ft./#sec at preferred gait)
  - Maximum Walk Velocity (30ft./#sec at maximum walking speed)

Table 1: ***Descriptive Characteristics of FM and Non-FM Participants***

	FM (*N* = 70)			Non-FM (*N* = 76)		
	%	*M*	*SD*	%	*M*	*SD*
Age	--	59.63	7.58	--	67.96	8.74
Gender	7		--	33	--	
Male	93			67		
Female						
Performance Measures						
CERAD Total	--	46.37	6.86	--	44.43	6.88
Animals	--	19.34	5.38	--	21.5	5.56
Digit Span Forward Score	--	10	2.17	--	9.97	1.94
Digit Span Backward Score	--	6.33	1.94	--	7.13	2.35
Trails A Time (# seconds)	--	38.83	18.29	--	36	12.73
Trails B Time (# seconds)	--	82.88	31.66	--	85.85	38.48
Stroop C Time (# seconds)	--	61.84	11.66	--	59.63	12.26
Stroop CW Time (# seconds)	--	147.12	31.6	--	151.73	48.02
Digit Symbol Substitution	--	60.01	14.32	--	61.84	19.49
FAB	--	31.76	6.38	--	34.07	4.63
30-sec Chair Stand (# of stands)	--	9.93	4.2	--	13.17	3.77
8 Foot Up and Go (# seconds)	--	6.19	2.44	--	5.5	1.34
Preferred Walk (# seconds)	--	7.72	1.57	--	6.87	1.18
Maximum Walk (# seconds)	--	5.47	1.1	--	4.6	0.84

Results

- Separate 2 (FM status) X 3 (time of day) MANCOVA analyses were performed on the data for the respective cognitive or physical measures. Age and gender were included as covariates.

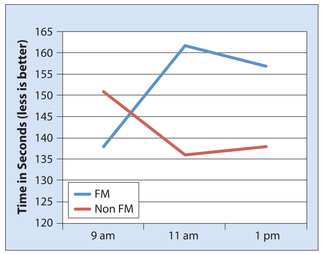
Cognitive Findings

- Session did not moderate the relationship between FM status and memory (CERAD), processing speed (DSST, animal fluency) or executive functioning (as measured by Trails A & B, Digit Span).
- Only executive functioning (as measured by the StroopCW) revealed an interaction, but not in the expected direction (see Figure 1).
  - FM participants performed better than the non-FM participants in the morning but performed worse in the afternoon ($p < .05$).

Physical Findings

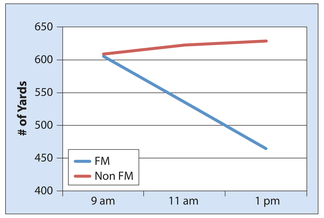
- Session did not moderate the relationship between FM status and balance (FAB) or lower body strength (30s chair stand).
- A significant FM status X session interaction was found when predicting performance on aerobic endurance (6-minute walk) and overall functional mobility (8 foot up and go) (see Figures 2 & 3).
- Marginally significant interactions were found for preferred and fast walk velocity (*ps* < .08).

Figure 1. Interaction of FM Status and Time of Day on Stroop CW Performance



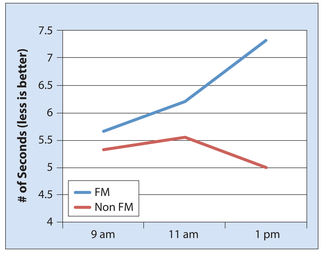
Note: F(2, 131)=4.22, *p*=.017

Figure 2. Interaction of FM Status and Time of Day on 6 Minute Walk Performance



Note: F(2, 128)=5.76, *p* = .004

Figure 3. Interaction of FM Status and Time of Day on 8 Foot Up and Go Performance



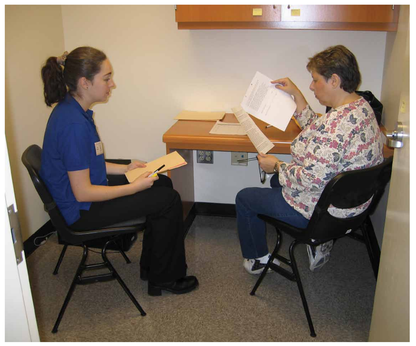
Note: F(2, 128)=3.20, *p*=.044

Conclusions

- Participants with FM tended to perform better earlier in the day (not later, as was expected).
- Non-FM participants were generally unaffected by time of day.

Implications

- Discovering one's "peak" time of day can be beneficial for those with and without FM
  - Medications and other treatments could be administered on a schedule that reflects a person's performance fluctuations.
  - Activities could be scheduled during a person's peak hours.
  - Clinical assessments and research studies should consider participant test times to insure accurate results.

Limitations and Future Directions

- No random assignment to sessions, so self-selection was possible in the current study; random assignment should be included in future studies
- Future studies should continue investigating the physiological mechanisms related to circadian differences in those with and without FM. For example:
  - HPA axis/cortisol link (Riva et al., 2010)
  - Sleep patterns/phase advancing (Epstein & Mardon, 2007)