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ORIGINAL RESEARCH

Rest–Activity Patterns in Older Adults with Heart Failure and Healthy Older Adults

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The purpose of this investigation is to examine differences in rest-activity patterns and sleep characteristics in older adults with heart failure (HF) and healthy older adults. The sample included older adults with HF ($n = 20$) and a reference group of healthy older adults ($n = 20$). Traditional cosinor analysis was used to assess three parameters of rest–activity from wrist actigraphy data: amplitude (range of activity), mesor (mean activity), and acrophase (time of peak activity). Traditional sleep characteristics were also determined from actigraphy data: total sleep time (TST), sleep latency (SL), sleep efficiency (SE), and wake after sleep onset (WASO). The HF group demonstrated significantly lower mesor and amplitude than the reference group ($p < .01$). The HF group had significantly greater TST ($p < .01$), but the groups had similar SE, SL, and WASO. Despite similar sleep characteristics to healthy older adults, overall rest–activity patterns were significantly dampened in those with HF.

***Keywords*:** heart failure, circadian rhythm, rest–activity patterns, sleep disturbance, geriatrics

Over 5 million people in the United States of America suffer from heart failure (HF) (Centers for Disease Control and Prevention, 2014). HF is commonly associated with activity intolerance (Centers for Disease Control and Prevention, 2014) and sleep disturbances (both subjective and objective) (Centers for Disease Control and Prevention, 2014; Wang, Hung, & Tsai, 2011). Subjectively, individuals with HF report overall sleep duration similar to healthy adults (Redeker & Stein, 2006). However, between 50–96% of individuals with HF report poor sleep quality (Garcia et al., 2012; Moon, Phelan, Lauver, & Bratzke, 2015; Redeker & Stein, 2006; Wang, Lee, Tsay, & Tung, 2010), as compared with 16–51% of healthy adults (Kim et al., 2015; Redeker & Stein, 2006). Findings regarding daytime sleepiness and daytime dysfunction due to poor sleep in HF are variable. Of those surveyed, 7–44% report excessive daytime sleepiness (Moon et al., 2015; Redeker et al., 2010; Redeker & Stein, 2006), and there are inconsistent reports of whether daytime dysfunction is more common in those with HF than healthy adults (Moon et al., 2015; Redeker & Stein, 2006).

Objective sleep methods (e.g., actigraphy) support the subjective findings of normal sleep duration and disturbed sleep (Redeker & Stein, 2006). Individuals with HF show more frequent awakenings during their sleep interval but a lower percentage of time awake, as compared with healthy adults (Redeker & Stein, 2006).

Disturbed sleep has been linked to increased risk of mortality in individuals with HF (Reinhard et al., 2013). Poor sleep quality in individuals with HF has also been associated with reduced cognitive performance, reduced quality of life, depression, and reduced functional independence (Garcia et al., 2012). Reports of daytime dysfunction in HF, due to sleep, have been associated with poorer cognitive function (Moon et al., 2015).

Rest–activity patterns can be observed as a biomarker of an individual's circadian rhythm. Circadian regulation, that is, consistently following a 24-hr rest–activity pattern, is associated with better health outcomes, including decreased mortality (Evans & Davidson, 2013). Dysregulated rest–activity is a manifestation of a dysregulated circadian system, making rest–activity patterns a commonly used measure of circadian rhythmicity (Gehrman et al., 2005). Rest–activity methods are less invasive and data are easier to collect than other measures of circadian rhythms, such as core body temperature or hormonal markers (i.e., melatonin) (Gehrman et al., 2005). When identified, dysregulated circadian rhythms are amenable to interventions (i.e., changes in the environment, biological processes, etc.) (Gehrman et al., 2005).

Rest–activity analysis goes beyond traditional sleep quality and sleep characteristics to examine rest and activity levels over a 24-hr day. Sleep characteristics include total sleep time (time in bed asleep), sleep latency (time in bed before falling asleep), wake after sleep onset (time spent awake after falling asleep), and sleep efficiency (percent of time spent in bed asleep). These sleep characteristics provide no new information about daytime rest and activity (see Figure 1). A study of 24-hr rest–activity patterns demonstrates whether an individual's circadian rhythm is synchronized or dysregulated. Rest–activity analysis reveals characteristics about an individual's nighttime activity, as well as its relationship to daytime activity. Rest–activity patterns have been studied extensively in older adults suffering from dementia, where disrupted nighttime sleep and extending sleep into daytime hours is common. Findings indicate impaired circadian rhythms and low levels of exposure to bright light result in loss of important environmental cues that regulate sleep (Gehrman et al., 2005). In dementia, circadian interventions to improve nighttime sleep have been effective (Deschenes & McCurry, 2009; Gehrman et al., 2005; Skjerve, Bjorvatn, & Holsten, 2004). A more thorough understanding of 24-hr rest–activity patterns may contribute to creating interventions to improve both daytime functioning and nighttime sleep in HF.

Rest–activity patterns have not been examined in-depth in the HF population. A study of individuals suffering from HF

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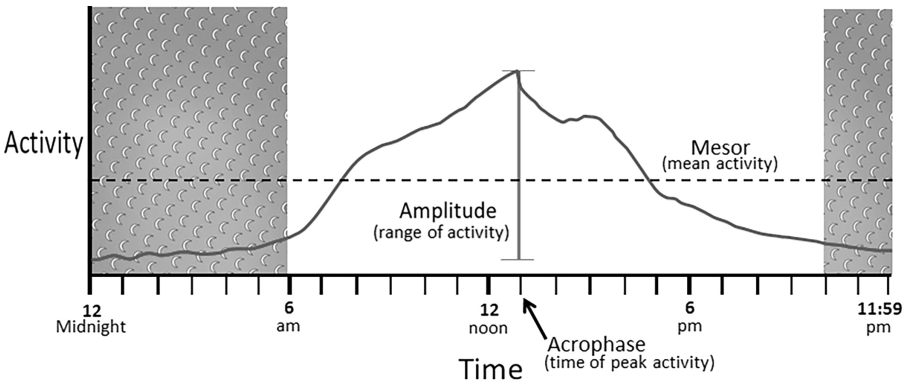

Figure 1 — Circadian rhythm analysis versus traditional sleep characteristics. Note. The shaded region represents the time of day that traditional sleep characteristics typically reflect. The solid line of activity shows the information gathered from circadian rest–activity analysis, including three parameters: mesor, amplitude, and acrophase. These parameters are determined from activity levels throughout the entire day.

with and without anergia (lack of energy) demonstrated very different rest–activity patterns (Maurer et al., 2009). Individuals with anergia and HF had a significantly smaller range of activity between the night and day than those without anergia (Maurer et al., 2009). No studies have compared rest–activity patterns of older adults suffering from HF to healthy older adults. This gap in rest–activity assessment is important since older adults with HF are reported to have disturbed sleep and lower daytime activity, and expected daytime sleepiness following disturbed sleep is not consistently reported. The purpose of this investigation is to: (1) examine differences in rest–activity patterns (e.g., mean activity, range of activity, and time of peak activity) between older adults with HF and healthy older adults; (2) further elucidate objective sleep characteristics (e.g., total sleep time, sleep efficiency, wake after sleep onset, and sleep latency) in older adults with HF, when compared with healthy older adults, and; (3) explore factors that may explain group differences in rest–activity patterns.

Methods

Sample

Two samples were recruited for this study. Older adults (aged 58 and older) with HF were recruited from a Midwestern HF clinic (Bauer et al., 2012) as part of a larger HF study examining the psychometric properties of a battery of neuropsychological tests (Bauer & Pozehl, 2011). The inclusion and exclusion criteria for the parent HF study can be seen in Table 1 (Bauer & Pozehl, 2011). Individuals were included in the current analysis if they had at least 5 days of actigraphy data (n = 20).

A reference sample of healthy older adults with actigraphy data were obtained from the Midlife Development in the United States (MIDUS) II study. Comprehensive biological assessments were conducted on a subsample of the 1,255 MIDUS participants from 2004–2009 (Ryff, Seeman, & Weinstein, 2010). MIDUS participants, with at least 5 days of actigraphy data (n = 440), were selected to match (by age, gender, and race) the HF group. Individuals were excluded if they had a diagnosis of HF or depression. The group of participants selected for this study (n = 20) were matched within 0.80 years of age, on average, and were matched for race and gender to the older adults in the HF group. The MIDUS study design and methods are described in detail elsewhere (Ryff et al., 2010).

Study Design

All study procedures for this secondary analysis were reviewed and received institutional review board approval.

Measures

Demographic data were obtained via chart review and self-report in the parent studies.

Number of Comorbidities. A number of comorbidities score was derived by summing the number of comorbid health conditions identified (via chart abstraction for the HF group and self-report for the reference group). This method is consistent with a well-established severity of illness scale (DUSOI, Duke University) (Parkerson, Broadhead, & Tse, 1993; Parkerson, Schunterman, & Sattler, 1998).

Depression Score. Depression was assessed using the Personal Health Questionnaire Depression Scale (PHQ-8) (Kroenke et al., 2009) (HF group) and the Center for Epidemiological Studies Depression Inventory (CES-D) (Radloff, 1977) (reference group). The PHQ-8 is a self-administered eight-item scale to diagnose and assess severity of depressive disorders in clinical studies (Kroenke et al., 2009). The measure has demonstrated validity in a large epidemiological population-based study (Kroenke et al., 2009). The CES-D inventory is a 20-item self-report scale designed to measure depressive symptoms (Radloff, 1977). This measure emphasizes depressed mood or affect and has demonstrated validity in a community-based older adult population (Radloff, 1977). Z-scores were created to compare the respective scales in the subsequent statistical analyses (Rubin, 2012).

Heart Failure Status. The following data were obtained via chart abstraction (HF group): duration of HF diagnosis, left ventricular ejection fraction (LVEF), total number of medications, New York Heart Association (NYHA) class, and etiology of HF (Bauer et al., 2012).

Rest-Activity Patterns. Wrist-actigraphy, using the Actiwatch 64 (Philips Respironics, Murrysville, PA), was used to assess 24-hr rest–activity patterns (Ryff et al., 2010). All participants wore wrist-actigraphy for a continuous 7-day period (Bauer & Pozehl, 2011; Ryff et al., 2010). The reference group also completed sleep diaries during the period that the watch was worn, to track subjective sleep patterns, and the time in and out of bed was used to mark rest and exclusion intervals in the Actiwatch (Ryff et al., 2010).

Table 1 Inclusion/Exclusion Criteria for Subjects with HF

Inclusion Criteria
> 21 years of age
English speaking and writing
Duration of HF > 6 months
Stable medication regimen for past 4 weeks
Exclusion Criteria
Current diagnosis of neurological illness or dementia (e.g., Alzheimer's dementia, Parkinson's, epilepsy)
History of substance abuse/treatment
PhQ-8 >10, indicating major depression
History of stroke
Hepatic insufficiency (AST/ALT more than twice normal limits)
Severe renal failure (serum creatinine > 2.5 mg/dl)
Anemia
Left ventricular assist device
History of the following within 3 months of study enrollment:
Acute myocardial infarction
Unstable angina
Coronary artery bypass graft surgery
Percutaneous transluminal coronary angioplasty
Biventricular pacemaker insertion
History of hospitalization within past 4 weeks

Abbreviations: HF = heart failure; PHQ-8 = Personal Health Questionnaire Depression Scale; AST = aspartate aminotransferase; ALT = alanine aminotransferase.

Traditional cosinor analysis was used to assess three parameters of rest and activity: amplitude, mesor, and acrophase (Gehrman et al., 2005). Amplitude is the difference between the maximum and minimum activity level; lower values indicate a weaker rhythm. Mesor is the 24-hr activity level; lower values indicate less overall activity. Acrophase is the time, during the 24-hr day, that activity peaks. The R-squared (RSQ) value indicates the reduction in squared error from using a model to summarize data compared with using the mean.

Sleep Characteristics. Wrist-actigraphy was also used to assess sleep characteristics (Ryff et al., 2010). This study explored standard Actiware sleep characteristics: total sleep time (TST), sleep latency (SL), wake after sleep onset (WASO), and sleep efficiency (SE). TST is the time in bed asleep. SL is the time in bed before falling asleep. WASO is the time spent awake after falling asleep. SE is the percent of time spent in bed asleep (e.g., time asleep/time in bed).

Data Analysis

Actigraphy data were downloaded to Respironics Actiware software Version 5.59. Sleep characteristics were obtained using the Actiware software standard analysis. Rest–activity data (activity each epoch), were exported from Actiware software to Microsoft Excel (Redmond, WA). The activity data collected outside of the intended data collection interval (i.e., the time that the Actiwatch was turned 'on' before the participant started wearing the device and after final removal) was excluded from data analysis. Rest–activity data collected in 15-s and 30-s epochs and were converted to 1-min epochs by averaging the levels of activity in each 1-min interval. For the analysis, 5 full 24-hr days were randomly selected for each HF group participant, using simple random selection. The total epochs were comparable between the two groups. Data were exported into SAS for traditional cosinor analysis.

Statistical analyses were conducted using IBM SPSS Statistics Version 22 (Armonk, NY). Paired samples *t* tests were conducted to describe the sample and test for group differences in demographics and health characteristics. A Chi-square test of independence was used to test for group differences in categorical variables (e.g., education, gender, and race). Paired samples *t* test was used to examine group differences in sleep characteristics and rest–activity patterns. Multiple regression was used to test predictors of the rest–activity patterns seen in these groups. Diagnosis of HF, depression scores, and number of comorbidities were included as predictors of each of the three rest–activity parameters in the multiple regression analysis. Depression has been associated with sleep and daytime function (Jaussent et al., 2011) and increased number of comorbidities has been associated with lower physical activity in older adults (Beveridge et al., 2015). The presences of particular comorbid conditions were not included as covariates due to the limited sample size. Counts of common comorbid conditions in the HF and reference groups are shown in Table 2. Age, gender, and race were not included because the groups were matched on these variables.

Results

Demographics

The demographic information for the two groups is displayed in Table 3. The HF group had significantly more comorbidities (mean = 5.25; *SD* = 2.67) than the reference group (mean = 1.90; *SD* = 1.74; $p < .01$). It was not feasible to determine the total number of medications for the reference group.

Rest–Activity Patterns

The HF group demonstrated significantly lower mesor (mean = 69.88; *SD* = 27.72) than the reference group (mean = 225.77; *SD* = 98.30; $p < .01$) (Table 4). In addition, the HF group had significantly lower activity amplitude (mean = 58.58; *SD* = 27.96) than the reference group (mean = 192.01; *SD* = 85.87; $p < .01$). The HF group had a lower average RSQ value (mean = .4575; *SD* = .154) for the cosinor model than the reference group (mean = .6275; *SD* = .123; $p < .01$). No significant group differences were noted in acrophase (the peak of daytime activity).

In multiple regression analyses, HF diagnosis was the only significant predictor of lower mesor (95% confidence interval [CI]: 91.12, 209.58; $p < .01$) and amplitude (95% CI: 76.59, 182.91; $p < .01$), after controlling for depression score and number of comorbidities (Table 5). Neither HF, depression, nor the total number of comorbidities were significant predictors of acrophase (Table 5).

Sleep Characteristics

The overall characteristics of sleep in those with HF were similar to the healthy controls (Table 6), except the HF group had significantly greater TST (mean = 470.06 min; *SD* = 67.08) than the reference group (mean = 394.89 min; *SD* = 75.05; $p < .01$). There were no significant differences in SL, SE, or WASO between the HF and reference groups.

Table 2 Comorbidity Counts by Group

	Heart Failure Group (*n* = 20)	Reference Group (*n* = 20)
Comorbidity	***n* (%)**	***n* (%)**
Diabetes mellitus	4 (20)	2 (10)
Cancer	9 (45)	3 (15)
Liver disease	0 (0)	1 (5)
Hypertension	10 (50)	1 (5)
Arthritis	2 (10)	13 (65)

Table 3 Demographic and Health Characteristics by Group

	HF Group (*n* = 20)	Reference Group (*n* = 20)
Demographic	**Mean (*SD*)**	**Mean (*SD*)**
Age	74.40 (7.49)	74.00 (7.12)
Male, *n* (%)	12 (60)	12 (60)
White, *n* (%)	20 (100)	20 (100)
Education, *n* (%)		
< High school	1 (5)	3 (15)
High school or equivalent	9 (45)	10 (50)
College	6 (30)	3 (15)
Bachelor's degree	3 (15)	2 (10)
Master's degree	1 (5)	2 (10
Health characteristics	Mean (*SD*)	Mean (*SD*)
Depression	2.80 (3.09)	5.65 (5.01)
Comorbidities*	5.25 (2.67)	1.90 (1.74)
Duration of HF (months)	56.55 (46.68)	
LVEF	30.75 (7.99)	
Medications (#)	10.3 (3.61)	
NYHA Class 2, *n* (%)	8 (40)	
NYHA Class 3, *n* (%)	12 (60)	
Ischemic HF, *n* (%)	14 (70)	

Abbreviations: HF = heart failure; LVEF = left ventricular ejection fraction; NYHA = New York Heart Association.

Note. *$p < .01$. Depression was assessed using the Personal Health Questionnaire Depression Scale for the HF group and Center for Epidemiological Studies Depression Inventory for the reference group. The scores reflected in this table represent the raw depression scores, not the adjusted z-scores used for analysis.

Table 4 Rest–Activity Patterns of the HF and Reference Groups

	HF Group (*n* = 20)	Reference Group (*n* = 20)
Variable	**Mean (*SD*)**	**Mean (*SD*)**
Mesor*	69.88 (27.72)	225.77 (98.30)
Amplitude*	58.58 (27.96)	192.01 (85.87)
Acrophase	13.95 (1.60)	13.67 (1.07)
RSQ*	.4575 (.154)	.6275 (.123)

Abbreviations: HF = heart failure; RSQ = R-sqaured.

Note. *$p < .01$.

Discussion

This study sought to: (1) examine differences in rest–activity patterns between older adults with HF and healthy older adults, (2) further elucidate objective sleep characteristics in older adults with HF, when compared with healthy older adults, and (3) explore factors that may explain group differences in rest–activity patterns. Our findings revealed significant differences in 24-hr mean activity levels and the range of activity in the older adults with HF, despite similar sleep characteristics among the groups.

The HF group had significantly dampened rest–activity patterns: the mean activity level (mesor) and range of activity during 24 hr (amplitude) was lower than the reference group. The lower mesor suggests that older adults with HF are less active, overall, than the comparison group. Changes in rest–activity patterns have not yet been well documented, but a previous study has reported lower levels of daytime physical activity in individuals with HF (Oka, Stotts, Dae, Haskell, & Gortner, 1993). Higher rates of napping (planned and unplanned) and activity intolerance (Centers for Disease Control and Prevention, 2014) in older adults with HF may also explain these findings. Higher activity levels at night are consistent with previous reports of difficulty staying asleep and frequent interruptions in sleep (Redeker et al., 2010; Redeker & Stein, 2006).

The lower amplitude suggests that older adults with HF do not reach the high levels of daytime activity observed in healthy adults. Higher maximum levels of daily activity have been associated with fewer harmful events, including death, hospitalizations, emergency department visits, and intercurrent illnesses (Howell et al., 2010). An explanation for these findings could be the severity of HF observed in this study. The HF group in this study did have moderate HF and, therefore, could have lower activity tolerance. Older adults with higher NYHA class in HF fatigue more easily and/or tolerate less activity.

The finding of lower amplitude in the HF group matches what was found previously in individuals suffering from HF and anergia (lack of energy) (Maurer et al., 2009). It is unclear whether anergia contributed to the findings in this study, because data about symptoms of anergia were not collected. Other symptoms not measured, such as pain or fatigue, could also contribute to some of the observed differences between the groups. The findings of lower mesor and amplitude match what has been found in a group of women with endometrial cancer, postsurgery, compared with women without a history of cancer (Rumble et al., 2015). This is the first study to compare the mesor and amplitude rest–activity patterns in HF to a group of healthy older adults.

In this investigation, we expected that the comorbid conditions found routinely in HF (Ho, Pinsky, Kannel, Levy, & Pitt, 1993) could explain the dampened rest–activity pattern, but it did not. The older adults with HF had significantly more comorbid conditions that the control, but the HF diagnosis persists as the only significant predictor of differences in mean activity level (mesor) and range of activity (amplitude). The differences in number of comorbidities between the HF and reference groups did not explain the differences observed in rest–activity patterns. While it may be feasible that certain comorbid conditions that occur with HF (i.e., diabetes and HF) may impact rest–activity patterns, we were not able to explore that assumption.

Certain medications common in older adults with HF, such as beta-blockers, may dampen activity tolerance and, therefore, 24-hr activity levels. Potential issues with dosing or side effects of specific medications can affect daytime sleepiness or function. The multiplicative effect of many medications (i.e., polypharmacy) can

Table 5 Multiple Regression Analysis Output for Mesor, Amplitude, and Acrophase in Both Groups

		β	Std. Error	95% Confidence interval	
Model 1	Dependent variable: Mesor				
	Constant	228.91	19.11	190.15	267.66
	Heart failure	–150.35*	29.21	–209.58	–91.12
	Comorbidities	–1.65	5.54	–12.88	9.57
	Depression score	20.88	12.49	–4.45	46.21
Model 2	Dependent variable: Amplitude				
	Constant	194.10	17.15	159.32	228.89
	Heart failure	–129.75*	26.21	–182.91	–76.59
	Comorbidities	–1.10	4.97	–11.17	8.98
	Depression score	14.58	11.21	–8.16	37.32
Model 3	Dependent variable: Acrophase				
	Constant	13.79	0.37	13.03	14.55
	Heart failure	0.49	0.57	–0.66	1.65
	Comorbidities	–0.06	0.11	–0.28	0.16
	Depression score	0.07	0.24	–0.42	0.57

Note. *$p < .01$.

Table 6 Sleep Characteristics of the HF and Reference Groups

	HF Group (*n* = 20)	Reference Group (*n* = 20)
Variable	Mean (*SD*)	Mean (*SD*)
TST (minutes)*	470.06 (67.08)	394.89 (75.05)
SL (minutes)	22.94 (23.82)	34.03 (20.91)
SE (%)	84.08 (5.68)	80.85 (11.43)
WASO (minutes)	52.90 (22.65)	45.89 (19.66)

Abbreviations: HF = heart failure; TST = total sleep time; SL = sleep latency; SE = sleep efficiency; WASO = wake after sleep onset.

Note. *$p < .01$.

further increase feelings of fatigue and thereby decrease activity. It is important to understand how medication management in older adults with HF may impact rest–activity patterns. Differences in the databases did not allow for direct analysis of specific medication, but, in post hoc analysis we found the number of medications, but not LVEF or NYHA class, was related to differences in mesor and amplitude within the HF group.

In addition to disruptions in rest–activity patterns, the HF group had significantly lower RSQ value in the cosinor analysis, indicating lower circadian rhythmicity. In other words, the lower RSQ means that the older adults with HF conform less to the typical rise of activity in the day and lower activity at night (i.e., the expected circadian rhythm of activity). A more flat level of activity throughout the day and night would contribute to a low RSQ and circadian rhythmicity. The lower mesor and amplitude in the older adults with HF supports this finding of a more flat circadian rhythm. The lower rhythmicity in older adults with HF could reflect a problem of both nighttime and daytime dysfunction. Individuals with HF may exhibit frequent nighttime awakenings due to how well their HF is managed, leading to circadian rhythm disturbances. For example, variability in adherence to dietary sodium restrictions, nighttime cardiovascular-related fluctuations in fluid volume and adherence to medication regimes, and daytime napping can precipitate nighttime awakenings.

Unlike a previous study using wrist actigraphy, older adults with HF had significantly more TST than the comparison group (Redeker & Stein, 2006). The comparison group in this study and the previous study have similar sleep duration, which indicates that the discrepancy is between the sleep duration of the two HF groups (Redeker & Stein, 2006). One possible explanation for this finding is that the previous study recruited individuals with more advanced HF (i.e., NYHA classification) and lower ejection fractions than what was observed in this study. The previous study had an average LVEF of 22.92 (*SD* = 8.99) (Redeker & Stein, 2006), compared with 30.75 (*SD* = 7.99) in this study. The previous study also had four (6.8%) individuals with NYHA class IV HF (Redeker & Stein, 2006), while this study had none. Results from our study suggest that older adults with HF may spend more time sleeping per day (TST) without having any significant differences in SE, WASO, SL. Overall, the sleep characteristics were very similar to the group of healthy older adults. Since our results contradict what has been documented previously, confirmatory follow-up studies should be conducted.

This study has some limitations. The sample size is small and lacks diversity, so generalizability is decreased. The majority of the sample was White, male, and with at least a high school education. Anthropometric data (e.g., BMI or waist circumference) for the participants were not available and could have explained some of the differences observed. The wrist-actigraph used in both groups could not indicate off-wrist status (i.e., whether the participant removed the Actiwatch at any time during the intended data collection interval). Newer technology can address this in future studies.

Future studies are needed to examine how factors, such as increased activity or napping restrictions, may impact rest–activity patterns in older adults with HF. In addition, further understanding

of rest–activity patterns may reveal opportunities to improve both sleep and daytime function in this group. Increased activity during the day could improve sleep at night. Consolidation of daytime napping may help older adults with HF better consolidate their nighttime sleep. Use of daytime diaries or accelerometry may help to determine potential explanations of lower daytime activity and may provide a new perspective for interventions (i.e., increased activity or napping restrictions) to promote environmental synchrony and more normal circadian patterns of rest–activity. Finally, the adverse outcomes associated with abnormal patterns of rest–activity should be investigated in subsequent analysis; it would be important to focus on how dampened rest–activity patterns may specifically affect older adults suffering from HF.

This study is the first to explore rest–activity patterns among older adults with HF compared with healthy older adults. This study contributes to current research on sleep in HF by revealing that, in spite of very similar objective sleep characteristics between older adults with HF and healthy older adults, the rest–activity patterns in older adults with HF are unique. Findings suggest that examination of factors influencing rest–activity patterns in HF may reveal opportunities to manage symptoms of daytime dysfunction.

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