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Volume and Patterns of Physical Activity Across the Health and Heart Failure Continuum

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ABSTRACT

Background: The benefits of regular physical activity (PA) are well documented in patients with heart failure (HF), however the amount and intensity of objectively measured PA and sedentary behaviour in HF with preserved (HFPEF) or reduced ejection fraction (HFREF) is not well known.

Methods: In a cross-sectional observational study the energy expenditure of 151 participants (HFPEF: n = 53; HFREF: n = 16; at-risk for HF: n = 48; control participants: n = 34) using SenseWear Mini Armbands (Body Media, Inc, Pittsburgh, PA) were monitored. PA outcomes included time spent in different PA intensities (light and moderate-vigorous PA), sedentary time, steps per day, total daily energy expenditure, PA energy expenditure, and the patterns of PA in bouts of ≥ 10 minutes of moderate-vigorous PA.

Results: The patients with HFPEF had the lowest volume of activity across the 4 groups. After adjusting for covariates, only steps per day remained significantly different across groups ($P = 0.0005$). A comparison of HFPEF vs HFREF indicated a higher amount of time in bouts

RÉSUMÉ

Contexte : Les bienfaits de l'activité physique pratiquée régulièrement ont été bien étudiés chez les patients atteints d'insuffisance cardiaque (IC), mais il en va autrement pour la mesure objective de la quantité et de l'intensité de l'activité physique ainsi que de la sédentarité en présence d'IC avec fraction d'éjection préservée (ICFEP) ou réduite (ICFER).

Méthodologie : Dans le cadre d'une étude d'observation transversale, la dépense énergétique de 151 participants (ICFEP : n = 53; ICFER : n = 16; à risque d'IC : n = 48; participants témoins : n = 34) a été mesurée à l'aide d'un petit brassard SenseWear (Body Media Inc, Pittsburgh, Pennsylvanie). Les paramètres d'évaluation de l'activité physique comportaient le temps consacré à des activités physiques de diverses intensités (légère et modérée à intense), le temps de sédentarité, le nombre de pas par jour, la dépense énergétique quotidienne totale, la dépense énergétique liée à l'activité physique et la fréquence des séances d'activité modérée à intense d'au moins 10 minutes.

Heart failure (HF) is one of the most prevalent cardiovascular syndromes worldwide and is associated with high morbidity and mortality rates.[1] Patients with HF have severely reduced exercise tolerance, and as a result activities of daily living (ADL) might require near maximal effort.[2] Encouraging patients with HF to perform daily physical activity (PA) might reduce mortality, hospitalizations, and risk for other comorbidities.[3] Moreover, daily PA might decrease disease progression and improve function, independency, and quality of life.[4,5]

For patients with HF, PA guidelines typically recommend at least 30 minutes of moderate intensity PA on most days of the week or exercise training at a moderate to vigorous intensity (ie, PA ≥ 3 metabolic equivalents [METs]).[6] Although studies have documented the beneficial effects of exercise training for patients with HF adherence to such programs might be problematic.[5,7] As an alternate to exercise training some investigators suggest that simple daily PA might be a viable substitute because it encompasses occupational, leisure time, and household activities and can be accomplished throughout the day.[8,9] For example, Corvera-Tindel et al. showed that by increasing daily walking duration, the exercise capacity as well as general well-being of patients with HF was improved.[8] For

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of ≥ 10 minutes of moderate-vigorous PA for patients with HFREF (median, 2.4 [interquartile range, 0-13.5] vs 26 [3.7-46.8]; $P = 0.0075$). In the at-risk group, PA was lower than the recommended levels in the guidelines.

Conclusions: Our findings suggest step count as the most robust outcome in evaluating daily PA in this population. Also, patients with HFPEF showed to be the least active group in the HF continuum. Monitoring volume and pattern of PA for those at risk of HF and patients with HFPEF could help to identify sedentary individuals and to develop tailored behavioural interventions for them.

Résultats : Les patients atteints d'ICFEP avaient le plus faible volume d'activité parmi les 4 groupes. Une fois les valeurs ajustées pour tenir compte de covariables, seul le nombre de pas par jour est demeuré statistiquement différent entre les groupes ($p = 0,0005$). Une comparaison entre les groupes ICFEP et ICFER a indiqué un plus grand nombre de séances d'activité modérée à intense d'au moins 10 minutes chez les patients atteints d'ICFER (médian 2,4 [intervalle interquartile, 0-13,5] vs 26 [3,7-46,8]; $p = 0,0075$). Dans le groupe à risque, l'activité physique était plus faible que ce que les lignes directrices recommandent.

Conclusion : Nos résultats suggèrent que le nombre de pas est le paramètre le plus fiable lorsqu'il est question d'évaluer l'activité physique quotidienne de cette population. De plus, les patients atteints d'ICFEP ont été le groupe le moins actif des patients se trouvant dans le continuum de l'IC. Surveiller la quantité et les habitudes d'activité physique chez les patients à risque d'IC et ceux atteints d'ICFEP pourrait faciliter le repérage des personnes sédentaires afin d'élaborer des interventions comportementales adaptées à leur situation.

many patients with HF daily PA might also be closely linked to clinical prognosis.[9,10] Several reports suggest that, for patients with HF, daily PA might be as strong a predictor of survival as is peak oxygen uptake.[9,11] Walsh et al. reported that daily PA, or more specifically inactivity in daily life (ie, sedentary living), was a better indicator of disease prognosis and mortality than cardiopulmonary exercise testing.[9]

Near half of the growing population of patients with HF have preserved ejection fraction (HFPEF),[2] the rest present with reduced ejection fraction (HFREF). The quantity and quality of PA in patients with HFPEF and indeed those at risk of developing HF has not been well studied. In addition, mechanisms of exercise intolerance in patients with HFPEF has been shown to be different than in patients with HFREF.[2] Thus the purpose of the present study was to explore the volume and patterns of daily PA in patients with HF and preserved vs reduced ejection fraction and to contrast these findings with those from healthy participants and patients at risk of developing HF.

Methods

Study design

This was a cross-sectional observational study. The sample size was determined on the basis of a power of 0.80, and an α of 0.05 using Cohen d of 0.867 ($f = 0.4335$) for daily energy expenditure (EE) between patients with HF and healthy control participants.[12] A total sample size of 55 was calculated. However, because this was a substudy of the larger Alberta **H**eart Failure **E**tiology and **A**nalysis **R**esearch **T**eam (HEART) research program,[13] (a prospective observational cohort study aimed to define new diagnostic criteria for patients with HFPEF), we were able to recruit 157 participants. The study was approved by the University's health ethics research board and all participants provided their written informed consent.

Study participants

All participants were enrolled in Alberta HEART and were assigned into groups according to their baseline clinical criteria.[13] The control group was comprised of healthy age- and sex-matched participants with no evidence of hypertension, coronary artery disease, diabetes mellitus, or any organ diseases and had no evidence of inflammatory or autoimmune conditions and were not taking any cardiac medications. The at-risk group consisted of patients with preserved left ventricular (LV) function but had ≥ 1 of the following: hypertension (≥ 3 medications or LV hypertrophy on electrocardiography or LV mass index > sex-matched upper limit of normal on an imaging test); diabetes mellitus (> 45 years of age); atrial fibrillation; or obesity (body mass index [BMI] > 30); confirmed acute coronary syndrome > 2 weeks; or chronic coronary artery disease with chest pain/shortness of breath or chronic obstructive pulmonary disease but with no signs of HF. The HF groups included patients with signs and symptoms of HF along with preserved left ventricular ejection fraction (LVEF; HFPEF) or reduced LVEF (HFREF). The HFPEF diagnosis was on the basis of the clinical phenotype of symptoms consistent with HF (including dyspnea, fatigue, exertional intolerance) and a LVEF > 45% whereas those with HFREF have HF symptoms with LVEF ≤ 45%. Exclusion criteria included age younger than 18 years; known malignancy with expected survival < 1 year; pregnant or recent pregnancy < 6 months; recent event (< 2 weeks since acute coronary syndrome, HF, or other admission); or severe mitral or aortic stenosis or severe pulmonary hypertension (> 60 mm Hg).[13]

Outcome measures

Daily PA was assessed objectively using the SenseWear Mini Armband (SWA; Body Media, Inc, Pittsburgh, PA). The SWA is a 3-axis accelerometer that incorporates data from 3 additional sensors (heat flux, galvanic skin response, and skin temperature) into its estimations of EE. The SWA data were used to quantify measures of daily EE, PA EE (PAEE), daily step counts, and time spent in different intensities of PA (ie, light, moderate to vigorous PA [MVPA]) and sedentary time. The estimates of EE using the SWA have been validated against the doubly labelled water technique and has also been shown to be valid and reliable in elderly populations and during exercise.[14,15] Participants were instructed to wear the

SWA for a minimum of 4 consecutive days, except during bathing or swimming. Upon completion of the 4-day collection period, the SWA device was returned and the data were analyzed using the manufacturer-provided software. To ensure an accurate representation of daily PA, valid days were entered into average when wearing time was $\geq$ 80% of the day.[16]

Daily EE was determined by averaging the minute-by-minute kilocalories (Kcal) expended over each day. Sedentary time was defined as EE $\leq$ 1.5 METs and represented as min/d.[17] PA was reported as steps per day, calculated by averaging the total daily steps from each day over the 4-day recording period. Time spent at different PA intensities was estimated by subdividing PA into light PA, consisting of activities requiring $>$ 1.5-2.9 METs (eg, ADL) and MVPA for PA $\geq$ 3 METs. In addition to defining PAEE as $\geq$ 3 METs, we assessed the PAEE $>$ 1.5 METs ($PAEE_{All}$), which has been suggested is an appropriate threshold for sedentary behaviour (vs activity) for older adults especially those with chronic conditions such as HF.[17] Finally, The $PAEE_{All}$ was calculated as the sum of PAEE associated with light and MVPA.

To achieve the health benefits associated with PA guidelines recommend that MVPA should be accumulated in bouts of $\geq$ 10 minutes (bout).[6] Therefore, distinguishing between continuous MVPA accumulated in bouts from sporadic activities could help depict a more explicit picture of activity behaviour for our study population. We developed an algorithm that first identified minutes of MVPA $\geq$ 3 METs and then calculated the number of bouts within each day. Further, bout length (ie, minutes) and the EE (Kcal) for bouts were also calculated. To be defined as a bout, 2 criteria had to be met: (1) it started and ended with a minute of activity $\geq$ 3 METs; and (2) it was $\geq$ 10 minutes in duration with only up to 2 minutes of activity $<$ 3 METs in that period.[18]

Statistical analysis

Continuous variables are presented as median with interquartile range (IQR) (unless otherwise stated) and discrete variables are presented as counts with proportions. The median was chosen as our marker of central tendency because it has been shown that there is a wide PA variability in healthy elderly individuals and patients with HF.[16,19] All statistical analyses were carried out using SAS software, version 9.4 (SAS Institute Inc, Cary, NC). Descriptive statistics were compared across all 4 groups using the Kruskal-Wallis test and χ^2 for continuous and discrete variables, respectively.

Quantile regression models were used to compare the medians of the 12 PA outcomes across all 4 groups after adjustment for age, sex, BMI, and the sleeping time. These variables were included in the model as adjustment variables because they were significantly different across groups.

A similar analysis was repeated to compare 4 activity outcomes of waking sedentary time, time spent at light PA, time spent in MVPA, and time spent in bouts between HFPEF and HFREF groups.

All tests of significance were 2-sided. The level of significance was set at 0.05 for all unadjusted tests of baseline characteristics. The Bonferroni method was used to adjust the significance levels of comparison tests for activity outcomes and to ensure a maximum experimentwise error rate of 0.05. Specifically, the level of significance was corrected at $0.05/12 = 0.0042$ for the 12 unadjusted tests and 12 adjusted tests for the comparison of 12 activity outcomes across all 4 groups. Also, the level of significance was corrected at $0.05/4 = 0.0125$ for the unadjusted tests comparing 4 activity outcomes between HFPEF and HFREF, because there were no significant differences between the 2 groups regarding age, sex, BMI, or sleeping time.

Results

One hundred fifty-one participants (median age 72 [IQR, 64-78] years, 46% female) were recruited. Data from 6 participants were removed from analysis because of their inability to comply with the minimum required SWA recording time. Participants wore the SWA for a median 4 [IQR, 3-4] days and median 23.8 [IQR, 23.4-23.9] h/d. Age, sex, BMI, and sleeping time were significantly different across groups (Table 1) and therefore considered as covariates to be controlled in the model. Because LVEF is a factor defining the group of HF, controlling for that would challenge the observatory nature of this study although it was significantly different across the groups ($P < 0.0001$). On the basis of the unadjusted results (Table 2), the groups were comparable in the total wearing time of the SWA ($P = 0.46$), daily EE ($P = 0.15$), waking sedentary time ($P = 0.0125$), and $PAEE_{All}$ ($P = 0.0158$). Across the 4 groups sedentary time accounted for approximately 66% of waking time for the control group and up to 78%-79% of waking time for the HF groups. The control group was the most active followed by at-risk and HFREF groups whereas the HFPEF group was the least active. For the unadjusted data significant differences across 4 groups were observed for steps per day ($P < 0.0001$), time spent at light ($P = 0.0003$) and MVPA ($P = 0.0003$), MVPA EE ($P = 0.002$), and the number, duration, and EE of bouts ($P < 0.0001$). However, when covariates were controlled for only steps per day remained significantly different across groups (Table 2).

Results showed that waking sedentary time and time spent completing light PA and MVPA were comparable across the 2 HF groups ($P = 0.04$, $P = 0.6$, and $P = 0.0169$, respectively; Table 2). The one notable difference between the HFREF and HFPEF groups was the time spent in bouts of PA. The HFREF group completed significantly more time per bout (median, 26 [IQR, 3.7-46.8] min/d vs median, 2.4 [IQR, 0-13.5] min/d; $P = 0.007$).

Discussion

To the best of our knowledge this is the first study to compare PA in healthy, at risk for HF, and patients with HFREF and HFPEF. The major new findings are: (1) steps per day was the most robust activity outcome to evaluate daily PA in this population; (2) patients with HFPEF completed the lowest volume of daily PA defined as time in light and MVPA; (3) the only significant difference between HFPEF and HFREF was the time spent at bouts of MVPA.

Step count is a common method to assess PA in healthy as well as chronic disease populations. The expected range for healthy older adults (older than 50 years) has been reported to be 6000-8500 steps per day.[19] Our control participants step

count was consistent with this range, but for the at-risk group it was not (Table 2). For elderly adults living with disability or chronic diseases the expected step count range has been reported to be 3500-5500 steps per day.[20] In the present study both HF groups reported significantly fewer steps per day (Table 2). It is noteworthy that the recommended step range for the HF population is between 7100 and 8000 steps per day.[19]

Despite the low step counts, results showed that across the various PA measures only steps per day remained significant after adjusting for covariates. This finding suggests that for older and overweight individuals regardless of sex, simply monitoring steps per day might provide the best estimate of daily PA as opposed to other measures of PA used in this study.

The present results suggest that patients with HFPEF completed the lowest volume of PA (ie, mild and MVPA) across the 4 groups. Further, both HF groups completed a lower volume of PA than the control group. Previous studies have reported that both HF groups have marked reduction in exercise capacity (eg, 3.9 METs for HFPEF and 3.4 METs for HFREF).[21] Thus, for these patients the burden of a given task might require a greater percentage of their peak aerobic power, leading to the early onset of fatigue, termination of a given activity, and a reduction in the overall volume of daily activity.

With respect to continuous MVPA, only the patients with HFREF achieved approximately 30 min/d whereas the HFPEF patients did virtually no continuous MVPA. This finding might be attributed to differences in medical history. It has been reported that patients with HFREF have a greater prevalence of myocardial infarction and/or previous cardiovascular procedures.[22,23] Indeed, the medical history of our HFREF cohort appears to be consistent with this observation (Table 1). Because of the medical history of our HFREF cohort is it conceivable that these patients received more advice regarding the importance of exercise for their condition, as inpatients and as outpatients. In a recent study among of 100,000 patients with HF (48% HFREF, 52% HFPEF) who were eligible for cardiac rehabilitation (CR), only 12% with HFREF and 9% with HFPEF were referred to CR at discharge.[24] In the same report, by reviewing approximately 10 years of hospital records a higher trend of CR referrals for HFREF vs HFPEF was noted. In addition, evidence-based treatment strategies for HFREF are far more established, which might have helped them to develop the skills necessary to cope better with their condition and sustain a more active lifestyle.[25] In contrast, the complex and heterogeneous nature of HFPEF makes it harder to be diagnosed in early stages and hence it is difficult to ascertain if patients received the same level of exposure to exercise recommendations as their HFREF peers.[26] In other words, it might be that patients with HFPEF received insufficient PA education and do not perceive the need to be more active beyond ADL. This might partially explain why the HFREF group recorded more time in bouts of MVPA. In terms of motivation, it is not likely that wearing the SWA affected participants, because it does not have a display and does not provide any feedback.[27]

One of the unique aspects of this study was the examination of sedentary behaviour. It has been suggested that sedentary behaviour is in fact distinctly different than the absence of PA.[28] The National Health and Nutrition Examination Survey indicated that, for healthy adults aged 60 years or older, sedentary behaviour accounts for approximately 60%-65% of waking time.[29] In this study, our patients with HF spent approximately 80% of their waking time sedentary (Table 2). In a review, Healy et al. reported that patients with

Table 1. Description of characteristics

	Control (n = 34)	At risk of developing HF (n = 48)	HFPEF (n = 53)	HFREF (n = 16)
Demographic characteristics				
Age, median [Q1-Q3]	71 [64-76]	66.5 [60.5-73.5]	75 [66-81]	72.5 [63-81]*
Female sex, n (%)	23 (68)	21 (44)	22 (42)	3 (19)*
BMI, median [Q1-Q3]	24.9 [23.2-27.6]	28 [25.8-31.4]	30.9 [27.4-34.2]	28.6 [26.7-31.4]*
NYHA class I-II, n (%)	NA	NA	40 (75)	12 (75)*
NYHA class III, n (%)	NA	NA	12 (23)	4 (25)*
Median LVEF [Q1-Q3]	63.9 [62-66.7]	64.9 [61.2-68.1]	61.7 [54.8-66.2]	37.8 [32.4-49.5]*
Median SWA valid days [Q1-Q3]	4 [3-4]	4 [4-4]	4 [3-4]	4 [3.5-4]
Comorbidities and CV history				
HTN, n (%)	4 (12)	42 (88)	40 (76)	10 (63)
Type II diabetes, n (%)	0	8 (17)	21 (40)	4 (25)
COPD, n (%)	0	3 (6)	13 (25)	5 (31)
Dyslipidemia, n (%)	7 (21)	25 (52)	34 (64)	10 (63)
Orthopaedic disorders, n (%)	1 (3)	8 (17)	11 (21)	2 (13)
Past CV procedures, n (%)†	0	5 (10)	10 (19)	6 (38)
Previous MI, n (%)	0	10 (21)	14 (26)	8 (50)
Signs and symptoms				
Dyspnea, n (%)	0	7 (15)	28 (53)	6 (38)
Fatigue, n (%)	2 (6)	8 (17)	25 (47)	9 (56)
Leg edema, n (%)	0	3 (6)	12 (23)	3 (19)

SenseWear from Body Media, Inc (Pittsburgh, PA).

BMI, body mass index; COPD, chronic obstructive pulmonary disease; CV, cardiovascular; HF, heart failure; HFPEF, heart failure with preserved ejection fraction; HFREF, heart failure with reduced ejection fraction; HTN, hypertension; LVEF, left ventricular ejection fraction; MI, myocardial infarction; NA, not applicable; NYHA, New York Heart Association functional classification; Q1-Q3, quartile 1 to quartile 3; SWA, SenseWear Armband.

* Significant difference across groups, $P < 0.05$.

† Previous CV procedures including pacemaker or implantable cardioverter defibrillator, coronary artery bypass grafting, or valve surgery.

Table 2. Daily measures of physical activity across the 4 groups

Variable	Control	At risk of developing HF	HFPEF	HFREF	Comparison across all 4 groups	
					Unadjusted *P*	Adjusted *P*[*]
Number of Participants	34	48	53	16		
Time on body, hours per day	23.7 [23.5-23.8]	23.8 [23.5-23.9]	23.8 [23.2-23.9]	23.8 [23.6-23.9]	0.4613	0.5075
Sleeping time, hours per day	7.0 [6.3-7.5]	7.2 [6.6, 7.8]	7.6 [6.4-8.4]	7.9 [7.5-8.8]	0.0141	NA
Steps per day, n	6281 [4399-8744]	4770 [1993-7601]	2121 [1098-3038]	2569 [1486-4673]	< 0.0001[†]	0.0005[†]
Waking sedentary, hours per day	11.1 [9.5-12.4]	12.0 [10.6, 14.1]	12.7 [11.4-14.3]	12.6 [10.9-13.2]	0.0125	0.0721
DEE, Kcal per day	2184.7 [1957.9, 2474.5]	2454.9 [2039.5-2861.6]	2267.2 [1704.4-2675.9]	2564.0 [2275.0-2744.1]	0.1523	0.5074
Light PA (1.6-2.9 METs), hours per day	4.5 [3.2-5.7]	3.4 [2.0-4.4]	2.2 [1.7-3.9]	2.5 [2.0-3.9]	0.0003[†]	0.0744
MVPA ($\geq$ 3 METs), hours per day	1.1 [0.6-1.5]	0.7 [0.3-1.8]	0.2 [0.1-0.5]	0.6 [0.1-1.4]	0.0003[†]	0.0075
$PAEE_{All}$ (> 1.5 METs), Kcal per day	875.5 [641.6-1238.0]	735.6 [448.2-1288.6]	445.0 [287.2-822.5]	722.7 [401.5-1123.2]	0.0158	0.1318
$PAEE_{MV}$, Kcal per day	316.5 [163.0-520.5]	241.8 [82.4-548.4]	56.4 [18.4-176.8]	235.4 [39.2-501.3]	0.002[†]	0.0185
Bout, n per day	1.7 [1.3-3.0]	1.3 [0.4-3.0]	0.2 [0.0-1.0]	1.8 [0.3-2.6]	< 0.0001[†]	0.0073
Bout length, min/d	39.0 [19.8-61.7]	23.0 [6.8-63.1]	2.4 [0.0-13.5]	26.0 [3.7-46.8]	< 0.0001[†]	0.0084
Bout energy, Kcal per day	205.5 [109.5-291.1]	140.3 [35.7-377.3]	15.4 [0.0-78.1]	139.1 [24.1-291.9]	< 0.0001[†]	0.0093

Data are expressed as median [first quartile-third quartile].

Bout, episodes of continuous moderate to vigorous physical activity lasting for at least 10 minutes; DEE, total daily energy expenditure; HF, heart failure; HFPEF, HF with preserved ejection fraction; HFREF, HF with reduced ejection fraction; Kcal, kilocalories; MET, metabolic equivalent (3.5 mL $O_2 \times kg - 1 \times$ minute $- 1$); MVPA, moderate to vigorous physical activity; NA, not applicable; PA, physical activity; $PAEE_{All}$, PA energy expenditure above sedentary level; $PAEE_{MV}$, PA energy expenditure $\geq$ 3 METs.

[*] Covariates included in the model were baseline grouping, age, sex, BMI, and sleep time.

[†] Significant at Bonferroni-corrected significance level of $0.05/12 = 0.0042$ across all groups.

various chronic diseases spent between 75% and 88% of their time sedentary.[30] The sedentary time observed in our patients with HF might partially be attributed to a reduced exercise capacity typically seen in patients with HF or perhaps apprehension associated with performing PA because of their cardiac history and comorbidities.[31] This underscores the need to educate all patients with HF (regardless of phenotype) on the importance of reducing sedentary time and performing mild or MVPA throughout the day.

Light PA encompasses predominately ADL. In elderly adults (older than 60 years) light activity accounts for approximately 30% of waking time.[32] Despite the inevitability of having to perform ADL, both of our HF groups appeared to spend considerably less time performing light PA (Table 2). It has been shown that for every 60-minute increase of light PA, independent of MVPA, there is approximately a 16% reduction in all-cause mortality.[33] Therefore, for patients with HF one of the strategies might be to simply encourage them to engage in higher volumes of light PA. Indeed, participation in light PA throughout the day has been shown to reduce sedentary time as well as results in greater engagement in overall daily activity.[34]

With respect to the at-risk group, our results show that although they do not have HF, their daily PA level was lower than what was observed in the healthy control participants as well as for the recommended levels daily PA.[35] The inverse dose-response relationship between PA and risk of HF has been well documented.[35,36] Interestingly, in a recent meta-analysis, Pandey et al. reported that participants who engaged in PA at twice or 4 times the basic guideline-recommended levels (approximately 500 MET-min/wk) had 19% and 35% lower risk of developing HF, respectively.[35] The PA volume of patients at risk of developing HF observed in this study (380 MET-min/wk) failed to achieve the basic guideline-recommended level, which highlights the importance of addressing this issue in practice. However, despite the well documented dose-response relationship between intensity and volume of PA and health benefits, recent evidence suggests that extensive benefits are achievable with a much lower dosage than what has been recommended in the guidelines.[37]

Limitations

Some studies suggest that more than 4 days of monitoring is required to ascertain daily PA.[38] However, Rowe et al. noted that 2 days of monitoring is sufficient for older populations (ie, older than 60 years).[39] In addition, our understanding of the HFPEF phenotype is still insufficient to fully explain underlying mechanisms of exercise intolerance and activity behaviour.[40] Finally, we were not able to assess clinical outcomes in this study and therefore further longitudinal research with a larger sample size of the HF spectrum is needed.

Conclusions

In the present study step count was the most robust outcome in evaluating daily PA. By monitoring daily PA we determined that patients with HF appear to be habitually sedentary, and those with HFPEF did virtually no continuous MVPA. Although PA guidelines for HF patients typically

recommend at least 30 minutes of moderate-intensity PA on most days of the week, our findings suggest that a more realistic initial goal for patient with HF would be to focus on reducing sedentary time and encouraging them to increase the volume daily activity though light PA spread throughout the day.

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Disclosures

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