Physical Activity Patterns in Rural-residing Spousal Caregivers and Cardiac Surgery Patients in the First 6 Months Post-Surgery

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Abstract

Background: Caregivers (CGs) play a major role in cardiac surgery patients' adoption of secondary prevention strategies. Little research has examined spousal CGs activities to preserve their own health and support patients' heart-healthy behaviors.

Purpose: The aims of this descriptive pilot study are to: 1) compare cardiovascular (CV) risk factors and physical activity (PA) levels and 2) examine trajectories of change in PA patterns at 3 and 6 weeks and 3 and 6 months after cardiac surgery.

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Sample: 28 rural residing adult (> 60 years) cardiac surgery patients and their spousal CGs. **Methods**: PA data was obtained from ActiGraph® accelerometers mailed to dyads at 4 time points after cardiac surgery. Descriptive analyses and multivariate hierarchical modeling were used to describe and identify PA patterns.

Findings: The dyads were older (CG M = 68.5 ± 6.6, Patient M = 70.7 ± 6 years) with primarily female CGs (92%) residing in small rural towns (n=26, 46.4%) or farm/ranch (n=16, 28.6%). CV risk factor concordance was evident particularly for hypertension (60.7%) and hypercholesterolemia (25%).

CGs and patients spent the majority of time in sedentary activity. Most patients (89.3%) completed cardiac rehabilitation programs and increased their mean minutes/day spent in moderate to vigorous PA over the 4 time points (13.3 ± 15.6 to 22.6 ± 24.4). However, CGs mean minutes/day remained virtually unchanged over time (15.8 ± 20.8 to 12.7 ± 11.7). Considered as dyads, 38% (n=8) showed essentially no change for either member, but for 29% (n=6) the caregiver showed no change while the patient activity increased.

Conclusions: CGs were similar in age and comorbidities to their spouses, however, CGs were less likely to increase their PA levels. Health disparities in CVD mortality in the rural population may have additional impact and underscores the need for future targeted interventions addressing CV risk in CGs.

Keywords: Health behavior, Cardiac surgery, Caregiver, Risk factors

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Cardiac surgery affects not only the lives of patients, but also their spouses who are typically the primary caregiver. Informal caregivers (CG) are relied on by 51% of cardiovascular (CV) patients after hospital discharge (Mosca et al., 2011). Research has shown that strained CGs for patients with cardiovascular (CVD) disease neglect their own healthy behaviors (Burton, Newsom, Schulz, Hirsch, & German, 1997) and have higher risk of mortality (Schulz & Beach, 1999). Little is known about the health of CGs for cardiac surgery patients returning home to rural areas from the urban centers where their surgery was performed. Studies have targeted health promotion for family members with CV risks (Mosca et al., 2008) but have not specifically focused on those family members with additional CG responsibilities, placing them at even higher risk. Therefore, the primary purpose of this descriptive longitudinal pilot study was to compare CV risk and physical activity in rural residing adult (≥ 60 years) cardiac surgery patients and their spousal CGs at the time of surgery and four time points in the first six months following hospital discharge. The specific aims are to: 1) compare CV risk factors and mean minutes spent in moderate or greater physical activity levels at 3 and 6 weeks and 3 and 6 months after cardiac surgery; and 2) examine trajectories of change in physical activity patterns in the first 6 months after cardiac surgery in patients and their spousal CGs.

Rural residents continue to have known disparities in life expectancy (Singh & Siahpush, 2014) with a higher prevalence of hypertension, physical inactivity (Schiller, Lucas, Ward, & Peregoy, 2012) smoking, obesity, and older persons (O'Connor & Wellenius, 2012). In fact, a

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study examining trends in rural-urban disparities and cause specific mortality in the US between 1969 and 2009 found that causes of death contributing most to the rural urban disparities included heart disease and stroke (Singh & Siahpush, 2014). Data also reveal that disparities have widened over time; excess mortality from all causes combined and from several major causes of death, including CVD in non-metropolitan areas was greater in 2005-2009 than in 1990-1992 (Singh & Siahpush, 2014). However, rural patients returning home after surgery in urban centers have reported positive support systems in their communities (Pesut, Laberge, Sawatzky, Mallinson, & Rush, 2013) and are more likely to enroll in cardiac rehabilitation (CR) programs (Adjusted Odds Ratio 3.30, CI 2.35 – 4.64) (Turk-Adawi, Oldridge, Tarima, Stason, & Shepard, 2014) compared to residents in urban locations.

Several studies have established the similarities in CV risk factors between patients and their partners (Di Castelnuovo, Quacquaruccio, Donati, de Gaetano, & Iacoviello, 2009; Macken, Yates, & Blancher, 2000; Meyler, Stimpson, & Peek, 2007). However, CGs awareness of their own CV risk is a concern. In spite of shared lifestyle behaviors and cardiac risk factors between family members and cardiac patients, 50% of family members with elevated lipid levels and 59% of those with elevated blood pressure were unaware of their personal risk factors (Mosca et al., 2008). Healthy behavior in CGs may be abandoned as they focus on their spouses' recovery from cardiac surgery. Secondary prevention targeted for the cardiac patient may be addressed, however, health promotion for the spousal CG with similar CV risks has had limited study.

Selection of variables for the current study was guided by concepts described in the Health Promotion Model (HPM) (Pender, Murdaugh, & Parsons, 2006). An underlying assumption is that CG and patient variables influence CG health outcomes. The HPM posits that prior health related behavior and personal factors are important determinants affecting health-promoting behaviors.

Prior health related behavior consists of usual "healthy habits" practiced by individuals. Physical activity represented the primary behavior of interest in our study. Interventions targeted for CR patients have been shown to positively influence the adoption of physical activity (Chase, 2011; Hall et al., 2010; Oliveira, Ribeiro, & Gomes, 2008). In addition, Falba and Sindelar (2008) reported that an individual's physical activity habits positively influence (Odds Ratio = 1.83 – 1.86) a spouse's physical activity.

Perceptions of physical activity have been found to differ between rural and urban settings. Rural-living participants indicated summer heat and winter cold as barriers to exercise as opposed to urban participants having more alternatives to exercise (King, Thomlinson, Sanguins, & LeBlanc, 2006). Rural participants, both men and women, viewed work on the farm as exercise and urban participants reported walking the stairs at work or going to a mall to walk as a form of exercise (King et al., 2006).

Personal factors are biologic factors such as gender and age which influence the CGs health outcomes. The majority of caregivers for cardiac surgery patients are women as men are approximately three times more likely to have cardiac surgery than women (Go et al., 2014). Older CGs with chronic disease caring for cardiac surgery patients reported significantly worse health related quality of life (HRQoL) compared to younger CGs without chronic disease (Rantanen et al., 2008; Rantanen et al., 2009a; Rantanen et al., 2009b). Other personal factors that may influence health outcomes include personal beliefs. Rural residents are more likely to believe that health is influenced by fate rather than personal responsibility (McConnell et al., 2010).

Physical activity levels, specifically moderate or more intense levels, were the health outcomes of interest in this study. Less frequent physical activity levels were reported by family members of CV patients with specific caregiving responsibilities and burdens (financial strain and upsetting behavior) (Mochari-Greenberger & Mosca, 2012). CV risk was found to be significantly higher in CGs with low physical activity levels as compared to non-CGs with low physical activity levels (von Känel et al., 2011).

Methods

Design

This descriptive longitudinal pilot study recruited a convenience sample from two Midwestern tertiary hospitals. Both hospitals provided cardiac surgery patients with similar postoperative hospital care and discharge education addressing incision care, signs and symptoms of infection, activity progression instructions and pain management strategies. This education was provided prior to discharge and similar print materials were sent home with the patients.

Sample

Subjects were eligible for the study if they were: a) cardiac surgery patient (CABS and/or valve surgery) and spouse; b) ≥ 60 years of age; c) living together; d) home address in a rural community; c) no serious comorbidities or cognitive impairments. The Rural Urban Commuting Area Codes (RUCA) created in part by the US Department of Agriculture's Economic Research Service were used to classify the subject's residence (Hart, Larson, & Lishner, 2005). RUCA codes are assigned at the ZIP code level and include 33 different categories. The categories of RUCA codes selected for this study included those classified as large rural, small rural, and isolated rural.

Of the 83 dyads meeting inclusion criteria for the study, 29 consented to participate and 24 completed the study. One dyad declined to participate at baseline and four other dyads declined after beginning the study. Two CGs did not meet the age inclusion criteria (57 and 59 years), however were included as their spouses were over 65 years.

CGs were primarily female and slightly younger than the patients. The majority (96.4%) of patients were recovering from CABS and one from valve replacement. In this study, 94.6% of the subjects were white. The patients had more comorbidities (M=3.07) compared to the CG (M=2.4). Approximately half of the CGs (47.4%) and patients (52.6%) reported being employed. The majority of the patients (89.3%) reported attending a CR program. Following cardiac surgery, patients are typically restricted from driving for 6 weeks. Patients in our study largely relied on CGs to transport them to cardiac rehabilitation programs. The demographic and clinical characteristics of the sample are depicted in Table 1.

Subjects resided in 24 different towns with a mean of 84 miles from the hospital where their surgery was performed. The majority of subjects (n=26, 46.4%) lived in a small, rural town, 16 resided on a farm or ranch (28.6%) with the remaining subjects reporting living in a small town (n=8, 14.3%) or in a rural area (n=6, 10.7%). They reported traveling .2 to 25 miles (mean = 9.4 miles) to visit their health care provider.

Measures

Baseline demographic (age, race, educational level, work status, and income) and clinical variables (co-morbidities and physical activity level) were collected via self-report. Selected data (type of surgery and hospital length of stay) were collected from the patient's medical record. Subjects described their residence as a farm/ranch, small rural town, small town, or in a rural area (not a farm/ranch).

Table 1

Demographic and Clinical Characteristics of the Sample

Clinical Variables	Caregivers (n=28)		Patients (n=28)	
	Mean (S.D.)	Range	Mean (S.D.)	Range
Age	68.5 (6.6)	57-82	70.7 (6.0)	67-83
Education (years)	13.6 (2.3)	8 – 17	13.1 (2.3)	8 – 17
BMI	29 (6.1)	20.6- 52.5	31.1 (5.2)	21.3- 38.7
Comorbidities	2.4 (1.3)	0-6	3.07 (1.3)	1-6

	Caregivers n (%)	Patients n (%)	
Gender (% female)	26 (92.9%)	2 (7.1)	
Cardiac Rehabilitation (yes)		25 (89.3)	
Cardiac Risk Factors			**Both Yes**
Hypertension	18 (64.3)	23 (82.1)	17 (60.7)
Hypercholesterolemia	9 (32.1)	20 (71.4)	7 (25)
Diabetes	7 (25)	9 (32.1)	4 (14.3)
Family History of Coronary Artery Disease	4 (14.3)	7 (25)	2 (7.1)
Tobacco Use	2 (7.1)	3 (10.7)	0
Body Mass Index	n=28	n = 27	
Normal Weight (18.5 – 24.9)	6 (21.4)	4 (14.8)	1 (3.6)
Overweight (25 – 29.9)	15 (53.6)	8 (29.6)	4 (14.3)
Obese (≥ 30.0)	7 (25)	15 (51.9)	5 (17.9)

Physical activity (PA) was measured objectively using the ActiGraph® accelerometer (Model GT3X: ActiGraph, Pensacola, FL) at 3 and 6 weeks and 3 and 6 months post-surgery. The ActiGraph® is small (4.6cm X 3.3cm X 1.5cm), lightweight (19g) and worn on an elastic belt with the device positioned over the right hip. Reliability and validity of the ActiGraph® has been reported for older (Copeland & Esliger, 2009; Gardiner et al., 2011; Matthews, 2005; Miller, Strath, Swartz, & Cashin, 2010) and obese adults (Feito, Bassett, Tyo, & Thompson, 2011; Lopes, Magalhães, Bragada, & Vasques, 2009). Test-retest reliability correlations

(Intraclass Correlation Coefficient (ICC)= 0.7 - 0.9) were reported in free-living individuals (n = 143) across separate administrations (Sirard, Forsyth, Oakes, & Schmitz, 2011).

The average daily number of minutes spent in PA of at least moderate intensity was the main variable that was obtained from the ActiGraph® for this study. Time (in minutes) spent in PA were estimated using Freedson, Melanson, and Sirard (1998) cut-points and moderate-lifestyle intensity activities were estimated using cut-points proposed by Matthews (2005). Weekly summary estimates (mean minutes/day) in sedentary, light/lifestyle, moderate/vigorous activity levels were compiled for all participants with at least 5 valid days (worn ≥ 8 hours) of accelerometer data.

Procedure

Approval from the institutional review committees (#176-09-EP) for each site was obtained. If both CG and the cardiac surgical patient met inclusion criteria and agreed to participate, written informed consent was obtained. Patient clinical data were retrieved from the medical records and spouse data were obtained via self-report. Baseline data were obtained from subjects prior to the patient's dismissal from the hospital. Completion of baseline data questionnaires took approximately 45 – 60 minutes.

All participants were instructed regarding accelerometer wear, placement, mailing procedures, and schedule. The principal investigator (PI) or research nurse contacted participants by phone at approximately 3 and 6 weeks and 3 and 6 months after discharge to complete follow-up questionnaires and validate that participants had received the accelerometer.

Data analysis

Using SPSS v.21, descriptive statistics (frequencies, means, SDs) were obtained for the demographic and clinical variables. Data collection was scheduled for 3 weeks, 6 weeks, 3 months, and 6 months following hospital discharge. The mean number of days since discharge for each data collection point was approximately as planned (24, 46, 97, and 186 days, respectively). Analyses for Aim 1 included means and standard deviations for minutes of activity at sedentary, light/lifestyle, and moderate/vigorous intensity levels calculated separately for caregivers and patients at each time point.

Analyses for Aim 2 involved examining plots of the raw data for each dyad. To explore the trajectories of change in moderate or more intense activity while taking into account potential intercorrelation of patterns within couples, we used HLM v.6 (Raudenbush, Bryk, Cheong, & Congdon, 2007) to fit a multivariate hierarchical model similar to that presented by Raudenbush, Brennan, and Barnett (1995). This two-level model treats the dyad as the unit of analysis and yields separate population estimates of the curve parameters for CGs and for patients, as well as estimates of the correlations among these parameters. Because the sample is small, analysis was confined to linear models (i.e., caregiver intercept and slope and patient intercept and slope). Time was computed as days from hospital discharge, and then centered so that model intercepts will estimate the population average minutes of moderate or more intense activity at 21 days after discharge (Raudenbush et al., 1995).

Results

Cardiovascular Risk

The cardiac risk factors noted in the majority of subjects included hypertension, hypercholesterolemia, and being overweight or obese (Table 1). Hypertension was the most common risk factor experienced by both patient and spouse (n=17, 60.7%), followed by hypercholesterolemia (25%). The majority of subjects were either overweight or obese with caregivers being more overweight (54%) and patients were more in the obese category (52%). More patients were diabetic (25%) compared to the CG (14%).

Physical Activity

Accelerometers were worn by caregivers and patients at the four time points with 15 caregivers and 11 patients consistently meeting the desired protocol of at least 10 hours per day, for ≥ 5 days at the four data points. ActiGraphs® returned with < 5 days of wear were excluded from the analysis (23.4%, n=39).

Comparison of average minutes spent in the different activity level categories revealed little differences between CGs and patients at each time point. In general, this sample of older adults spent approximately 2 - 2.5 hours daily in light or lifestyle activity, 10 – 20 minutes in moderate to vigorous physical activity and the remainder of the time in sedentary activity (Table 2).

Table 2

Physical Activity Data

	Caregiver				**Patient**			
Daily Minutes in Physical Activity Categories (Accelerometer)	**Wk 3** N=19 Mean (S.D.)	**Wk 6** N=22 Mean (S.D.)	**M 3** N=19 Mean (S.D.)	**M 6** N=22 Mean (S.D.)	**Wk 3** N=20 Mean (S.D.)	**Wk 6** N=22 Mean (S.D.)	**M 3** N=17 Mean (S.D.)	**M 6** N= 18 Mean (S.D.)
Sedentary	1263 (55)	1258 (64)	1262 (74)	1279 (76)	1297 (68)	1275 (65)	1264 (95)	1271 (75)
Lifestyle/Light	161 (51)	169 (57)	166 (67)	148 (67)	129.8 (60)	148.9 (54)	154.8 (80)	146 (63)
Moderate/ Vigorous	16 (21)	13 (14)	11 (12)	13 (12)	13 (15)	16 (19)	21 (24)	23 (24)
PA Frequencies Accelerometer	**Wk 3** N=21 n (%)	**Wk 6** N=21 n (%)	**M3** N=19 n (%)	**M6** N=17 n (%)	**Wk3** N=21 n (%)	**Wk 6** N=22 n (%)	**M3** N=17 n (%)	**M6** N=19 n (%)
> 30 min/day in PA	3 (15.8)	2 (9.1)	2 (10.5)	3 (13.6)	3 (15)	4 (18.2)	5 (29.4)	6 (33.3)

To examine the trajectories of change in physical activity level over time, population curves from the multivariate hierarchical linear model were fit to the activity data (Figure 1). Tests of the estimates of fixed (population) effects suggest that moderate activity is significantly greater than zero at 3 weeks for both caregiver and patient (estimated at approximately 15 minutes). By six months, estimated activity at this intensity level for the patient has on average increased to 25 minutes (slope p = .09), but for the caregiver has remained about the same, decreasing to 13 minutes (slope p = .47). Tests of the estimated variance components suggest that there is significant variability of both patient and caregiver intercepts around the population intercept, and significant variability of patient slopes around their population value (all $p < .0005$). Considerable variability was also found in the caregiver slopes (p = .06).

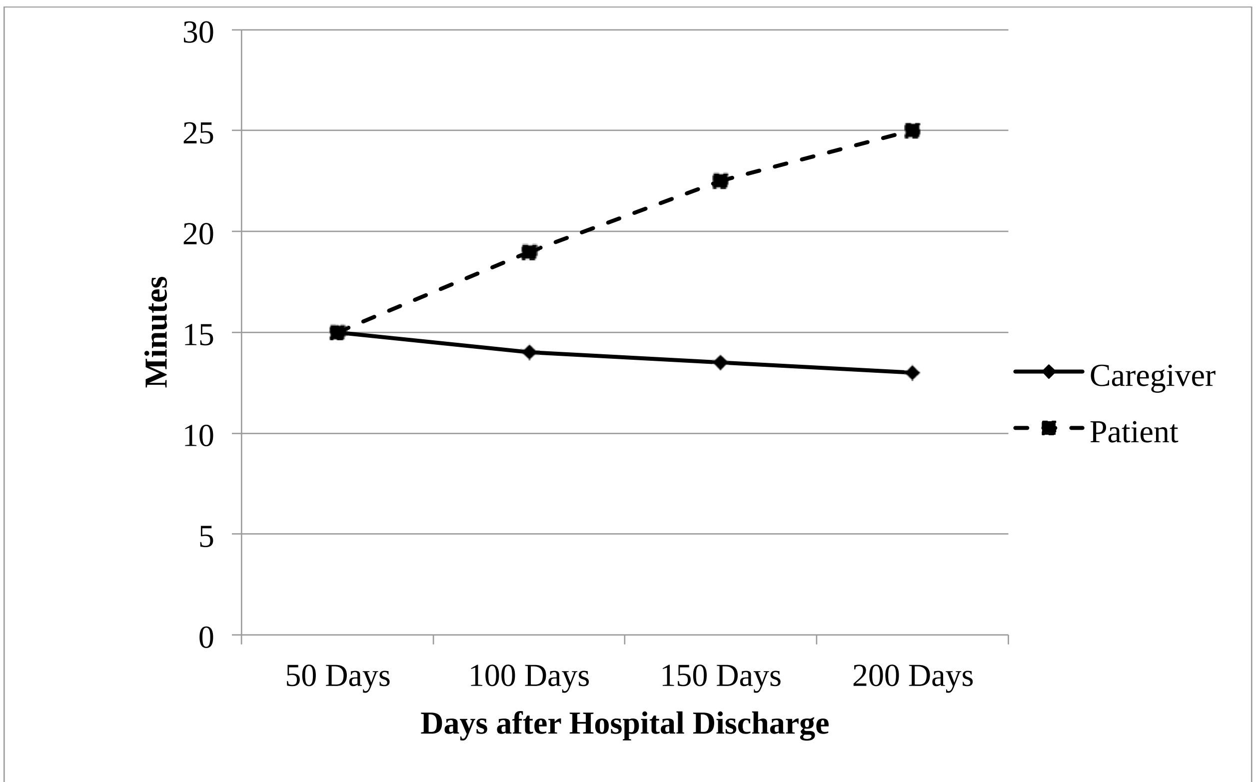

Figure 1. Population curves from multivariate HLM fit to activity data

A strong negative correlation of caregiver intercept and slope (-.84) indicates that higher initial activity for a caregiver was associated with smaller increases or even decreases across the first 6 months. In contrast, the patient intercept and slope was less strongly correlated (-.30). Patient and caregiver intercepts were positively correlated (.35), but their slopes showed virtually no association (-.04).

Categorization of trajectory slopes for individuals showed that of 21 caregivers with sufficient data to estimate a trajectory, 2 increased activity, 15 showed essentially no change, and 4 decreased activity. Of 21 patients, 7 increased, 10 were unchanged, and 4 decreased. Considered as dyads, 38% (n=8) showed essentially no change for either member, but for 29% (n=6) the caregiver showed no change while the patient activity increased.

Discussion

The aim of this pilot study was to provide information about CV risk factors and physical activity patterns in a sample of rural-residing adult cardiac surgery patients and their spouses. A high degree of concordance between these rural patients and their spousal CGs was evident for risk factors particularly hypertension and BMI. Similar risk factor prevalence has been documented in cardiac patients and their spouses including diabetes (Thomson, Niven, Peck, & Howie, 2013) smoking (Di Castelnuovo et al., 2009), BMI (Di Castelnuovo et al., 2009; Thomson et al., 2013) and physical activity participation (Thomson et al., 2013). These data are consistent with studies reporting significantly more obesity and self-reported coronary heart disease among rural residents (O'Connor & Wellenius, 2012). Clearly, interventions to reduce cardiac risk could be beneficial for both CG and patient.

Accelerometer data in this study revealed that both CGs and patients spend the majority of their time (21 hours/day) in sedentary activity. Copeland and Esliger (2009) observed similar patterns in healthy older adults (n=38), noting that approximately 14 hours/day were spent in light or sedentary activity. National recommendations for older adults emphasize reducing sedentary behavior in this population to lower risks of CV disease (Nelson et al., 2007).

With the exception of the 3 week time point, patients consistently spent more time in PA compared to CGs.   In our sample, patterns of PA revealed that most patients could increase activity levels to meet the requirements for CV risk reduction, but few sustained this level. The majority of patients appeared to increase their PA, at least initially, which may correspond with their attendance in CR programs. Consistent with the HPM, physical activity participation did influence health behavior outcomes in the patients. However, the assumption that behaviors of one spouse may influence the other was not evident in the physical activity participation by CGs. Strong evidence has established the effectiveness of CR programs in increasing PA (Chase, 2011) but these programs have not routinely included spousal CGs. These results suggest that patients tend to respond to CR and recognize the importance of healthy lifestyle behavior, while the CG was less likely to increase time spent in PA that could impact CV risk.

Little objective PA measurement in CGs has been documented. However, older adult CGs (n=24) and non-caregivers (n=48) wearing accelerometers in a study by Marquez et al. (2012) averaged 8 and 11 minutes per day, respectively in moderate or greater physical activity levels. This is similar to results in the current study where CGs averaged 11 – 16 minutes per day in PA. CGs may need different strategies to enhance their PA within the time constraints of their caregiving responsibilities. For example, shorter, more frequent bouts of activity may be more feasible for CGs to accomplish (Marquez et al., 2012). Interventions tailored to the CGs individual situation, allowing flexibility while respecting time constraints may be more effective. Booster sessions tailored to time points specific to PA patterns could be tested.

Although the sample was small, the longitudinal design allowed for examining patterns of PA for both the CGs and patients. PA activity for patients generally increased with no appreciable change noted in CG participation in PA. A few CGs did increase their time spent in PA over the 6 month period, however, this was not consistently correlated with the patient PA. Such a finding contrasts with Falba and Sindelar (2008) who reported that involvement by one spouse in exercise is associated with exercise in the other spouse. Further studies are needed to determine barriers such as CG burden or financial considerations which may interfere with adoption of activity behaviors.

Limitations

The findings of this study are subject to several limitations. First, this small convenience sample may not be generalizable to CGs and cardiac surgery patients representing urban and more diverse populations. In addition, only spousal CGs were included in this study. Future studies could include caregivers regardless of their relationship to the cardiac patient. Although accelerometers are an objective measure of PA, subjects are aware of this measurement which may have potentially influenced their activities.

Examination of the individual plots for cases having all four observations indicated that about 30% of the cases exhibited some degree of nonlinearity, usually within the first 6-9 weeks after hospital discharge. Although our results appear to reflect the overall trend (improvement or decline) even for these cases, the very early recovery period needs further study in order to more precisely model the trajectories and to gain understanding of factors influencing behavior changes during that time.

Implications

Future longitudinal intervention studies focused on CG health are essential. CGs in this study were similar in age, CV risk, and comorbidities to their spouses. However, focus on the patient's recovery without acknowledgement of similar risks in the CG may subsequently impact outcomes in both partners. Spousal CGs with many of the same risks as patients are in need of interventions which tailor strategies to prevent decline for both CG and patient. Lifestyle changes need to occur within the individual but also may be valuable in the overall home environment to impact both the patient and the CG. For example, changing dietary habits in the home and establishing routines including physical activity. Changes in CG lifestyle are also preventative strategies to reduce CV risk and avoid undergoing a cardiac intervention, themselves.

The goal of the National Prevention Strategy, a provision in the Affordable Care Act, is to "increase the number of Americans who are healthy at every stage of life" (National Prevention Council, 2011). As health care delivery in this country shifts from a focus on sickness and disease to a focus on prevention and wellness, the need for informal CGs will increase. Widening health disparities stemming from CVD mortality in the rural population as compared to urban counterparts (Singh & Siahpush, 2014) may have additional impact and underscores the need for future targeted interventions addressing CV risk in CGs. Preserving CG health is necessary to improve the ability to function as a CG and partner for the patients to whom they provide care.

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