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Factors Influencing the Impact of Depressive Symptoms on Physical Functional Capacity After Cardiac Rehabilitation

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Abstract

Purpose: This study aims to determine (1) if depressive symptoms in the year following completion of cardiac rehabilitation impact physical functional capacity and (2) if exercise, perceived benefits and barriers, self-efficacy, and social support moderate this relationship.

Design: This longitudinal correlational secondary data analysis included 379 cardiovascular rehabilitation patients.

Methods: Participants completed measures of depression and potential moderating variables at baseline, 2 months, 6 months, and 12 months and 6-minute work test at baseline and 12 months and wore heart rate monitors to measure exercise for 12 months.

Findings: Poorer physical functional capacity was predicted by depressed mood score. This relationship was moderated by the percentage of time exercising in target heart rate zone and family support of exercise, but not by perceived benefits and barriers or self-efficacy for exercise.

Conclusions: Depressive symptoms negatively impact physical functional capacity, and this relationship is moderated by family support and the percentage of time exercising in target heart rate zone.

Clinical Relevance: Improving percentage of time exercising in target heart rate zone may be a mechanism by which patients with depressed mood can optimize physical functional capacity.

Keywords: Cardiovascular disease; depressive symptoms; depression; exercise.

Background/Context

More than 500,000 people having a cardiac event qualify for cardiac rehabilitation (CR) annually (Ades et al., 2017). For those who attend, these programs have shown effective improvement in blood pressure and heart rate, decreased symptoms of depression and anxiety, and improved physical function and quality of life (Gardiner et al., 2017; ter Hoeve et al., 2015; Yohannes, Doherty, Bundy, & Yalfani, 2010). Long-term outcomes of CR include significant decreases in morbidity and mortality and increases in health-related quality of life (Sumner, Harrison, & Doherty, 2017). Important to consider regarding the gains in health outcomes is the negative impact of co-occurring depressive symptoms.

Depression occurs in one third of patients in CR (Gostoli, Roncuzzi, Urbinati, Morisky, & Rafanelli, 2016), with nearly half of CR patients reporting at least mild depressive symptoms (Banack et al., 2014). It is suggested that these rates of depressive symptoms are underreported (Hare, Toukhsati, Johansson, & Jaarsma, 2014). Depressive symptoms undermine rehabilitation efforts for patients in CR (Gostoli et al., 2016). Symptoms of depression vary in cardiac patients from those indicative of major depressive disorder to transient subclinical depression, with both being related to poorer self-management behaviors (Gostoli et al., 2016; Hare et al., 2014; Luyster, Hughes, & Gunstad, 2009; Song, 2009). Given the high rates of depressive symptoms and the potential impact on recovery, it is important to address depressive symptoms and their impact on health behaviors and outcomes for patients in CR.

One of the primary goals of CR is improved physical functional capacity through supervised exercise. Of the

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supervised phases of CR, Phase II is a 36-session outpatient physical activity rehabilitation commonly prescribed to those recovering from cardiac events with Phase I occurring in the hospital (McMahon, Ades, & Thompson, 2017). Patient gains in physical functional capacity during CR, as measured by the 6-minute walk test, have been shown to be between 36 and 89 m (Gardiner et al., 2017; Gremeaux et al., 2011; Ragawanti, 2014). Once a patient completes a CR program, they move from structured exercise to lifestyle exercise. Lifestyle exercise, or routine physical activity that is planned and structured in everyday life, is important to maintain gains in physical functional capacity (Dunn, Andersen, & Jakicic, 1998; Wright, Moore-Schiltz, Sattar, Josephson, & Moore, 2018). With known declines in physical activity of nearly 50 minutes weekly within 6 months following CR (Perez, Fleury, & Belyea, 2016), engaging in lifestyle exercise is a critical secondary risk prevention behavior for patients completing CR programs. Influences on lifestyle exercise and physical functional capacity include the presence of other health conditions, mental health, environmental factors, self-efficacy, belief in the benefits of exercise, and perceptions of support (Martin & Woods, 2012; Perez et al., 2016).

Importantly, those individuals with higher depressive symptoms pre-CR experience diminished gains in physical functional capacity at the conclusion of CR (Spatola et al., 2018), with less known about the relationship between depressive symptoms and physical functional capacity following completion of CR. With known declines in physical functional capacity in general for patients following CR, it is important to consider the impact that depressive symptoms may have on this population. Furthermore, it is unknown if additional exercise and social factors may help to explain why some patients with depressive symptoms sustain greater physical functional capacity than others. By identifying the predictors of decreased physical functional capacity in this population, clinicians can be equipped to predict at-risk patients and provide additional support.

Study questions were as follows: (1) Do depressive symptoms in the year following completion of CR negatively impact physical functional capacity? (2) Do exercise, perceived benefits and barriers to exercise, exercise self-efficacy, and family social support for exercise moderate the relationship between depressive symptoms and physical functional capacity?

Methods

Study Design and Sample

This secondary data analysis study was completed on data collected as part of a randomized controlled trial with a convenience sample of 379 CR patients having myocardial infarction, coronary artery bypass graft, and/or percutaneous coronary intervention. Participants in the parent study were recruited from five Phase II CR programs in Cleveland, Ohio. All participants completed informed consent, and human subjects review board approval was obtained. Participants met the following inclusion criteria: (1) aged ≥54 years; (2) experienced a myocardial infarction, coronary artery bypass graft, or angioplasty; (3) resided within a 60-mile radius of the study sites; (4) can read and speak English; and (5) were in the last month of a 12-week Phase II CR program. Potential participants were excluded if they had concurrent valve surgery, neurological deficits, renal or pulmonary complications, or obvious musculoskeletal functional disabilities or were considered high risk for safe participation in cardiac exercise programs.

Parent study participants were randomized into three groups: (1) usual care, (2) a cognitive behavior change program, or (3) a family system-based improvement program of daily behavior change (Moore, Jones, & Alemi, 2016). Both intervention groups were provided five 1.5-hour educational sessions on the use of behavior change strategies and booster telephone calls. A full description of the parent study intervention can be found in Moore et al. (2016). All participants received the usual care provided by the CR program, including 12 weeks of supervised exercise three times weekly and four educational sessions on diet and stress modification. The analysis herein controlled for intervention group effects.

Data Collection and Measurement

Participants enrolled in the randomized controlled trial completed all measures at 4 points over a year (baseline, 2 months, 6 months, and 12 months), with baseline starting at completion of Phase II CR. Exceptions to the four time point measurement include lifestyle exercise variables, which were measured continuously over 12 months, and the 6-minute work test, which was done at baseline and 12 months only to minimize participant burden. *Individual and clinical factors* were measured using demographic questionnaires and the Charlson Comorbidity Index for determination of comorbid conditions.

Physical Functional Capacity

Physical functional capacity is an evaluation of a person's ability to perform physical tasks and an estimation of maximal oxygen uptake (Ragawanti, 2014). Physical functional capacity was measured in this study using the 6-minute work test (Carter, Holiday, Nwasuruba, et al., 2003). This test incorporates the 6-minute walk test with attention to body weight in order to more closely align the test with maximum oxygen uptake during exercise. The 6-minute work test was calculated as Distance × Body Weight. This test is a valid measurement with improved predictive abilities of mean peak oxygen uptake over the 6-minute walk test and is highly reproducible (Carter, Holiday, Stocks, Grothues, & Tiep, 2003). A trained researcher measured each participant's weight and the distance walked in a flat corridor over 6 minutes at each measurement point.

Depressive Symptoms

Depressive symptoms were measured using the 15-item Geriatric Depression Scale (GDS), with a potential score range of 0–15. A reliability Cronbach's coefficient of .98 was found in this study. This scale has shown adequate sensitivity and specificity for patients 55 years and older with cardiovascular disease (CVD) and does not include somatic symptoms that may falsely elevate depressive symptom scores in the presence of CVD (Haworth, Moniz-Cook, Clark, Wang, & Cleland, 2007). Higher scores indicate more depressive symptoms, with a suggested cut-point of 5 indicating potential mild-to-moderate depression (Haworth et al., 2007). Depressive symptoms were assessed four times over the year, with a participant's highest score used in the analysis.

Potential Moderators

Perceived benefits and barriers to exercise was measured using the 43-item Exercise Benefits/Barriers Scale (Sechrist, Walker, & Pender, 1987) that had a reliability Cronbach's coefficient in this study of .79. Higher scores indicate more positive perceptions of benefits as compared to barriers to exercise. *Exercise self-efficacy*, the perceived confidence of the individual to continue exercising, was measured using the eight-item Adherence Self-Efficacy Scale (McAuley, 1993), which in this study had a reliability Cronbach's coefficient of .98. This scale examines the confidence (as a percentage from 0 to 100%) of participants to exercise three times a week at a moderate or higher intensity. Higher scores indicate greater perceived exercise self-efficacy. *Social support*, the perceived level of family support for exercise, was measured using the Social Support for Exercise Scale family subscale (Sallis, Grossman, Pinski, Patterson, & Nader, 1987), which had a reliability in this study of .87. This scale uses a Likert-type scale to assess perceived support with 13 items rated from 1 (*none*) to 5 (*very often*). Higher scores indicate more perceived family support of exercise. *Lifestyle exercise* was objectively measured daily for 12 months using a wristwatch Polar RS400 heart rate monitor. Minutes of exercise were counted when occurrences of heart rate elevation exceeded 10 minutes and were calculated in 15-second intervals. Target heart rate zone (THRZ) was determined by research staff at baseline and provided to all individuals at the end of their CR program. Because maximal oxygen consumption and rate-perceived exertion are not significantly affected by beta blockers (Wonisch et al., 2003), the method of calculating individual THRZ was not altered based on medications. Percentage of time in THRZ was calculated as the percentage of the minutes of exercise that occurred in individual participant THRZ. Participants mailed back monitors monthly on receipt of a new monitor. This method of recording exercise demonstrates good criterion-related validity and test–retest repeatability as compared with electrocardiogram (Engström, Ottosson, Wohlfart, Grundström, & Wisén, 2012). The number of hours exercised and the amount of time exercising in THRZ comprised the measures of lifestyle exercise used in these analyses.

Data Analyses

Descriptive statistics for baseline participant characteristics were computed using frequency distributions for categorical variables and mean and standard deviation for continuous variables. Primary analysis used the highest GDS score as a continuous variable. Multiple linear regression method was used to test the moderating effect of hours of exercise and time in THRZ, baseline perceived benefits and barriers to exercise, exercise self-efficacy, and family social support for exercise on the association between depressive symptoms and functional status at 12 months. Moderation analysis was performed on the mean-centered variables, which provides the same results seen in structural equation modeling (Hayes & Rockwood, 2017). We built regression models to estimate differences in physical functional capacity for each potential moderator while controlling for the effects of age, gender, body mass index, and comorbid score. In addition, the intervention effect of the parent study was controlled for by adding it into the model as a covariate. In all moderation analyses, we assumed that the missing data followed a missing-at-random pattern. Thus, all estimators provided unbiased regression parameter estimates. To provide additional insight in those moderation effects that showed significance, a post hoc analysis using the Johnson–Neyman's region of significance was performed. This analysis identifies the point at which the moderating variable demonstrates an interaction effect on the relationship between the predictor and outcome variable (Hayes, 2018). All data analyses were performed using SPSS 24 and STATA 15, with alpha values set at .05.

Results

Descriptive Characteristics

All 379 participants of the parent study completed the measures and were included in this secondary data analysis. Descriptive information about the sample is shown in Table 1.

Predictor and Outcome Variables

Depressive Symptoms

Participants reported relatively low levels of depressive symptoms (see Table 2). A large range of depressive symptoms was reported with 12% of participants at least once over the study year at or above the cut-point of 5, indicating potential mild-to-moderate depression.

Exercise Minutes and Percentage of Time Exercising in THRZ

Participants completed a mean of 2.1 hours of exercise a week over the study year following completion of CR. Of the time exercising, less than a third of this time on average was spent in THRZ.

Analysis of Study Questions

Regression analysis showed that depressive symptoms negatively impacted physical functional capacity when controlling for study group, baseline age, gender, body mass index, and comorbidity (ß = −22.79, CI [−40.32, −5.26], $p = .01$). Two variables, family social support for exercise and time exercising in THRZ, were found to moderate the relationship between depressive symptoms and physical functional capacity. Total time exercised, perceived benefits and barriers to exercise, and exercise self-efficacy did not demonstrate moderation of the relationship between depressive symptoms and physical functional capacity (see Table 3).

The moderation model for family social support for exercise, $F(9, 224) = 23.6$, $p < .001$, $R^2 = .486$, was significant (see Table 3). Social support alone was not a significant predictor of physical functional capacity. In this model, every 1-unit increase in GDS depressive symptoms was associated with a 22.57-unit (feet) decrease in the 6 minute work test physical functional capacity. The interaction effect in this model accounts for a significant proportion of the variance in physical functional capacity ($b = −1.91$, $t(224) = −2.11$, $p = .036$), indicating an enhanced effect of depressive symptoms on physical functional capacity. Figure 1 shows that, as family social support for exercise increases, the conditional effect of depressive symptoms on physical functional capacity decreases. Figure 2 shows the conditional effects of depressive symptoms at three levels (mean and mean ± 1 standard deviation) of perceived family support for exercise. At a low level of family social support for exercise (score of 15.2), the impact of depressive symptoms on physical functional capacity remained the same ($b = −4.06$, $t(224) = −0.329$, $p = .742$). For those participants reporting average (24.9) or high levels of family social support for exercise (34.6), the negative relationship between depressive symptoms and physical functional capacity was intensified ($b = −22.57$, $t(224) = −2.538$, $p = .012$ and $b = −41.08$, $t(224) = −3.249$, $p = .001$, respectively).

The moderation model for the percentage of time exercising in THRZ was also found to be significant, $F(9, 194) = 23.2$, $p < .001$, $R^2 = .52$. In this model, significant effects were found for depressive symptoms, time in THRZ, and the interaction effect on physical functional capacity. For every 1-unit increase in the percentage of time exercising in THRZ, there is a 2.55-unit increase in physical functional capacity, and for every 1-unit increase in depressive symptoms in this model, there is a 22.66-unit decrease in physical functional capacity. The interaction effect in this model accounts for a significant proportion of the variance in physical functional capacity ($b = 0.91$, $t(194) = 2.89$, $p = .004$), indicating a reduced effect of depressive symptoms on physical functional capacity. Examination of the interaction plot provides a visual display of the effect of depressive symptoms on physical functional capacity, which is significantly negative for those with a percentage of time exercising in THRZ at less than 36.35 (see Figure 3). Figure 4 shows the conditional effects for levels of percentage of time exercising in THRZ. For those participants with low percentage of time exercising in THRZ, the negative effect on physical functional capacity is minimized. Specifically, at low (2.37%) and average (31.34%) levels of time exercising in THRZ, the impact of depressive symptoms on physical functional capacity is worse ($b = −49.09$, $t(194) = −3.626$, $p \leq .001$ and $b = −22.66$, $t(194) = −2.469$, $p = .014$). This is in contrast to those participants reporting higher percentages of time exercising in THRZ (60.30%), in which the relationship between depressive symptoms and physical functional

Table 1 Descriptive baseline characteristics

Characteristic	Overall Sample $N = 237$
Age, years (range: 54–89)	67.2 ± 7.8
Female, %	27.0
Married, %	78.5
Years of school completed	15.5 ± 3.0
Income	
Under 30,000	13.7%
30,000–59,000	33.9%
60,000 and above	52.4%
BMI	29.4 ± 5.3
Comorbidities (number)	1.7 ± 1.6

Note. Comorbidities were measured by Charlson Comorbidity Index. Income, $N = 233$; BMI, $N = 235$. BMI = body mass index.

Table 2 Means and standard deviations of predictor and outcome variables

Measure	Sample Size	Mean	*SD*	Range
Depressive symptoms	237	2.11	2.00	0.05–11
6-Minute work test (in feet)	237	1,160.42	361.32	80–2,300
Hours of exercise (annual)	237	130.51	95.50	0–514.87
% Time in THRZ	206	36.62	29.07	0–99.36
Perceived benefits and barriers to exercise	237	134.91	13.26	106–170
Exercise self-efficacy	236	87.49	15.88	31.25–100
Family social support for exercise	236	25.81	9.68	10–48

Note. Outcome variables of depressive symptoms are the highest Geriatric Depression Scale score over 12 months. Six-minute work test was measured at 12 months. Hours of exercise and % Time in THRZ were calculated from 12 months of exercise. Predictor variables of perceived benefits and barriers to exercise, exercise self-efficacy, and family social support for exercise were measured at baseline. THRZ = target heart rate zone.

capacity remained unchanged ($b = 3.76$, $t(194) = 0.305$, $p = .761$).

Discussion

Depressive symptoms are predictive of poorer physical functional capacity for participants in the year following CR. The occurrence of mild-to-moderate depressive symptoms reported at 12% of participants in this study is lower than the rates suggested by Gostoli et al. (2016) or Banack et al. (2014). It is unclear why the rates of depressive symptoms are lower in this specific sample; potential explanations for this discrepancy may be geographical sample differences or the measurement and cut-point differences between studies. What is clear is that the detriment of depressive symptoms on physical functional capacity is moderated by family support of exercise and the percentage of time exercising in THRZ. Other variables, including total

Table 3 Effects of five moderating variables on the relationship between depressive symptoms and functional capacity

	Coefficient	*SE*	*t*	*p*
Model 1				
R^2 = .489, MSE = 66668.46				
Constant	3,327.174	204.077	16.303	<.001
Depressive symptoms (*X*)	−19.744	9.098	−2.170	.031
Time EXERCISING (*W*)	0.449	0.201	2.230	.027
X × *W*	−0.038	0.083	−0.452	.652
Model 2				
R^2 = .489, MSE = 66522.74				
Constant	3,389.162	199.600	16.980	<.001
Depressive symptoms (*X*)	−22.571	9.305	−2.426	.016
Perceived benefits and barriers to exercise (*W*)	1.343	1.437	0.935	.351
X × *W*	−1.405	0.733	−1.917	.056
Model 3				
R^2 = .487, MSE = 66981.38				
Constant	3,385.610	200.972	16.846	<.001
Depressive symptoms (*X*)	−18.660	9.118	−2.046	.042
Exercise self-efficacy (*W*)	2.196	1.163	1.888	.060
X × *W*	−0.875	0.509	−1.720	.087
Model 4				
R^2 = .486, MSE = 67081.48				
Constant	3,397.793	199.336	17.046	<.001
Depressive symptoms (*X*)	−22.573	8.895	−2.538	.012
Family social support for exercise (*W*)	0.488	1.880	0.259	.796
X × *W*	−1.908	0.904	−2.111	.036
Model 5				
R^2 = .519, MSE = 62646.71				
Constant	3,251.508	215.931	15.058	<.001
Depressive symptoms (*X*)	−22.664	9.181	−2.469	.014
Time exercising in THRZ (*W*)	2.554	0.678	3.769	<.001
X × *W*	0.912	0.316	2.891	.004

Note. Moderation effects of model variables between depressive symptoms and 6-minute work test. Time exercising = the number of hours of exercise completed over 12 months; Time exercising in THRZ = percentage of minutes exercised in target heart rate zone.

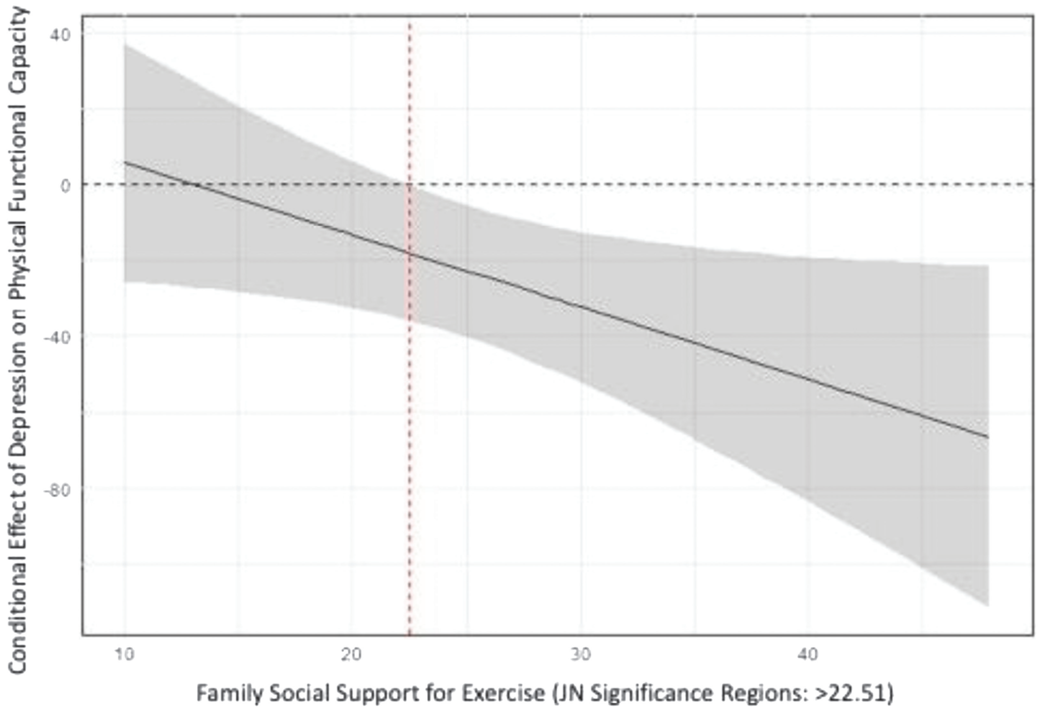

Figure 1. Moderating effects of family social support for exercise on the relationship between depressive symptoms and functional capacity. The effect of depressive symptoms on physical functional capacity is significantly negative for reporting family social support for exercise greater than 22.51 (JN = Johnson-Neyman's region of significance). The shadow indicates the confidence band of the conditional effect.

time exercising, perceived benefits and barriers to exercise, and exercise self-efficacy, were not found to moderate the relationship between depressive symptoms and physical functional capacity in this study.

Primary findings of this study indicate that depressive symptoms over a year can be detrimental to physical functional capacity of patients a year following completion of a CR program. In general, healthcare clinicians demonstrate inconsistent documentation of depressive symptoms the year after a cardiac event. The variable documentation, which may be related to evidence of inconsistent reporting of depressive symptoms by patients, may be partially explained by repression or suppression of symptoms (Hare et al., 2014). Furthermore, in both clinic and research

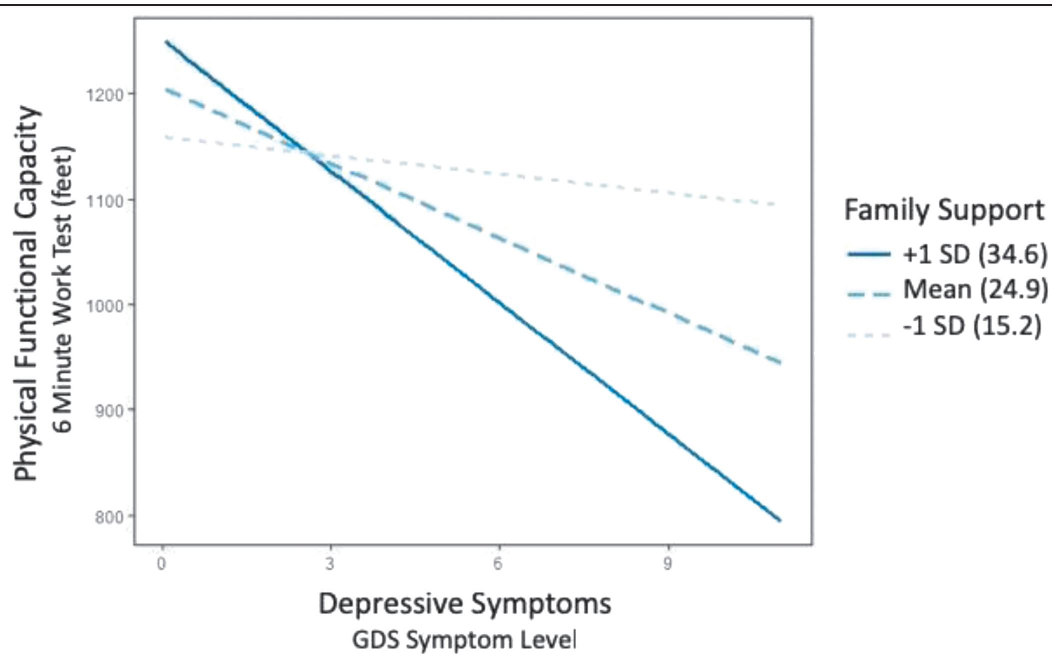

Figure 2. The relationship between depressive symptoms and physical functional capacity conditional on family support for exercise.

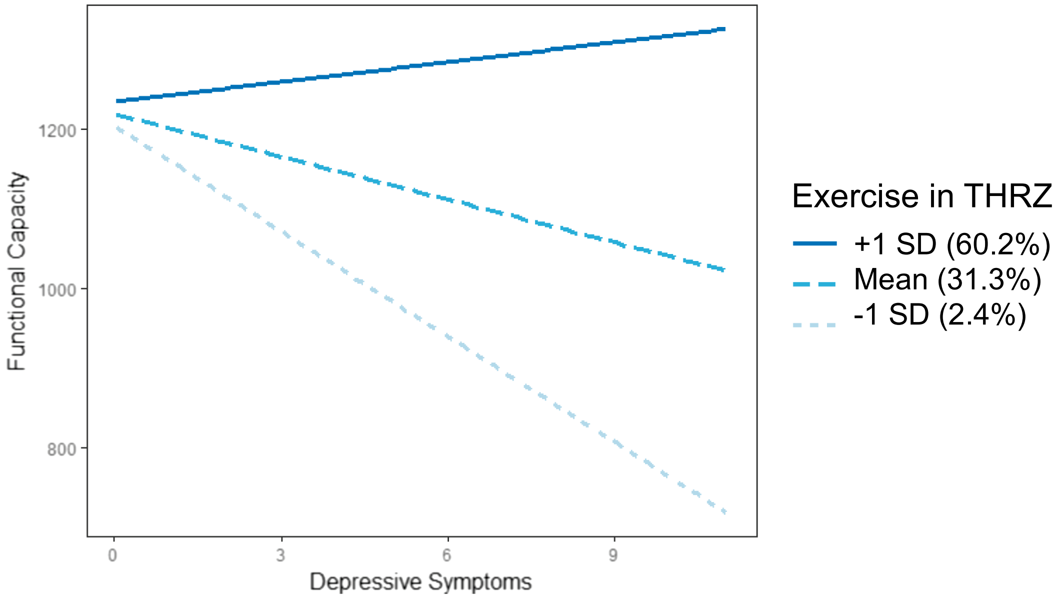

Figure 3. The relationship between depressive symptoms and physical functional capacity conditional on percentage of time exercising in target heart rate zone (THRZ).

settings, there may be a lack of appropriate screening tools or the focus may be on cut-points that miss patients with subclinical symptoms (Hare et al., 2014). The results of this study demonstrate the negative impact of depressive symptoms on physical functional capacity in patients following CR. This suggests that it is critical that these symptoms be identified and treated. Our findings indicate that repeated measurement and subsequent treatment of depressive symptoms by clinicians has the potential to improve physical outcomes in this population.

The importance of treating depressive symptoms was shown in a recent 12-year study when, in older persons,

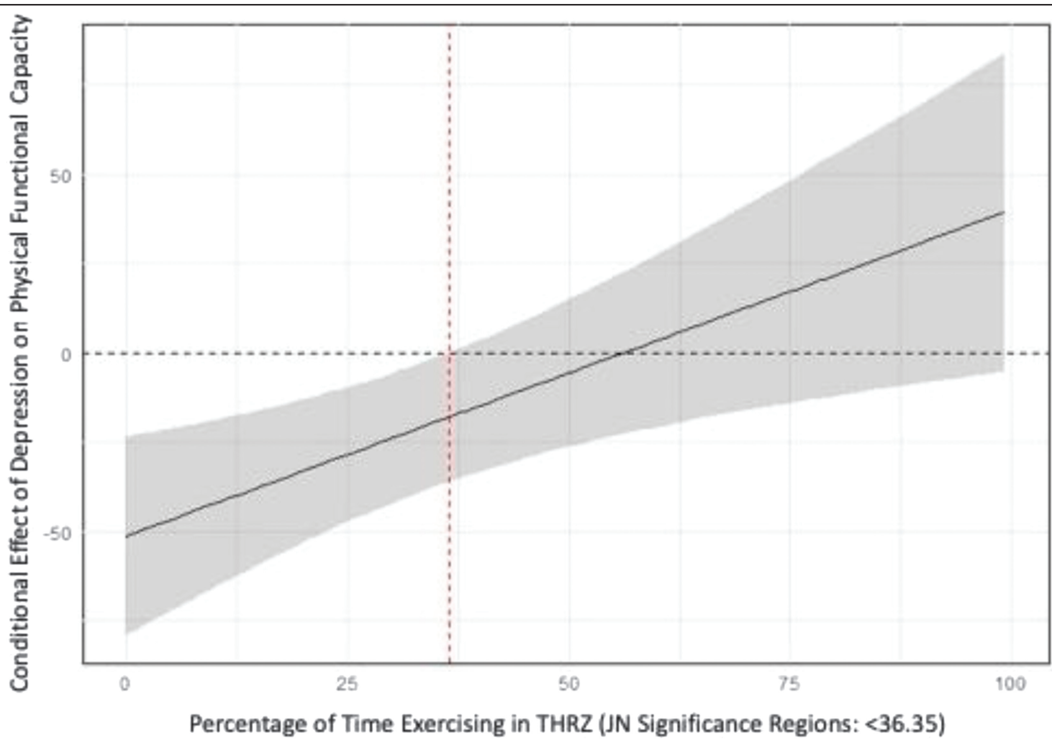

Figure 4. Moderating effects of family social support for exercise on the relationship between depressive symptoms and physical functional capacity. The effect of depressive symptoms on physical functional capacity is significantly negative for those with time exercising in target heart rate zone (THRZ) of less than 36.35% (see Figure 2). For those participants with low time exercising in THRZ, the negative effect is minimized as this time increases. The shadow indicates the confidence band of the conditional effect.

depressive symptoms were found to be predictive of higher mortality (Mirza et al., 2017). Within our study, it is unclear if participants are experiencing a general increase in depressive symptoms, which could lead to higher mortality as in Mirza et al. (2017), or if these symptoms are transient given the limited 12-month study period. The connection between depressive symptoms and physical functional capacity may be one mechanism by which morbidity or mortality is increased in patients following CR.

Maintaining improved physical functional capacity following CR continues to be problematic. Other studies have found that comorbid conditions, mental health, environmental factors, self-efficacy, belief in benefits of exercise, and perceptions of social support impact physical functional capacity or physical activity (Martin & Woods, 2012; Perez et al., 2016). In our study, with the exception of family social support, those factors were not found to moderate the relationship between depressive symptoms and physical functional capacity.

Previous studies have shown a paradoxical relationship between physical activity and depressive symptoms. For individuals experiencing depressive symptoms, physical activity is negatively impacted (Gostoli et al., 2016). In addition, it has been shown that depressive symptoms are also reduced with a medium effect size as a result of physical activity (Rebar et al., 2015). This reduction in depressive symptoms as a result of physical activity has also been shown in patients following a cardiac event (Janzon, Abidi, & Bahtsevani, 2015). Results from this study demonstrate an important moderation effect of exercise in THRZ on the debilitating effects of depression on physical functional capacity. It is interesting that total amount of time exercised did not moderate the relationship. These findings suggest that emphasis on exercising in THRZ can be especially important for CR patients with depressive symptoms.

Our findings support the need for greater understanding of the role of perceived family social support for exercise and its influence on physical functional capacity. In post-CR patients, friend support, but not family support, has been found to mediate the relationship between study group and exercise (Pinto & Dunsiger, 2015). Furthermore, in a more general population, coworker and friend support, but not family support, predicted physical activity (Sarkar, Taylor, Lai, Shegog, & Paxton, 2016). In the study reported herein, family social support for exercise for those with higher depressive symptoms demonstrated a greater negative impact on physical functional capacity than those with fewer depressive symptoms. A possible explanation for the seemingly detrimental effect of family support of exercise on physical functional capacity may be related to additive perceptions of burden from the patients on family members. This idea is connected with the suggestion that patients do not want to burden their family with responsibilities such as exercise (Holder, Young, Nadarajah, & Berger, 2014). Perceptions of support may invoke feelings of being a burden by the patient, particularly for those with depressive symptoms. These feelings of burden may be greater and therefore additionally prone to a negative impact on physical functional capacity.

Implications of Findings

Maintaining gains in physical functional capacity following completion of CR is important to both researchers and practitioners. For practitioners, knowledge that depressive symptoms may have a negative effect on physical functional capacity for patients after CR provides evidence of the need for careful and repeated screenings for depressive symptoms before and after CR. Those with elevated depressive symptoms should be identified as at risk for declines in physical functional capacity and evaluated for treatment of these symptoms. It is also important for practitioners to recognize that percentage of time exercising in THRZ may be an important factor in reducing the negative impact of depressive symptoms on physical functional capacity. Thus, assisting people to engage in lifestyle physical activity at a predetermined intensity can be particularly beneficial to cardiac patients with depressive symptoms. Further research should explore the impact of depressive symptoms on physical functional capacity, specifically the impact of both the timing and severity of depressive symptoms. In addition, continuing to determine factors affecting the relationship between depressive symptoms and physical functional capacity may be an important route to improving overall quality of life in patients recovering from cardiac events.

Study Limitations

Findings should be considered within the limitations of this study. One limitation is the regional geographic area in which the study was conducted may not be representative of those in other areas or distinct CR centers. In this study, a variety of CR programs were included, encompassing both small and large hospital systems; however, they were all located in a single city. The sample also reported relatively high incomes, which although common in patients attending CR is not necessarily generalizable to the larger population of patients with cardiovascular disease. Furthermore, this study is limited to CR participants with myocardial infarction, coronary artery bypass graft, and/or percutaneous coronary intervention and may not be generalizable to patients with other diagnoses. Beyond limitations with the sample, it is possible that

Key Practice Points

- Depressive symptoms in the year following cardiac rehabilitation predict poorer physical functional capacity.
- Repeated measurement of depressive symptoms is critical to identifying patients at risk for poor outcomes.
- Greater attention to depressive symptoms is needed within the year following cardiac rehabilitation to improve the physical functional capacity of these patients.
- A greater percentage of time spent exercising in target heart rate zone may mitigate the detrimental effects of depressive symptoms on physical functional capacity.

significant changes may occur with regard to social factors that may impact the outcomes of this study not captured in this analysis. Also, it is not known whether or not these participants had depressive symptoms prior to CR or whether these symptoms were in response to their recent health event. Acute symptoms of depression may have a different impact on physical functional capacity than chronic depressive symptoms.

Conclusions

In conclusion, for the year following CR, depressive symptoms are predictive of poorer physical functional capacity. Family social support of exercise enhanced the negative effect of depressive symptoms impact on physical functional capacity. Alternatively, percentage of time exercising in THRZ reduced the negative effect of depressive symptoms on physical functional capacity. Future research should focus on the implementation of post-CR lifestyle exercise to identify effective interventions for adherence, especially in those with depressive symptoms. Improving the modifiable factor of exercise, particularly by focusing on exercising within THRZ, may be a mechanism by which patients with depressive symptoms can optimize physical functional capacity following CR.

Conflict of Interest

The authors declare no conflict of interest.

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