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Couples' physical activity concordance during cardiac rehabilitation

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Abstract

Physical activity plays a central role in cardiac rehabilitation, serving as a pivotal factor in recovery and secondary prevention. Interpersonal factors within patients' romantic relationships play a critical role in the rehabilitation process, as partners tend to show behavioral concordance in their health behaviors. This study aimed to investigate the interdependence of physical activity between Acute Coronary Syndrome (ACS) patients and their partners, as well as the role of relationship satisfaction in moderating this concordance. Utilizing 21 daily diary assessments from couples, we examined co-fluctuations in patients' and partners' daily physical activity. A significant concordance in couples' physical activity was found. However, relationship satisfaction did not moderate this association, suggesting that couples' daily concordance occurred regardless of their average satisfaction level. These results highlight the potential influence of partners on each other's health behaviors. Our findings suggest important implications for the development of dyadic interventions aimed at promoting physical activity as an integral component of cardiac rehabilitation and secondary prevention.

Keywords

Romantic Relationships, cardiac rehabilitation, physical activity, health behavior concordance, relationship satisfaction

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Introduction

Cardiovascular diseases are the leading cause of death globally. The mortality rate climbed from 12.1 million in 1990 to 18.6 million in 2019 (Roth et al., 2020). Coronary artery disease is a common type of cardiovascular disease (Sanchis-Gomar et al., 2016). Its acute clinical manifestation, known as Acute Coronary Syndrome (ACS), requires immediate medical attention (Bhatt et al., 2022; Göritz & Rennung, 2019). ACS can cause severe disabilities such as heart failure and acute renal failure and, in many cases, results in death (Kolansky, 2009; Göritz & Rennung, 2019; Wah, 2017). Thus, disease management is crucial to improving health outcomes for individuals experiencing ACS (De Luca et al., 2004; Pouralijan Amiri et al., 2019).

Cardiac rehabilitation is essential to the recovery process and to the prevention of secondary conditions in individuals who have experienced ACS (American Heart Association, 2019). Rehabilitation often focuses on modifying the patients' lifestyle to help lessen cardiovascular risk factors. These include smoking cessation, healthy diet maintenance, weight management, stress reduction, and increasing physical activity (Kachur et al., 2017; Sandesara et al., 2015). Despite the well-documented positive effects of these health behavior changes, patients tend to find it difficult to adhere to rehabilitation programs and guidelines (Daly et al., 2002; Pedretti et al., 2023).

Interpersonal factors such as social support are critical to adherence to the medical regimens required for recovery from cardiovascular diseases (Ambrosetti, 2021; Artinian et al., 2010). One of the most influential social bonds for many adults that impacts numerous aspects of their lives, including emotion regulation and well-being (Mikulincer & Shaver, 2005), is their romantic relationship. When individuals perceive their resources as insufficient to cope with their health-related stressors, they often turn to support from their romantic partners (e.g., Crowley & Pederson, 2022; Zajdel et al., 2021). Bodenmann (2005) defined dyadic coping as describing partners' shared efforts to manage the stress they face. In the case of a complex medical condition, adaptive dyadic coping is known to be associated with better adherence to treatment recommendations. For example, in a longitudinal study on post-surgery prostate cancer patients, partners' support was found to prospectively predict adherence to recommended rehabilitation routines (i.e., pelvic floor exercises; Hohl et al., 2016). However, support is only one facet of partners' influence on each other's health behaviors, and other indirect social influences may occur. For example, a daily diary study of knee osteoarthritis patients found that both daily partners' autonomy support and partners' physical activity were associated with patients' physical activity levels (Martire et al., 2013).

Indeed, another key facet of partners' influence on rehabilitation is the extent to which patients' and partners' health behaviors are concordant (Jackson et al., 2015). Research has consistently shown that couples exhibit similarities in various health-related domains, including dietary intake, physical activity, and smoking habits (Arden-Close & McGrath, 2017; Christakis & Fowler, 2008; Meyler et al., 2007; Pachucki et al., 2011; Reynolds et al., 2006). When individuals adopt healthier lifestyles, their partners are likely to improve their health habits (e.g., Christakis & Fowler, 2008; Cobb et al., 2014; US dollar et al., 2009; Homish & Leonard, 2008). Notably, this similarity does not mean that both partners are

necessarily engaging in high levels of health behaviors; rather, it indicates that partners are attuned to each other's habits, aligning either positively or negatively. These findings point to the interdependence within romantic partnerships (Fitzsimons et al., 2015). Because of this interdependence, examining health behaviors at the dyadic level is critical. The main goal of the current study was to assess the level of interdependence in cardiac patients and their partners regarding one of the most critical rehabilitative behaviors: physical activity. Determining the level of this concordance can clarify whether interventions should be offered at the individual level or designed to address both partners.

Physical activity has been found to contribute significantly to cardiac disease recovery (Franklin & Cushman, 2011; Mozaffarian et al., 2008). However, despite recommendations to adopt an active lifestyle, achieving sufficient physical activity remains a particularly challenging goal for ACS patients (Eyre et al., 2004; Smith et al., 2001; Sniehotta et al., 2006). Couples' physical activity levels tend to be correlated (Perry et al., 2016), such that one partner's exercise regimen is likely to influence the other partner's level of activity. For example, two studies using seven-day accelerometer data showed a positive association between romantic couples in moderate-to-vigorous physical activity (Pauly et al., 2020). In another study using accelerometers to assess middle-aged and older couples over seven days, there was concordance in couples' activity behaviors (Harada et al., 2018). Partners tend to be more active when they are concordant in their physical activity levels or engage in physical activity together (Berli et al., 2018; Pauly et al., 2020). This association between couples' physical activity has also been observed in medical contexts, such as among knee osteoarthritis patients (Martire et al., 2013) and prostate cancer survivors (Myers Virtue et al., 2015). However, to the best of our knowledge, the association between physical activity levels among ACS patients remains unexplored.

From a theoretical perspective on partners' goal-related processes, when romantic partners are satisfied with their relationship, they are more likely to adopt a systematic orientation when pursuing their goals (Fitzsimons et al., 2015). This orientation tends to be characterized by a higher motivation to accommodate each other's actions and support one another (Fitzsimons et al., 2015; Wieselquist et al., 1999). Relatedly, partners who are satisfied with their relationship are more likely to exhibit similarities and be influenced by each other's attitudes and behaviors (Burleson & Denton, 1992; Gonzaga et al., 2007). Indeed, research indicates that relationship satisfaction can strengthen couples' behavioral alignment in health domains. For instance, partners with higher relationship satisfaction exhibit greater similarities in alcohol consumption (Meiklejohn et al., 2012) and report more joint health behaviors, such as eating and exercising together (Wilson & Novak, 2022). In the context of cardiac rehabilitation, satisfied couples may be more adept at providing mutual encouragement or planning shared physical activities – both of which can boost concordance in daily exercise (Sher et al., 2014). Consistent with this reasoning, we posited that satisfied couples would show higher concordance in their physical activity.

The current study

Given the potential role partners can play in shaping ACS patients' rehabilitative behaviors, the current study utilized a daily diary design to explore the relationship between

patients' and their partners' physical activity. Prior research on couples' concordance has often relied on cross-sectional (e.g., Ashe et al., 2020; Jeong & Cho, 2017), aggregated correlations (e.g., Meyler et al., 2007) or used multilevel analyses focusing on within- and between-level predictions (e.g., Brazeau & Lewis, 2021; Harada et al., 2024; Pauly et al., 2020). More recent approaches suggest that to better capture the concordance between two partners' behaviors or states, it should be modeled as a concurrent, non-directional covariation between partners' processes (DiGiovanni et al., 2024; Qaiser et al., 2023). This entails examining whether partners' daily physical activity aligns within each dyad, rather than assuming a unidirectional effect from one partner to the other – an approach we adopt in this study. Furthermore, we also examined whether this relationship varied as a function of relationship satisfaction. The data used for this study were obtained from a larger research project focusing on the adjustment of couples to cardiac illness. This project involved a baseline assessment, followed by a 21-day daily diary assessment in which both partners reported their daily physical activity.

Using these data, the following hypotheses were tested: Hypothesis 1: patients and their partners will show concordance in their daily physical activity. Hypothesis 2: Relationship satisfaction will moderate the concordance between couples' physical activity. The daily diary data allowed us to examine these hypotheses by modeling physical activity concordance at the daily level (i.e., whether on days when one partner was more physically active than usual, the other partner was also more active that same day). Additionally, we tested cross-level moderation by a between-couple factor, specifically couples' average relationship satisfaction, to assess whether stable differences in relationship quality influenced the strength of this day-to-day concordance.

Method

Transparency and openness promotion

We report how we determined our sample size, all data exclusions, all manipulations, and all measures that were included in the study. The data and analysis code are available at https://osf.io/2d67a/?view_only=bd328bf63226438ab53438a096b517ce. Data were analyzed using R version 4.2.2 (R Core Team, 2022).

Participants and procedure

Data were collected from November 2017 to March 2020. The sample was composed of male patients and their female partners, recruited from the Cardiac Prevention and Rehabilitation Program (CPRP) of the Sheba Medical Center, Israel, subsequent to the patient's first acute coronary event. All couples were heterosexual. According to the Heart Disease and Stroke Statistics (Tsao et al., 2022), men have a higher probability than women of experiencing a cardiac event across nearly all age brackets. Among women who experience an acute cardiac event, there is a greater likelihood that they will be older and widowed (Tsao et al., 2022). Consequently, given the potential difficulty of recruiting female cardiac patients who met the inclusion criteria and had a living or healthy partner,

the present study was composed exclusively of male patients and their female partners. Potential patients' medical files were screened for eligibility. The inclusion criteria were being over age 35 (to rule out a first-time coronary event that was related to a congenital disease), having experienced their first acute coronary event [manifested as a myocardial infarction (MI) or severe unstable angina (UA)], and cohabitation with their current partner for at least one year. The exclusion criteria included having a comorbid physical illness or cognitive disability. Additionally, exclusion was applied if the partner had a physical illness or cognitive disability, and either the patient or the partner exhibited a lack of fluency in Hebrew.

During the study period, a total of 3,318 patients were referred to the CPRP. After screening their medical files for eligibility, 2,569 patients (77.4%) were excluded (see Figure 1 in the supplemental materials for a more detailed overview of the recruitment process). Out of the initial pool, 749 patients (22.6%) were contacted by phone to arrange a meeting at the CPRP. Prior to this meeting, 341 patients (45.5%) were excluded. The remaining 408 patients (54.4%) attended the in-person meeting with the research team. During this meeting, they received comprehensive information about the study and were required to provide informed consent, which also involved permission to recruit their partners. During the same meeting, the eligibility of both partners was evaluated, leading to the exclusion of 49 other patients (12%). Out of the remaining 359 eligible dyads, 228 (either patient or partner) declined to participate (63.5%). In the end, 131 couples (36.5%) took part in the baseline assessment; of these, 94 couples (71.8%) completed the daily diary assessment period.

During the first session, the participants completed the baseline online questionnaires. The couples were then introduced to the 21-day daily diary assessment protocol and were instructed on how to complete it. They could choose whether to receive the daily online questionnaires via smartphone or email. A research assistant contacted any participant who failed to complete two or more diary entries in a row. The participants were asked to complete all the questionnaires separately. Nine participants had no Internet access and therefore were provided with printed copies of the questionnaires. For compensation, the couples were given gift cards worth US$220. The couples' diary data were used when both patient and partner had a minimum of five diary entries (there was a 28.2% drop-out rate during the study). No significant differences in illness severity, relationship duration, age, or socioeconomic status were found between couples who completed the diary assessment and couples who only completed the first session. On average, patients completed 19.1 (SD = 3.7) diary entries, and the partners completed 18.4 (SD = 4.0).

Sample characteristics

In the current study, the mean age was 57.7 (range: 35–90, SD = 10.3) for patients and 54.6 (range: 35–73, SD = 9.9) for their female partners. Couples had been married or cohabiting for an average of 29.6 years (range: 1–55; SD = 13.5) and had an average of 3.12 children (range: 1–11; SD = 1.7). Almost half of the sample (46.2%) defined their socioeconomic status as high, 31.5% defined their socioeconomic status as average, and 22.3% as below average. Most patients (92.4%) and partners (89.7%) had a high-school

education, and most patients (65.6%) and partners (68.50%) had a part- or full-time job at the time of the study. In Israeli society, the notion of ethnicity is best characterized by religion and religious beliefs. In the current sample, 167 (88.8%) described themselves as Jewish, 1 (0.5%) described herself as Christian, and the rest did not report any affiliation with religion (11.7%). In addition, 35 (18.6%) described themselves as religious, 44 (23.4%) described themselves as traditional, 88 (46.8%) described themselves as secular, and 1 (0.5%) described himself as atheist. The rest (10.6%) did not report on their religious beliefs. All couples self-identified as man-woman couples.

Measures

Demographic information. At the baseline assessment, the participants completed a demographic questionnaire where they indicated their age, relationship duration in years, number of children, level of education (1 = elementary to 6 = PhD), subjective socioeconomic status (1 = much above average to 5 = much below average), and employment status (1 = full-time job; 2 = part-time job; 3 = unemployed; 4 = retired; 5 = on sick leave; 6 = other).

Physical activity. The patients and their partners reported their daily physical activity by responding to the following item: "If you engaged in physical activity today, please describe the type of activity and its duration." Participants could choose up to three types of activities and respond on a scale ranging from 0–100 minutes for each activity. The total daily minutes were calculated for each participant as the sum of their daily activities. Due to the very small number of responses of more than 100 daily minutes ($N = 150$, 4%) of physical activity, this variable was transformed to a maximum score of 100 minutes. As a sensitivity test, we reran the analysis using the original, untransformed scale (i.e., including values exceeding 100 minutes) but found that the overall pattern of results remained the same.

Relationship satisfaction. The patients and partners reported their daily relationship satisfaction on the four-item Couples Satisfaction Index (CSI-4; Funk & Rogge, 2007), which ranged from 0–5. The items were adapted to reflect daily relationship satisfaction (e.g., "*Today*, I felt that I had a warm and comfortable relationship with my partner"). Following the multilevel reliability approach of DiGiovanni et al. (2023), which accounts for dyadic and nested data structures, we treated partners as indistinguishable, and obtained several reliability components: First, the between-couple reliability was = .63, indicating the scale differentiates couples and therefore can be averaged to create a single dyadic score. We also obtained between-person-within-couple reliability = .99 reflecting stable differences between the two partners in a given couple and a reliability of change (day-to-day fluctuations within persons) = .80. Variance-component decomposition showed that 30.5% of the total variance lay between couples, indicating that some couples are systematically higher or lower in relationship satisfaction compared to others. Another 23.1% was attributable to between-person-within-couple differences, reflecting individual tendencies within couples. Additionally, 13.9% of the variance was at the couple-by-day level, suggesting that couples experience some shared daily fluctuations (e.g., both partners having "good" or "bad" relationship days together), and 13.0% was at the person-by-day level, indicating that

individuals' day-to-day swings in satisfaction are also substantial. Accordingly, we derived one between-dyad relationship-satisfaction score per couple: (a) we averaged the four CSI items within each day, (b) averaged those daily means across the 21 days for each partner, and (c) averaged the two partner means to yield a single dyadic value.

Data analytic approach

The data had a multilevel structure of diary days (Level 1) nested within persons (Level 2), who were themselves nested within dyads (Level 3); operationally, days are crossed with persons, so we used a mixed-effects framework that accounts for both within-person and within-dyad dependence. Following practices in dyadic modeling (DiGiovanni et al., 2024), we implemented a non-directional model to examine daily physical activity concordance, ensuring that results were not contingent on the designation of either partner as the predictor or outcome.

To account for possible time trends in physical activity across the 21-day diary period, we first regressed each individual's raw physical activity scores on time (days) to remove any systematic changes over time:

$$PA_{\text{ti}} = \beta_0 + \beta_1 \cdot \text{Time}_{\text{ti}} + e_{\text{ti}}$$

Where PA_{it} represents the raw daily physical activity score on day t for individual i, β_0 is the intercept, β_1 Time_{ti} represents the linear trend over time, and e_{ti} represents the residualized variation in physical activity after accounting for linear trends. The residuals from this regression were extracted and z-scored to remove between-person differences in mean levels and variances. This process yields a standardized, detrended physical activity measure:

$$PA_{\text{ti}} = \frac{e_{it} - \overline{e}_i}{\sigma_{e_i}}$$

To assess daily concordance in partners' standardized physical activity levels, we then estimated a two-level model using the *lmerTest* package (Kuznetsova et al., 2017). An intercept-free model was specified because each participant's physical activity scores were individually z-scored, eliminating individual differences in the intercept (DiGiovanni et al., 2024). In this framework, patients' time-residualized, z-scored physical activity level served as the outcome, while partners' corresponding time-residualized, z-scored physical activity level was included as a Level 1 predictor.

At Level 2 (between dyads), we included each couple's average relationship satisfaction as a cross-level moderator, examining how satisfaction influenced daily concordance. This relationship satisfaction variable was grand mean centered, allowing us to interpret the main concordance effect at the sample-average level of satisfaction and to see how deviations from this average moderated the within-dyad physical activity concordance. Additionally, relationship satisfaction was not modeled as a direct predictor of physical activity; since z-scoring was applied within-person, any between-dyad differences were removed from the dependent variable. As a result, there was no meaningful variance left at the dyadic level for relationship satisfaction to explain.

Therefore, the level-1 equation (within-person, within-dyad) was:

$$\text{Pt\_PA}_{\text{td}} = \beta_{\text{d1}} \cdot \text{Pr\_PA}_{\text{td}} + r_{\text{td}}$$

where: Pt_PA_{td} is the detrended, standardized physical activity score for the patient from dyad d on day t, Pr_PA_{td} is the detrended, standardized physical activity score for the partner on the same day, β_{d1} represents dyadic concordance, and r_{td} is the within-dyad residual variance.

The Level-2 equation (between-dyad, cross-level moderation by relationship satisfaction) was:

$$\beta_{\text{d1}} = \gamma_{10} + \gamma_{11} \cdot \text{RS}_{\text{dyad}} + u_{\text{d}}$$

where: γ_{10} represents the average dyadic physical activity concordance, γ_{11} captures the moderating effect of relationship satisfaction (RS) on concordance, and u_{d} is the between-dyad residual variance of concordance.

Results

Preliminary analysis

Table 1 presents the descriptive statistics for the variables. As the table shows, patients engaged in more physical activity than their partners, both in terms of days in which some physical activity was reported (69% vs. 39%) and in terms of the average total time across the diary period (M = 35.41 vs. 19.54 minutes). A multi-level model indicated that patients reported significantly more physical activity minutes (*Est.* = 15.56, SE = 0.37, $p < .001$). In addition, patients' and partners' daily physical activity was positively associated with each other. We ran an unconditional two-level model and found that 25.19% of the variance in patients' physical activity was at the between-person level, indicating that this variable mostly varied at the within-person level. In other words, while there were consistent differences in physical activity levels among patients, a significant amount of variability was observed within individuals across different time points.

Table 1. Descriptive statistics and zero-order correlations.

					Zero-order correlations[a]			
Variable	*M*	*SD*	Range	PA days (%)	1	2	3	4
1. Patients' PA	35.48	31.44	0–100	69	—	.22***	.12***	.08**
2. Partners' PA	19.31	29.91	0–100	39		—	.16***	.18***
3. Patients' RS	14.19	4.67	0–21				—	.54***
4. Partners' RS	13.17	5.27	0–21					—

Note. PA = physical activity. RS = relationship satisfaction. *$p < .05$. **$p < .01$. ***$p < .001$.
[a]The zero-order correlations were computed using the participants' means across the diary period.

Although age and socioeconomic status have been linked to physical activity (Gidlow et al., 2006; Sun et al., 2013), these variables could not be included in our final model due to the within-person standardization of the outcome, which eliminates between-person variance. However, to assess their potential effect, we tested a model with age and socioeconomic status as Level-2 predictors. Neither age (*Est.* = 0.26, *SE* = 0.21, $p = .22$) nor socioeconomic status (*Est.* = 2.55, *SE* = 2.02, $p = .21$) significantly predicted physical activity, supporting their exclusion from the primary model.

Dyadic concordance mixed model

As noted above, to test whether partners' daily physical activity was associated with patients' daily physical activity, we fit a two-level non-directional mixed-effects model (DiGiovanni et al., 2024). Notably, 16 couples could not be included in this part of the analysis because at least one partner did not report any physical activity across the diary period, making it impossible to compute residual scores for those dyads. As shown in Table 2, there was a significant positive main effect of day-level partners' physical activity on patients' physical activity ($\beta = 0.12$, $SE = 0.03$, $p < .001$). This indicates that according to H1, on days when partners engaged in higher-than-usual physical activity, patients also tended to increase their own activity.

Cross-level moderation of couple-level relationship satisfaction. Contrary to our second hypothesis, the cross-level interaction between partners' physical activity and couples' average relationship satisfaction was not significant ($\beta = 0.00$, $SE = 0.01$, $p = .98$), suggesting that relationship satisfaction did not moderate day-to-day physical activity concordance.

Variability in physical activity concordance among couples. To capture the possibility that couples differ in how strongly they show concordance in physical activity, we fit a non-moderated non-directional model (without including relationship satisfaction as a moderator) in which the effect of partners' daily physical activity on patients' daily physical activity was allowed to vary across dyads. We extracted slopes from this simpler model because it reflects the unconditional heterogeneity in concordance; the random-slope variance was virtually identical when the (non-significant) physical activity × relationship-satisfaction term was included, so no information was lost while the

Table 2. Results of multilevel model examining daily physical activity concordance.

Effect	*Est.* (*SE*)	df	*t*	*p*	95% CI
Day-level partners' PA	0.115 (0.032)	63.22	3.63	<.001	[0.053, 0.178]
Day-level partners' PA X person-level patients' RS	0.000 (0.009)	61.82	0.03	.976	[−0.017, 0.017]

Note. PA = physical activity. RS = relationship satisfaction. CI = confidence intervals. All physical activity variables were residualized for time trends and z-scored within-person before analysis.

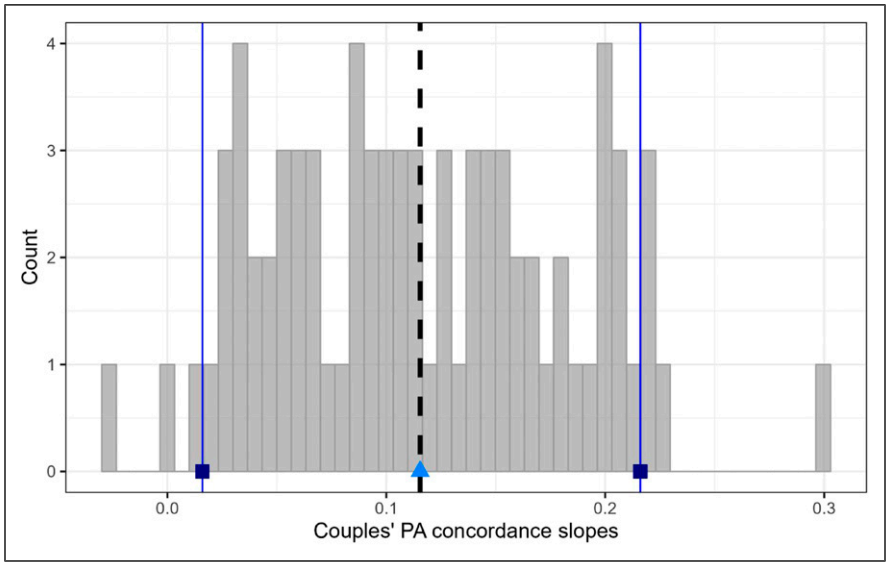

Figure 1. Distribution of couple-specific physical activity concordance slopes. *Note.* PA = physical activity. The dashed vertical line represents the fixed effect, while the solid blue lines mark the 2.5% and 97.5% quantiles.

interpretation remained cleaner. This approach yielded a random slope $SD = 0.14$ (95 % CI = 0.00–0.47), indicating that some couples displayed stronger physical activity concordance than others. Figure 1 presents a histogram of the estimated couple-specific slopes. Consistent with the fixed-effects estimate, the average couple-specific slope was also 0.12. However, the random slope distribution demonstrated meaningful heterogeneity. Just over half of all couples (52.6%) had a slope below 0.12, whereas 47.4% had a higher-than-average slope. More specifically, only one couple (1.3%) exhibited negative concordance; 34 couples (43.6%) fell within the lower range of concordance ($0 \leq$ slope <0.10); 35 couples (44.9%) were in the mid-range ($0.10 \leq$ slope <0.20); and eight couples (10.3%) were in the high range, with slopes exceeding 0.22.

Discussion

Physical activity is a critical component of rehabilitation from ACS, a severe and common heart condition (Dibben et al., 2023; Bhatt et al., 2022; Göritz & Rennung, 2019). Nevertheless, adherence to recommended physical activity guidelines is often challenging for patients (Stonerock & Blumenthal, 2017). Previous studies have documented the significant role played by romantic partners in each other's health behaviors (e.g., Jackson et al., 2015; Christakis & Fowler, 2008

Cobb et al., 2014; US dollar et al., 2009; Homish & Leonard, 2008). One manifestation of this interdependence is the often observed concordance in partners' health-related

behaviors, including their physical activity (Arden-Close & McGrath, 2017; Jackson et al., 2015). The current study aimed to examine, for the first time, the level of concordance in physical activity between heterosexual couples after the male partner's first ACS. We also examined the interplay between couples' satisfaction and physical activity concordance. We expected that when couples were satisfied with their relationship, they would exhibit greater physical activity concordance, since they were more likely to share a lifestyle and provide support for each other's health-related attitudes and behaviors.

Daily concordance in physical activity

Utilizing daily diary data from cardiac patients and their partners, the couples' concordance was examined at the within-person level. Consistent with our first hypothesis, we found that on days when partners reported higher-than-usual physical activity, patients also tended to engage in higher levels of activity themselves. This positive association highlights the central role that romantic partners can play in influencing one another's rehabilitative efforts, aligning with previous work demonstrating couples' concordance in physical activity (e.g., Harada et al., 2018; Martire et al., 2013; Pauly et al., 2020). However, in contrast to our prediction, couples' daily physical activity concordance was not moderated by their relationship satisfaction, indicating that couples' daily activity levels remained concordant regardless of their average couple-level relationship satisfaction.

Interestingly, while the majority of couples showed a positive association in their day-to-day activity levels, a considerable portion exhibited only modest associations, and a smaller group demonstrated little or no concordance or even negative associations (i.e., one partner was more active primarily on days when the other was less active). This pattern reveals how partners' daily behaviors align with one another in varying degrees. These findings suggest that patients with ACS and their partners may influence each other's physical activity on a daily basis. Our results highlight potential avenues to enhance adherence to physical activity recommendations among cardiac patients by leveraging couples' interdependence. For example, incorporating both partners into rehabilitation interventions may be a valuable strategy to boost the efficacy of these interventions (Sher et al., 2014).

However, the observed variation in physical activity concordance suggests that couples may differ in how their exercise habits align, suggesting that not all couples may benefit equally from a dyadic approach. Future research might explore which dyadic and contextual factors (e.g., shared schedules, emotional closeness, or conflicts over exercise preferences) underlie this variability in couple-specific concordance. Identifying the characteristics of couples who display particularly strong or weak day-to-day concordance may not only illuminate new avenues for tailoring cardiac rehabilitation to each couple's unique interaction style but also help determine who would benefit most from a dyadic intervention versus an individual-focused approach, thereby optimizing the allocation of resources.

The idea of a dyadic approach to rehabilitation is consistent with Transactive Goal Dynamics Theory, one of the main models addressing goal interdependence in close relationships (Fitzsimons et al., 2015). This model posits that goal pursuit is more

effective when partners' goals are linked and coordinated. A recent meta-analysis found that dyadic interventions for physical activity tended to be more effective than interventions targeting individuals (Carr et al., 2019). Interestingly, this meta-analysis indicated that when both members shared the same physical activity goal (i.e., have the same goal for one target person in the couple), the effect size was larger. Therefore, although involving both partners in the rehabilitation may be beneficial, the intervention should still prioritize the patients if the ultimate goal is to increase patients' physical activity.

It is important to note that in our sample, the male patients were more physically active than their female partners. This pattern is consistent with findings that in the general population, men tend to be more physically active than women (Hallal & Andersen, 2012; Trost et al., 2002). However, it may also be related to the fact that the rehabilitation program from which the sample was recruited targeted the patients' physical activity. Supporting individuals with chronic illnesses can place a significant burden on caregivers, leading to neglect of their own physical and mental well-being, (Adelman et al., 2014; Pinquart & Sörensen, 2003). Given the limited opportunities for engaging in health behaviors due to caregiving demands (Schulz & Beach, 1999), dyadic physical activity interventions may prove to be particularly beneficial for caregivers, especially in the case of female caregivers, who are at a higher risk of experiencing a caregiver burden (Adelman et al., 2014).

It is also important to note that this study was conducted in Israeli society, a cultural context characterized by strong family ties and interpersonal interdependence (Kagitcibasi et al., 2010; Litwin et al., 2008; Silverstein et al., 2010). Prior research has suggested that in cultures where close-knit familial and social bonds are emphasized, couples may be more likely to rely on one another and motivated to promote each other's goals (Markus & Kitayama, 2014). This cultural backdrop may have shaped the observed physical activity. Future research should examine whether similar patterns emerge in societies with differing cultural orientations toward interdependence and individualism.

The role of relationship satisfaction

Satisfying intimate relationships contribute to various salubrious health outcomes (Berkman et al., 2000; Robles et al., 2015). However, contrary to our second hypothesis, we found no evidence that couples' average level of relationship satisfaction moderated day-to-day physical activity concordance. This result diverges from prior studies suggesting that relationship satisfaction can bolster concordance in health behaviors (Burleson & Denton, 1992; Meiklejohn et al., 2012; Sher et al., 2014). One interpretation is that relationship satisfaction exerts more distal or indirect effects on health behavior coordination, rather than driving immediate, day-to-day co-fluctuations in activity. Indeed, couples experiencing high satisfaction might offer more general support or encouragement (Campbell et al., 2005; Rafaeli, 2009), but the actual decision to be active on a given day may arise more on proximal factors (e.g., available time, fatigue, mood) than on global relationship quality. Alternatively, in the high-stakes context of ACS rehabilitation, patients may pay close attention to their partners' physical activity regardless of their broader relationship dynamics, leading to widespread daily concordance irrespective

of satisfaction levels. Further investigation is needed to unpack how relationship satisfaction might manifest more subtly, such as in long-term adherence or in couples facing greater relationship strains.

Together, these results emphasize the potential utility of designing couple-oriented interventions for cardiac rehabilitation. Even without pronounced differences in relationship satisfaction, many couples appear to spontaneously shape each other's daily behavior. By capitalizing on this dynamic, rehabilitation programs might encourage partners to jointly schedule or monitor physical activity to amplify adherence. While global relationship satisfaction did not directly shape these daily processes, couple-based approaches may still be worthwhile if they focus on concrete strategies for co-managing daily routines or overcoming day-to-day barriers, rather than relying primarily on global relationship quality to facilitate change.

Limitations and future directions

The daily diary method used in the current study has a significant advantage in terms of ecological validity, since it makes it possible to capture events in the partners' lives within their natural contexts (Bolger et al., 2003). However, this method relies on self-report data which are susceptible to various biases (e.g., recall bias), thereby limiting the internal validity of the results. Future studies should incorporate different operationalizations of physical activity to better understand the effects we examined. This could include objective measures such as wearable devices or accelerometers, which provide more accurate data and control for different physical activity intensities (Prince et al., 2008).

One important limitation of our approach is that our concordance estimate is averaged across all days of the study, which may mask day-to-day fluctuations within couples. A couple could exhibit negative concordance on some days and positive concordance on others, averaging out to a near-zero effect overall. Future research could extend the daily diary period or employ dynamic modeling approaches (e.g., time-series or phase-based analyses) to capture shifts between periods of high and low (or negative) concordance. Such designs may illuminate the temporal patterns of concordance, offering finer-grained insights into how couples' activity levels co-fluctuate or diverge over time.

Furthermore, our data do not provide meaningful information on causality and hence leave some key questions unanswered. For instance, we cannot determine whether partners' activity led patients to become more active (and thus, to show day-level physical activity concordance), or if the reverse relationship holds true. Further research is warranted to explore the underlying mechanisms responsible for physical activity concordance. For example, the motivational theory of role modeling (Morgenroth et al., 2015) suggests that the social influence of role models operates through three distinct yet interconnected functions. Role models (a) act as behavioral models through observational learning, (b) represent the attainability of a specific goal thus showcasing that the desired outcome is achievable, and (c) serve as a source of inspiration, motivating others to strive towards similar goals. It is important to assess these mechanisms in future studies to achieve a better understanding of the extent to which each contributes to physical activity concordance.

Another limitation of the current study stems from the composition of our sample, which consisted of male patients and their female partners. This recruitment decision was guided by the fact that women who experience a cardiac event are likely to be older and widowed (Tsao et al., 2022). These gender-related differences present potential challenges when recruiting female patients with a partner. It is likely that different findings would emerge if the sample had included women as patients and men as their partners. Finally, our study followed participants' physical activity in the immediate aftermath of the patient's cardiac event. While longitudinal studies have shown higher physical activity levels during the six months after a cardiac event (Adorni et al., 2022; Greco et al., 2021), it is worth considering that this initial phase may represent a period when patients are particularly motivated to change their behavior or when partners provide greater caregiving, leading to increased commitment to the rehabilitation goals. To better understand how couples' physical activity concordance develops over extended periods, long-term assessments are essential.

Summary

The current study focused on the physical activity concordance between ACS patients and their romantic partners. We found a day-level concordance in couples' physical activity, while relationship satisfaction did not significantly moderate this day-to-day effect. These findings highlight the potential benefits of incorporating partners into rehabilitative interventions to enhance physical activity in patients with ACS. Future research is needed to explore causal dynamics, the underlying mechanisms, and the evolution of physical activity concordance over time.

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Open research statement

As part of IARR's encouragement of open research practices, the authors have provided the following information: This research was not pre-registered. The data used in the research can be publicly posted. The data can be obtained at: https://osf.io/2d67a/?view_only=9323a56e02af416a856ecd699ceecfd8. The analytic code used in the research can be publicly posted. The code can be obtained at: https://osf.io/2d67a/?view_only=9323a56e02af416a856ecd699ceecfd8. The materials used in the research cannot be publicly shared but are available upon request. The materials can be obtained by emailing: ophirlesh@gmail.com

Ethical statement

Ethical approval

This study was approved by the Chaim Sheba Medical Center Research Ethics Committee (approval no. 3251–16-SMC) on May 29, 2017.

Informed consent

All participants provided written informed consent prior to enrolment in the study.

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Data Availability Statement

The datasets generated during and/or analyzed during the current study are available in the Open Science Framework (OSF) repository, https://osf.io/2d67a/?view_only=bd328bf63226438ab53438a096b517ce

Supplemental Material

Supplemental material for this article is available online.

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