



Couples-based health behavior change interventions: A relationship science perspective on the unique opportunities and challenges to improve dyadic health

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ABSTRACT

Epidemiological studies indicate that better marital quality is associated with less morbidity and premature mortality. A number of interpersonal processes related to marital quality are also associated with health-relevant surrogate biomarkers across different physiological systems. Despite these replicated correlational findings, few interventions have harnessed interpersonal processes as potential interventions to enhance health. Building on Dr. Janice Kiecolt-Glaser's model of relationships and health, we propose that couples-based health behavior change interventions may represent an effective way to decrease dysregulation across autonomic, endocrine and immune systems and, ultimately, improve dyadic health. Given that the cohabiting partner is an essential part of the social context in which the behavior change is being pursued, it is important to consider the relational issues triggered by dyadic interventions. Using a relationship science perspective, this article reviews the literature on couples' concordance in health behaviors and health outcomes, the potential pathways underlying this concordance, theories of the couple as a self-sustaining social system, dyadic adaptation of individual self-regulation strategies, effective and ineffective social support and social control in couple relationships, the integration of relationship-building and health behavior change strategies, and the consideration of key moderators related to the nature of the relationship and the context surrounding the relationship. These findings highlight the importance of adopting a relationship science perspective when designing and testing dyadic interventions to improve health outcomes. The data reviewed provide insights on how to optimize couples-based health behavior change interventions to reduce physiological dysregulation and improve dyadic health.

Epidemiological studies indicate that individuals in a long-term committed relationship live longer than their unmarried counterparts [1]. Relatedly, relationship ruptures, such as separation, divorce, or bereavement, are associated with transient increases in morbidity and mortality risk [2,3]. However, being in a marital-like relationship is not always protective. The quality of the couple's relationship also matters for health outcomes [4]. One's spouse can be a main source of stress and conflict in some couples [5]. Conversely, couples reporting high relationship quality may be more susceptible to the social contagion of stress and poor health within their relationship [6]. Spouses are thus mutually influencing each other's health trajectories over time.

Dr. Kiecolt-Glaser and colleagues [7–9] have proposed comprehensive models detailing biopsychosocial pathways through which both marital strains and support are associated with health outcomes. Broadly speaking, marital quality is thought to influence social-cognitive processes, emotion regulation, as well as health behaviors. Negative marital interactions elicit stress-related changes in autonomic, endocrine, and immune functioning, while marital support may protect against stress-related immune dysregulation. In particular, negative marital interactions are associated with the overproduction of

inflammatory mediators leading to chronic low-grade inflammation, which is associated with risk for a range of age-related chronic diseases [8]. Importantly, there are reciprocal relationships among the psychological, behavioral, and physiological processes underlying the effects of close relationships on health over time. For example, both poor sleep and a diet high in saturated fat increase stress-related production of proinflammatory cytokines following a marital conflict [10,11].

Given the growing recognition of the role of close relationships in health, there have been calls for the development of relational interventions to improve health outcomes [12,13]. In an effort to do so, relational interventions may target different psychological, behavioral, social, or physiological mechanisms. We propose that couples-based health behavior change interventions might be uniquely suited to promote optimal dyadic health. Modifiable health behaviors account for about 40% of the early mortality in Western countries [14]. These health behaviors are influenced both directly and indirectly by one's spouse. Failure to consider the social context in which the health behavior change is being pursued may undermine intervention effectiveness. However, including both partners in a dyadic intervention can also activate unhelpful relational dynamics. In order to be effective, these

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dyadic interventions have to consider and address these relational issues. Simultaneously, these dyadic interventions also provide an opportunity to work on spousal support processes and stressful couples' interactions through the health behavior change process. This paper reviews factors related to the degree of concordance in health outcomes among couples and the unique relational issues encountered when delivering health behavior change interventions to spouses. This review focuses mostly on diet and physical activity, although similar issues are likely present for other health behaviors.

1. Couples concordance in health behaviors and health trajectories

Couples exhibit significant concordance in the extent to which they engage in health behaviors. In cross-sectional studies, small to moderate within-couples correlations have been observed in diet-related behaviors, including total caloric intake [15–17], overall diet quality [18], consumption of foods high in sugar, fat, and salt [19–21], and consumption of fruits and vegetables [19,22–24]. In longitudinal studies of cohabiting couples, a partner's dietary habits became more similar to the other partner's eating patterns over time [25,26]. Similar concordance is also observed for physical activity and sedentary behavior. In a dyadic daily diary study, patients with knee osteoarthritis reported walking more steps on days when their partners were more physically active than usual [27]. Dyadic actigraphy assessments have shown couples' concordance in moderate-vigorous physical activity as well as sedentary behavior, particularly television watching [28,29]. In a 6-year longitudinal study, changes in exercise frequency were correlated among couples [30]. Importantly, couples who exhibit greater spousal concordance in negative health behaviors also display greater synchrony in poor health trajectories over time [31].

A number of reviews have reported positive within-couple correlations for several cardiovascular risk factors, including diastolic blood pressure, triglycerides, low-density lipoprotein cholesterol, and inflammatory markers, such as C-reactive protein and fibrinogen [32,33]. The risk associated with poor spousal health is substantial. A meta-analysis indicates that a partner's history of diabetes or prediabetes increases diabetes risk by 26% for the other partner [34]. Similarly having metabolic syndrome increases spousal risk for metabolic syndrome by 30% [35]. In the Framingham cohort study, when one spouse developed obesity, the partner's obesity risk increased by 37% over 32 years [36]. In a 25-year follow-up of the Atherosclerosis Risk in Communities cohort, when one partner became obese, the obesity risk almost doubled for the other partner [37]. Furthermore, in an 8-year longitudinal study, a partner's elevated body mass index was associated with one's risk of developing type 2 diabetes over time [38].

A number of large-scale epidemiological studies have assessed spousal concordance across several cardiovascular risk factors. These studies often used the American Heart Association's "Life Simple 7" to define poor cardiovascular health by classifying 7 modifiable risk factors, i.e., smoking status, body weight, total cholesterol, blood glucose, physical activity, and diet, as ideal, intermediate, or poor [39]. In a study of 5364 married couples or domestic partners in the USA, both partners had nonideal cardiovascular health in 79% of the couples. This effect was largely driven by concordance in elevated body mass index, poor diet, and physical inactivity, and was maintained at the 5-year follow-up [18]. Nearly one out of four couples were comprised of partners presenting concordant physical inactivity, poor diet, or elevated body mass index [18]. Similar spousal concordance in composite metrics of cardiovascular health has also been observed in epidemiological studies in Japan [40], Korea [41], and Ireland [42]. In a comparison of population-based cohorts in different countries, couples' concordance in hypertension was seen in the USA (38%), England (47%), India (20%), and China (21%) [43], highlighting the cross-cultural nature of this phenomenon. These data suggest that a large proportion of individuals in a committed relationship share

multiple cardiovascular risk factors with their spouse.

2. What gives rise to couples' concordance in health?

Assortative mating, the non-random selection of partners with similar characteristics, accounts for some of the spousal concordance in health. For example, individuals tend to select partners with similar weight status [44] and cardiovascular risk factors [45]. Furthermore, individuals' health behaviors tend to converge with those of their spouse over time. In a 4-year longitudinal study of newlyweds, a spouse's poorer pre-marital diet quality was associated with negative changes in diet quality for the other partner [25]. Similarly, weight gain trajectories over time tend to be correlated among cohabiting partners [44,46]. Concordance in health outcomes is more pronounced in older adults who have been cohabiting with their spouse for several decades [47].

Convergence in health trajectories over time is attributable to several factors, including influences external to the couples [6]. Spouses share environmental exposures such as air pollution, neighborhood quality, and housing quality. Due to their pooled economic assets, they share financial strains and resources. They often experience major life events and life transitions together leading to shared stress exposure. Even when a stressor is not directly impacting both partners, stress spillover and crossover processes may lead to increased stress for the "unexposed" partner. In a classic study of air traffic controllers, on days when there was more air traffic than usual, both the employee and their spouse reported more conflict and withdrawal in their relationship at night, indicating that work stress spilled over into the romantic relationship, thereby creating stress for both spouses [48].

Furthermore, partners tend to have similar social networks comprised of family and friends. This shared social network shapes social norms and the social pressure felt to engage in or avoid certain health behaviors. Descriptive norms (i.e., what we perceive others are doing), and injunctive norms (i.e. what we perceive others would approve of) from social network members influence weight-related behaviors more than broader social norms [49].

Convergence in health may also be due to shared exposure to viral and bacterial pathogens. Given their cohabitation and sexual activity, spouses are likely to be exposed to each other's viral and bacterial illnesses. Herpesvirus infection is a good example of this phenomenon. To avoid being cleared by the host's immune system, viruses from the herpesvirus family transition into a latent state that is undetectable by the host's immune system after the primary infection. Reactivation of these opportunistic viruses occurs when cellular immunity wanes. Kiecolt-Glaser et al. [50] have conducted seminal work showing that psychological stress can lead to the reactivation of latent viruses. Latent herpesvirus reactivation can then increase the risk of viral transmission to the partner even after the initial infection and promote immune dysregulation in both partners. For example, having a spouse with herpes simplex virus-2 is a risk factor for HSV-2 seroconversion over time [51]. Similarly, kissing, touching and sexual behaviors lead to exchange of saliva and other biological fluids that can influence partner's gut microbiota, the diversity and richness of the microbes colonizing one's gut [52]. Couples' concordance in gut microbiota profile is more pronounced among couples who have a closer relationship [53]. Poor marital quality has also been associated with changes in the gut microbiota via changes in depressive symptoms. Further, poor marital quality was also associated with increased permeability of the gut barrier leading to greater translocation of bacterial endotoxin into blood circulation, a process that can contribute to chronic low-grade inflammation [54].

Convergence in health is also related to shared daily routines and the co-creation of a home environment that facilitates or hinders certain health behaviors. For instance, spouses are the most frequent regular eating companion [55]. They are often involved in meal planning, purchasing, and preparation. They influence the type of food that is brought into the house [56]. From an operant conditioning perspective,

they provide both verbal and nonverbal positive reinforcements for the preparation or purchase of certain foods by the other partner. Due to social modelling, one partner influences the other spouse's food diversity and quantity. Partners are also in a unique position to monitor, comment, and reinforce their partner's food choices and eating-related behaviors [57]. Similarly, partners play a key role in determining access to home exercise equipment [58], and the number of televisions in the house [59]. Partners also influence whether leisure time is spent doing physical or sedentary activities [60]. Ewart's Social Action Theory [61] highlights that health habits and daily routines follow predictable scripts, action sequences in which successive events are reinforced by the previous action and guide the next action in a process that occurs largely outside of conscious awareness. Importantly, one's action scripts are socially intertwined with action scripts of the spouse and other family members, making them harder to change without considering the social context.

In long-term, committed relationships, spouses also tend to incorporate their partner in their cognitive representation of the self [62]. In this context, the spouse can provide opportunities for self-expansion when the partner's resources, interests, and identities are starting to be seen as one's own to some extent [63]. This suggests that when one partner self-categorizes themselves or develop an identity as a physical active person, it may be protective for both partners [64]. We-ness or we-talk, the use of first-person plural pronouns ("we") over the use of singular pronouns ("I") when describing personal or relationship events, is an implicit linguistic marker of interdependent self-construal [65]. High we-ness has been associated with greater relationship satisfaction both cross-sectionally and longitudinally [66,67]. Partner we-ness also buffered spouses' physiological reactivity during a marital conflict discussion [68,69]. Among patients with type 2 diabetes, partners we-ness was associated with better patient self-care behavior, including healthier diet and regular physical activity. However, interdependent self-construal can also increase social contagion of poor health in some contexts. Among couples in which both partners engaged in emotional eating, high we-ness was associated with greater body mass index, particularly among women [70]. Similarly, in a sample of knee osteoarthritis patients and their partners, higher patient pain on a given day was associated with their spouse's poorer sleep that night, and this effect was more pronounced among those reporting more interdependent self-construal [71].

In addition to these unintentional influences, individuals often actively engage in intentional attempts at changing their partner's behaviors [72]. Health-related spousal social control is defined as an individuals' attempt to influence, regulate, or constrain their spouse's health-related behaviors [73]. About 95% of cohabiting spouses report trying to influence their partner's health-related behaviors, with diet and physical activity being the most common targets of these social control attempts [74]. Health-related social control may operate indirectly by promoting the internalization of a sense of obligation toward close others to engage in or avoid certain health behaviors in order to be able to perform meaningful social roles. Social control can also act directly by reminding or encouraging the spouse to engage in health-promoting and avoid health-compromising behaviors [73]. Spousal health-related social control behaviors can take different forms [75]. Some are positive including reminding, encouraging, persuading, or modelling the behavior, while others are negative, such as nagging, pressuring, or inducing guilt [75]. A meta-analysis of cross-sectional studies indicates that positive social control strategies are associated with improved health behaviors, while there is a negative, but not significant association between negative spousal control strategies and health behavior change [76]. In longitudinal studies, negative social control is often associated with poorer lifestyle behaviors over time [77, 78].

The dual effects model of social control suggests that social control attempts carry both benefits and costs [79]. Although they may promote a healthier lifestyle, social control attempts can also generate

psychological distress for the receiving spouse. They may lead to feelings of guilt and shame by signaling that the person is not independently managing their health and not living up to their partner's expectations. They may also be perceived as intrusive and lead to feelings of frustration and resentment. In certain circumstances, social control attempts can backfire and elicit psychological reactance and attempts to regain autonomy by ignoring the partner's influence attempt, hiding unhealthy behaviors from the spouse, and even doing the opposite of what is suggested [75,80]. For example, in a daily diary study of osteoarthritis patients, patients had lower physical activity on days when their partner pressured them to be more active [27]. The contextual model of social support proposes that relationship quality moderates the impact of social control attempts. Spouses who report poor relationship quality are more likely to construe social control attempts as coercive and controlling [81]. Individuals dissatisfied in their romantic relationship were more likely to engage in behavioral resistance in response to social control attempts, compared to individuals reporting better relationship quality [82].

3. Couples-based interventions for health behavior change

Early studies of couples-based weight management show a small advantage of couples-based interventions over individual interventions at post-treatment. However, this advantage disappeared at follow-up assessments [83]. In a later meta-analysis, dyadic interventions were more effective at promoting physical activity than individual interventions, but couples-based interventions were no more effective than other types of dyads, such as friends or coworkers [84]. In two larger-scale studies, intensive couples-based interventions outperformed individual interventions on some health behaviors, but not all pre-specified outcomes [85,86]. In a meta-analysis examining HIV relevant behaviors, including condom use, HIV testing, and medication adherence, couples-based interventions outperformed individual interventions [87]. In another review on a range of health behaviors, Arden-Close & McGrath [88] reported that about half of couples-based interventions led to superior outcomes compared to individual interventions, highlighting significant heterogeneity across studies. More research is needed to determine in which context couples-based interventions outperform individual interventions in promoting sustained health behavior change. The dual model of social control suggests that couples-based interventions may inadvertently elicit psychological distress and relationship stress, which may undermine long-term health behavior change [79]. In order to be maximally effective, couples-based interventions may need to pay attention and address the unique relational issues triggered by the spouses' shared participation in the intervention. Table 1 summarizes five fundamental issues to consider in designing couples-based health behavior change interventions.

4. The couple as a self-regulating system

Cohabiting partners are an integral part of the relational context in which the health behavior change process is being pursued. Partners co-create a home environment that will promote or hinder certain health behaviors. Many theories view the couple as a system that is more than the sum of its parts. According to the Transactive Goal Dynamics theory, two interdependent individuals within a couple relationship are best conceptualized as a single self-regulating system in which resources are pooled, rather than two self-regulating agents [89]. The model highlights that close others can have both positive and negative effects on goal progress. Transactive gains, a state of enhanced goal achievement due to the partners' direct or indirect involvement in goal pursuit, is more likely to occur when opportunities and motivation for interdependence occurs in the context of effective goal coordination. Goal coordination involves the efficient use of the couples' pooled goal-relevant resources, which is most likely when both partners engage in goal facilitating action, efficiently divide goal pursuits, and minimize goal

Table 1
Five key issues to consider in the development of couples-based health behavior change interventions.

Opportunities and Challenges	Unanswered Questions/ Future directions	Relevant Theories
<i>In which context does a couple-based approach lead to better outcomes than an individual approach?</i>		
Couples-based interventions may lead to changes in both members of the dyads and longer lasting behavior change than individual interventions. However, couples-based interventions may be less effective for some individuals.	Few randomized controlled trials have directly compared couples vs. individual interventions. Moderation analysis will help identifying couples who are more likely to benefit from dyadic interventions.	Transactive goal dynamics ⁸⁹ Contextual model of social control ⁸¹ Dyadic health influence ¹⁰³
<i>Should the behavior change techniques target the couple as a unit and/or one or both individual members of the dyad?</i>		
Applying individual behavior change techniques in a dyadic context can raise relational issues that may create resistance to behavior change. It is unclear how to best adapt individual behavior change techniques to a dyadic context.	Few studies have compared different dyadic adaptations. Researchers must better describe their dyadic intervention techniques to allow comparisons across studies.	Interdependence theory ¹²³ Social Action Theory ⁶¹ Compendium of dyadic intervention techniques ¹²⁵
<i>How and when to address interpersonal processes maintaining certain health behaviors?</i>		
Help couples better understand how certain health behaviors may play a bonding or emotion regulation function in their relationship.	Which couples would benefit from these strategies? How to best address these interpersonal processes?	Social Action Theory ⁶¹ Family System Therapy ⁹¹ System-Symptom fit ⁹²
<i>How to promote effective spousal support in the context of health behavior change?</i>		
Health behavior change interventions provide a context to improve spousal support processes. However, even well-intended support can backfire if it does not match what is wanted or needed by the recipient.	Few studies have compared different types of support or collaboration approach to promote spousal health behavior change	Dual effects model ⁷⁹ Self-determination ¹³⁶ Dyadic/Communal coping ¹⁴⁴⁻¹⁴⁵ Invisible support ¹⁵⁶ Self-efficacy ¹⁶⁴
<i>Does the inclusion of relationship-building strategies improve the efficacy of health behavior change interventions?</i>		
These interventions provide an opportunity to improve communication and relationship quality through the behavior change process. However, interventions may become longer, more complex, require more training, and become less scalable with the addition of a relationship-building component.	Which couples would benefit from relationship-building strategies? Dismantling studies are required to test whether the addition of this component improves health behavior change and dyadic health.	Common principles of change model ¹⁸⁰ Attachment theory ¹⁸¹

conflict. Transactive loss, a state when goal progress is impeded by one’s partner, may occur in the context of poor relationship quality or poor goal coordination. This can result from goal conflict or the absence of a shared goal representation, i.e. a shared understanding of what needs to be changed, whether it is important to change it, who needs to change it, and how to change it. Furthermore, the Manhattan effect highlights that high relationship commitment is associated with greater support for a partner’s goal, unless this goal is seen as threatening the relationship [90].

Family system theory also proposes to view couples as a self-regulating social system that strives to maintain its homeostatic balance. Over time, couples develop daily routines, rituals, and relationship

rules that help maintain a relative relational well-being. When a new behavior is introduced or is removed from the system, different components of the social system may react to re-establish the system homeostasis. In family treatment of childhood obesity, Pratt & Skelton [91] describe some families as being “organized” around weight-related behaviors. Their family routines, habits, and implicit and explicit family rules promote sedentary behaviors and excess caloric intake. For example, a couple may have developed the habit of spending most of their leisure time at night watching television and ordering in fast food.

Rohrbaugh and colleagues [92] propose the concept of system-symptom fit to explain why health behavior change may be difficult for some couples. They argue that some health behaviors, such as shared eating of highly palatable foods or shared television watching, may play an important relational function for some couples. These behaviors may represent important stimuli to generate shared positive emotions or to downregulate the negative emotions of one or both partners. Given these relational functions, these behaviors may be particularly resistant to change for some couples. There is some empirical evidence supporting this system-symptom fit phenomenon. Among dual smoking couples, shared smoking episodes was associated with greater positive affect, even when one partner has been diagnosed with a heart or lung disease [93]. Couples concordant in marijuana use reported and were rated as expressing less anger and more constructive interactions during the discussion of a relationship conflict, compared to couples having discordant drug use [94]. Among couples who shared unhealthy behaviors, higher relationship quality was associated with greater body mass index among women [95]. In daily diary studies, on days when participants smoked or engaged in sedentary behaviors with their partners, they reported more intimacy and closeness, compared to days when they did not engage in these unhealthy behaviors together [96]. These studies highlight that unhealthy behaviors may be resistant to change because of their relational function for some couples.

A number of studies have reported that romantic partners sometimes engage in undermining behaviors that interfere with health behavior change [97]. Undermining partner behaviors can take different forms. Examples include tempting the partner with foods that they are trying to avoid, refusing to change their diet or to engage in physically demanding activity, disregarding the partner’s health goals, or criticizing the partner for trying to change the family routines [98]. Although only a minority of individuals will actively attempt to sabotage their partner’s health behavior change efforts, most of the partner’s undermining attitudes and behaviors are unintentional and partners may not be consciously aware that they are interfering with their spouse’s health goals [97]. For example, when it comes to overfeeding one’s partner, motivations include showing love, avoiding hunger for the other, avoiding waste, being respectful or polite, or asking their partner to finish their food leftovers [99]. In cross-sectional studies, partner’s undermining behaviors were associated with poorer diet quality and less weight management efforts [97,100]. Individuals with diabetes who reported that their spouse was tempting them with food that they were trying to avoid were more likely to have uncontrolled blood sugar [98]. From a family system perspective, these partner undermining behaviors may represent conscious or unconscious attempts to re-establish the relational homeostasis within the family system.

5. How does the spousal context influence the efficacy of individual self-regulation strategies?

Individual self-regulation strategies play a key role in health behavior change. The Health Action Process Approach (HAPA) provides a useful framework to understand the deployment of different self-regulation strategies over time [101]. HAPA distinguishes two broad phases in the behavior change process: the motivation phase leading to the formation of an intention to change, and a volitional phase during which different behaviors are enacted to plan, initiate, and maintain the

behavior change. Once an intention has been formed, the person will engage in action planning during which they will set goals to specify when, where, and how to engage in or reduce a given health behavior as well as coping planning to identify potential obstacles to behavior change and ways to overcome them. Subsequently, the person will engage in action control self-regulation strategies to translate the plan into actual behaviors. HAPA proposes three inter-related self-regulation processes during the action control phase. The person must maintain an awareness of the standards or goals sets, the person has to engage in ongoing self-monitoring to make sure that their behaviors align with their goals, and they have to engage in self-regulatory efforts when a discrepancy between the goals and the behaviors is noted. Given that relapses are the norm rather than the exception, this self-regulation process is ongoing during the maintenance phase. This model also ascribes a key role to self-efficacy, the beliefs in one's capacity to perform a given behavior, and highlights that self-efficacy to initiate a behavior may be different from self-efficacy to maintain the behavior. The model proposes that social support can facilitate different components of the health behavior change process. However, a better understanding of how the spousal context influences the efficacy of individual self-regulation strategies is an important future research direction [102].

Although motivation is typically conceptualized as an individual variable, the Dyadic Health Influence Model argues that partners shape their respective beliefs and attitudes about health-related behaviors, including risk appraisal, outcome expectancies, or attitude about the desirability or enjoyability of a given behavior, as well as their respective self-efficacy beliefs [103]. The few studies that have examined social-cognitive predictors of intentions to change from a dyadic perspective indicate that partner's beliefs, attitudes, and behaviors may impact one's health-related motivation. Daily intentions to engage in physical activity were significantly positively correlated among couples [104]. An individual's intention to exercise was related to their partner's self-efficacy, over and above their own's self-efficacy [105]. Having a partner with high mastery was associated with greater increases in physical activity over time among older adults [106]. Moreover, spousal similarity in the belief that progression of cardiovascular disease could be controlled was associated with greater changes in healthy eating over time [107]. Furthermore, one partner's motivation may influence the behavior change process of the other partner. In their transtheoretical model of change, Prochaska & DiClemente [108] propose that individuals differ in their readiness to engage in behavior change. In a study of 1899 couples, an individual's self-efficacy to engage in healthy eating or regular physical activity was lower when their partner reported being at an earlier phase of readiness to change than they were [109]. Individuals who were not ready to change also construed their partner's social control attempts as more controlling, experienced more negative emotions, and reported a diminished intention to change their behavior following the social control attempts [110]. These studies highlight the spouses' mutual influences on the formation of intentions to change. To our knowledge, other motivational theories examining hedonic or automatic processes have not been investigated from a dyadic perspective [111].

Motivational interviewing is a multimodal intervention that aims at increasing intrinsic motivation for health behavior change through patient-centered collaborative communication [112]. Motivational interviewing aims at eliciting "change talk", i.e., patient's own talk revealing consideration, motivation, or commitment to change. One strategy often used in motivational interviewing is highlighting the discrepancy between the person's current behavior and their values or goals. While motivational interviewing with individuals is effective at eliciting behavior change [113], motivational interviewing including significant others [114,115] or motivational interviewing focusing specifically on the couples have received mixed support [116]. The development of interventions to promote motivation in both members of the couple is an important area for future research.

A number of behavior change techniques have been shown to be helpful in promoting volitional processes leading to changes in diet and physical activity [117]. However, the implementation of these techniques in a couples-based context may require some adaptation. Planning interventions have been studied the most in this regard. Implementation intention is a self-regulation technique that consists of establishing if-then rules specifying when, where and how a given behavior will be enacted as well as how obstacles to engage in this behavior will be dealt with. Prestwich et al. [118] showed that collaborative implementation intentions done with a coworker, i.e., making if-then plans to do physical activity jointly with a coworker, lead to larger increases in physical activity than implementation intentions done individually. However, dyadic planning to increase physical activity in couples was not associated with greater increase in physical activity, compared to individual planning [119]. A later study compared individual planning, a dyadic planning arm where partners worked together in defining the plan for the target participant, and a collaborative planning arm where couples planned joint activity. At the 6-month follow-up, only the dyadic planning group showed a significant increase in moderate-vigorous physical activity, compared to a health education control group [120]. Although many observational studies suggest that joint engagement in physical activity is beneficial for couples [121,122], intervention studies suggest that "forcing" spouses to do physical activity together may not always be effective. Lewis et al. [123] argue that couples can influence each other in different ways to achieve behavior change. While some couples want to engage in the behavior together, others may prefer to perform different activities or to practice the behavior with other people. As such, it is important to recognize the need for independence of some individuals, even in a context of interdependence [124]. Spouses may support their partner's health goals by taking over some tasks or rearranging their individual or joint schedule to accommodate the other spouse and allow them to carry out their desired activity.

Other behavior change techniques may also need to be adapted to a dyadic context [61,103,123]. Here are some examples to consider. Stimulus control is a helpful strategy to change dietary habits. Individuals are instructed to reduce exposure to certain food items by avoiding purchasing or bringing them into their house. This strategy can elicit resistance from the other partner who may not be willing or ready to stop consuming some food items. It may thus be desirable to negotiate the implementation of diet-related stimulus control strategies with the spouse. Self-monitoring is another key strategy to initiate and maintain health behavior change. Self-monitoring, the ongoing monitoring of the alignment of one's behavior with one's goal, can have two broad functions. It can help identify triggers for the desirable and undesirable behaviors, and it can have a key self-regulation function by prompting the individual to act in accordance with their goals. In addition to identifying individual triggers for unhealthy behavior, joint self-monitoring has the potential to help identify couples-based triggers for shared unhealthy behaviors. Furthermore, while discussing one's triggers with one's spouse may help foster a dyadic coping approach, it can also activate self-conscious emotions of guilt and shame that are powerful barriers to the behavior change process. Similarly, relapse prevention strategies are important interventions to promote the maintenance of behavior change. In dyadic relapse prevention, both spouses identify situations at high risk for one or both partners to revert to the old behavior patterns and plan on how spouses will help each other resume the desired behaviors. For dyadic relapse prevention to be effective, spouses need to agree on how they collaborate with each other in the behavior change process. Empirical research is needed to identify which dyadic adaptations of these self-regulation strategies are the most effective. To accomplish this, the use of a compendium of dyadic intervention techniques to describe and classify such dyadic interventions is important to help isolate the effects of specific dyadic techniques on health outcomes across different empirical studies [125].

6. How does one provide effective spousal support for change in interdependent behaviors?

Although perceptions of the availability of social support in times of need are consistently associated with better psychological adjustment, physical health, and goal progress, specific support behaviors or interactions, often studied using enacted or received support, are not always associated with better outcomes [126]. While social support was generally associated with better health behavior [127], it was unrelated or negatively associated with goal progress in some studies [128]. Of note, because a variety of conceptualizations and measurement of received support exist in the literature, it sometimes overlaps with the concept of positive social control [129]. The relational processes influencing variability in the effectiveness of positive social control strategies likely also apply to enacted social support. Conceptually and empirically distinguishing received or enacted social support from positive social control using validated assessment tools is an important future direction to isolate the effects of specific interpersonal processes.

In studies of received social support, it is impossible to disentangle whether the association of received support with poor outcomes is due to the need for support (e.g. being exposed to more stressors or challenges) or to the support process per se. However, there are several studies suggesting that providing effective social support can be challenging. Received support can create feelings of indebtedness and inequity within the relationship, it can reduce self-efficacy by signaling one's inability to deal with the problem, or it can even be perceived as intrusive or inappropriate when the type of support provided may not match what is needed or wanted by the recipient [130–133]. Furthermore, well-intended emotional support may promote co-rumination, excessive negative talk and focus on problems, and is associated with greater depressive symptoms, particularly when it occurs in romantic relationships [134]. There might be a cost to poorly delivered social support. In a 10-year follow-up of the MIDUS study, more received emotional support was associated with higher mortality risk among participants who reported poor perceived partner responsiveness, i.e. that they did not feel understood, validated, or cared for by their partners [135]. A number of approaches have been proposed to reduce the paradoxical effect of received support.

According to self-determination theory, a given social environment can promote goal pursuit by allowing the fulfillment of the fundamental needs for autonomy, competence and relatedness, leading to the emergence of intrinsic motivation toward self-directed and personally-relevant goals [136]. According to this model, autonomy support will be more effective at building motivation than more directive forms of social support [137]. Autonomy support entails providing a rationale for the behavioral prescription, offering choices among different ways to fulfill the behavioral prescription, eliciting and acknowledging the person's feelings toward the chosen activity, encouraging proactive behaviors, and conveying confidence in the person's capacity to perform the behavior [138]. In addition to providing autonomy support for the initiation of the behavior, providing positive feedback throughout the change process, particularly expressing gratitude toward one's partner change efforts, may foster autonomous motivation over time [139]. In observational studies, greater autonomy support, as reported by the participants or coded by independent raters, was associated with greater weight loss among individuals participating in weight management interventions [140,141]. However, in a randomized trial, a couples-based behavioral weight loss intervention supplemented with an autonomy support training was associated with increased autonomy support, but did not differ in weight loss, compared to the couples-based behavioral weight loss only group [142]. More work is needed to develop spousal autonomy support interventions promoting health behavior change.

A number of theoretical models highlight that dyadic or communal forms of coping can provide unique benefits to both partners [143–145]. Lyons et al. suggest that the communal coping process implies ongoing communication about the stressors, spouses working together to deal

with the challenges that one or both members are facing, and at least one of the partners perceive joint coping efforts as being advantageous or needed [144]. Bodenmann's dyadic coping model suggests that this joint collaboration can take different forms; one partner may directly assist the other spouse, temporarily take over their partner's responsibilities, or both partners can work together to jointly deal with challenges [145]. Joint coping efforts have been associated with better adherence to diet, lower depressive symptoms, better relationship satisfaction, and lower systemic inflammation [146–148]. Dyadic coping may also buffer the impact of stress on health behaviors [149]. In applying this model to the chronic illness context, Helgeson et al. [150] argue that communal coping requires a shared illness appraisal — the perception that the illness is a joint rather than an individual problem — which then facilitates cooperative efforts to manage the illness. This shared appraisal may reduce the cost associated with received support by promoting reciprocity in support exchanges, by building self-efficacy in pooling the partners' resources, and by reducing support mismatch via ongoing conversation about the shared challenges. Among patients expecting spousal involvement in illness management, spousal social control was associated with less behavioral reactance [151] and less psychological distress [152]. Similarly, diet-related spousal social control was associated with dietary adherence only among patients expecting spousal involvement in illness management [153]. Both self-reported and coded communal coping was associated with better patient self-care behavior [154]. However, collaboration was associated with worse outcomes among type I patients with low shared illness appraisal [155]. These studies highlight that a shared illness appraisal may impact how individuals with chronic illness construe social support and social control exchanges. Relatedly, using the concept of transformation of motivation, Lewis et al. [123] propose that ascribing a relational meaning to the behavior change process, i.e., perceiving that the behavior change will benefit not just the partner but also the relationship with the partner, could enhance the efficacy of dyadic interventions.

Another line of research suggests that the so-called invisible support is a way to provide social support that minimize cost to the receiver. The concept of invisible support was first evidenced in dyadic daily diary studies when on a given day one partner reported having provided support, but the other partner did not report having received support. In a seminal study, individuals studying for an important professional exam experienced the least amount of distress on days when their partner reported providing support, but they did not report receiving support [156]. Social perception of interactions with one's romantic partner are often biased [157]. For example, in the context of conflicting goals between partners, individual may choose to sacrifice their own goals in order to facilitate their partner's goal attainment. However, only about 50% of the time, individuals accurately perceive that their partner has made a sacrifice for them [158]. In longitudinal studies using coded social support interaction tasks, invisible support, defined as support transactions that were more conversation-like, that subtly de-emphasize the role of the provider and recipient, and that deflect the attention away from the problem, was associated with greater goal progress over time [159,160]. Relatedly, a number of studies suggest that the most effective social control strategies are indirect in nature, such as modelling or changing the environment [75,161]. In daily diary studies, partner's self-regulatory effort to engage in physical activity as well as joint engagement in physical activity were associated with more physical activity for the other partners [104,162]. Greater spousal invisible social control was also associated with better daily glycemic control among patients with type 2 diabetes [163]. In the context of interdependent health behaviors, such as physical activity and diet, these "invisible" social support or social control strategies may be particularly relevant. These strategies would first require the person to develop awareness of the interdependence in the behavior to change and then to modify their own behavior or their home environment to shift their partner's behavior in the desired direction. To our knowledge, no intervention has been designed to increase invisible support per se.

Other authors have proposed that effective support will aim at enhancing the partner's perceived self-efficacy at enacting the behavior change. Bandura [164] proposed that self-efficacy can be built via successful enactments of the behavior leading to mastery experiences, social modelling and vicarious learning, verbal persuasion of one's ability to make the behavior change, and the reduction of emotional and physiological arousal. Spouses are well-positioned to support their partner's efficacy through these four routes. Partners can provide scaffolding and encourage their partner to gradually perform the desired behavior. As discussed earlier, by modelling the behavior change, they can facilitate their partner's change. Partner's verbal persuasion through encouragement was also linked to greater goal progress and increased self-efficacy over time [165]. From an interpersonal emotion regulation perspective, romantic partners are well-positioned to help reduce their spouse's stress-related emotional and physiological arousal and can help diminish maladaptive emotion regulation strategies [166, 167]. Furthermore, spouses' beliefs about their partner's abilities and capacities influence their partner's outcomes. When spouses had more confidence in their partner's ability to manage their illness, patients had better physical function, engaged in more physical activity, and had less symptom severity over time [168,169]. In the context of congestive heart failure, spouses' belief about their partner's illness management self-efficacy was associated with survival, over and above the patient's own self-efficacy [170]. Similarly, priming the mental representation of a close other who expects the person to succeed at a given task, increases the person's belief in their ability to succeed as well as their persistence and performance on a task [171]. Relatedly, the Michelangelo phenomenon proposes that by providing affirmation, a spouse can help their partner work toward their ideal selves and achieve desired behavior change [172].

7. Balancing and integrating health behavior change and relationship functioning interventions

A number of studies show that relationship quality moderates the effects of couples-based health behavior change interventions. In a dyadic intervention with type 2 diabetes patients, females who reported lower relationship satisfaction experienced smaller weight loss, compared to those with higher relationship quality [173]. Similarly, Knoll et al. [119] reported that a dyadic planning intervention led to a decrease in moderate and vigorous physical activity among target persons reporting lower relationship quality. Accordingly, some couples may benefit less from dyadic intervention or may need to address relationship issues in addition to health behavior change. Relatedly, family system theory suggests that for some couples, both first order and second order changes are needed to make lasting changes in health habits, with the former targeting health behavior change and the latter targeting relational dynamics [91]. This suggests that the inclusion of relationship-building strategies in dyadic health behavior change interventions may promote sustained behavior change at least for some couples.

Beyond general marital quality, specific interpersonal processes associated with health-relevant biomarkers could be targeted in dyadic interventions to promote better health outcomes. Kiecolt-Glaser and colleagues have shown that couples who engaged in more hostile interactions across both conflict and support contexts exhibited larger increases in proinflammatory cytokines following the discussion of marital disagreements, compared to couples exhibiting less hostile behaviors [174]. Hostile negative interactions may thus be a key factor to target in dyadic intervention. Interpersonal capitalization is another interpersonal process associated with health-relevant biomarkers. Capitalization, the process of sharing positive experiences with close others, is associated with increases in positive mood and perceived relationship quality, especially when the receiver responds in a responsive or enthusiastic manner [175]. More capitalization is associated with lower inflammation among individuals experiencing chronic

stress [176] as well as lower systolic blood pressure in men and higher heart rate variability in women during a couple's conflict discussion [177]. Couples' communication patterns have also been associated with health outcomes. In the demands-demands pattern, both partners criticize each other, generating negative spousal interactions. The demand-withdraw pattern occurs when one partner nags the other, who in response shuts down and avoids conversation, ultimately leading to more demanding behaviors from the other partner. In the withdrawal-withdrawal pattern, both partners avoid discussing unpleasant issues, increasing the risk of losing intimacy over time. The demand-withdraw pattern was associated with higher baseline IL-6, greater cortisol and epinephrine response to marital conflict, and slower wound healing [178,179]. These studies provide insight on specific interpersonal processes that could be targeted in couples-based interventions to promote health behavior change and dyadic health.

Relationship-building strategies within health behavior change interventions may have three broad goals: reducing hostility and negative interactions, improving communication and support processes, or modifying positive interaction patterns that maintain unhealthy behaviors. Benson et al. [180] propose that there are five principles common to effective couple therapies: helping the couple develop a dyadic conceptualization of the behavioral pattern, reducing emotion-driven dysfunctional interpersonal behaviors, eliciting avoided private behavior, improving communication, and identifying and capitalizing on the couple's strengths. In the context of health behavior change interventions, these five principles could be applied in the following manner: increasing awareness and understanding of the interdependence in health behaviors within the relationship; identifying the relational function -either increasing positive or decreasing negative experiences- and the shared triggers of certain health habits; expressing emotional experiences in response to spousal social support or social control attempts; improving communication to reduce negative interactions and promote effective collaboration for both individual and shared health goals; and actively identifying the strengths of the relationship and capitalizing on previous and ongoing success experiences in supporting both individuals and shared healthy habits.

8. Individual and contextual moderators

Individual differences in attachment style may influence how individuals respond to a dyadic intervention. Individuals with high attachment avoidance may feel less comfortable about opening up and depending on their partner, while individuals with high attachment anxiety who worry about abandonment and rejection from their partner, may respond to spousal support attempts or lack thereof with greater negative emotions, impeding both behavior change and support from their partner. Experimental studies show that insecure attachment negatively influences the appraisal of standardized spousal social support interactions [181]. The type of support strategies may thus need to be adapted as a function of the partners' attachment styles. For example, individuals with higher attachment avoidance reported a loss of autonomy after a social support discussion with their spouse, unless their partner provided more invisible support [182]. Furthermore, couple's concordance on obesity status and other lifestyle behaviors is another factor that may influence how couples approach a dyadic intervention. For example, couples discordant on obesity status reported more social control from the partner without obesity, and the efficacy and emotional response to spousal social control strategies was moderated by the partner's obesity status [183,184]. Weight stigma within romantic relationship was associated with poorer relationship functioning [185], highlighting potentially different relational dynamics between couples concordant and discordant on obesity status.

Several contextual factors may also influence dyadic interventions with couples [186]. A number of studies suggest that there might be gender differences in the effects of couples-based interventions. In a weight management trial, women lost more weight in couples-based

compared to individual interventions [187]. In contrast, in the nationally delivered Diabetes Prevention Program in the USA, men who participated with their spouse were more likely to lose 5% of their weight, a target recognized for its significant health benefits, including improved cardiovascular health and reduced diabetes risk. However, this effect was not seen among women [188]. In an observation study, marital conflict was associated with unhealthy eating in women, but not in men [16]. More work is needed to understand in which context gender is an important moderator of the efficacy of couples-based interventions.

Furthermore, age and developmental stage may also influence dyadic interventions. Older couples who have been together for several decades are more likely to show a higher degree of concordance in health behaviors than younger individuals [47]. The developmental stage of the couples will also influence whether it is relevant to consider the influence of other family members in the intervention. For example, couples with young children are less likely to be able to do physical activity together and parents of adolescents may adjust their diet to fit their adolescent's needs and preferences. Furthermore, homosexual couples show less gendered social roles and may respond differently to their partner's social control attempts compared to heterosexual couples [189]. Lower socioeconomic status is associated with greater spousal concordance in poor health behaviors and financial strain may prevent both partners from participating in an intervention at the same time [18]. Given cultural differences in how effective support is expressed and provided [190], the delivery of effective dyadic interventions may also differ across cultures. Accordingly, couples-based behavior change interventions must be adapted to the sociocultural context in which they are delivered.

9. Identifying mechanisms linking dyadic interventions and health outcomes

The specific mechanisms linking interpersonal relationship quality and health are still unclear [191]. By modifying specific interpersonal processes and health-related behaviors, dyadic interventions have the potential to test some of the biopsychosocial mediational pathways linking social relationships and health. Couples-based interventions may impact health-relevant biomarkers, such as circulating markers of inflammation, through multiple pathways, including: 1) increasing physical activity and healthy diet, and eventually decreasing adiposity; 2) decreasing marital stress by reducing negative couple interactions; 3) improving spousal support processes by increasing communication and collaboration; and 4) bolstering individual self-regulation using dyadic or communal coping approaches. In addition to studies testing the overall effects of dyadic interventions on health, dismantling studies comparing the effects of dyadic interventions including different treatment components targeting specific interpersonal and behavior processes will be helpful in evaluating the role of specific interpersonal processes on health-relevant biomarkers.

10. Disseminating couples-based behavior change interventions to promote dyadic health

Couples-based interventions range from shared participation without specific instructed interactions between partners to multi-sessions, multi-component interventions involving several structured interactions between partners, delivered in person, online, or via telephone [125]. Currently, little is known about the most effective format and components of couples-based health behavior change interventions [125]. Innovative clinical trial methodology, such as the multiphase optimization strategies [192] and Bayesian adaptive clinical trial design [193], will be key in identifying the most important treatment components within complex interventions and the individual or couples characteristics that may influence efficacy of couples-based health behavior change interventions. These findings will inform the

development scalable dyadic interventions that can be disseminated to targeted populations that are most likely to benefit from such interventions.

11. Conclusion

In summary, epidemiological studies indicate that better marital quality is associated with improved health outcomes. We argue that couples-based health behavior change interventions are potentially useful relationship-based interventions to improve health outcomes. However, to be optimally effective, dyadic interventions must identify and address the key relational issues triggered by the shared participation of both partners in the intervention. Although these relational issues can present a challenge to the health behavior change process, they also provide an opportunity to address negative couple interactions and enhance spousal support processes. Future research should strive to use theory-driven interventions, improve measurements of specific interpersonal processes, test different dyadic adaptation of individual behavior change techniques, examine moderators of dyadic treatment efficacy, investigate the mediational biopsychosocial pathways, and develop scalable interventions to harness the effects of social relationships on health.

CRedit authorship contribution statement

Jean-Philippe Gouin: Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Conceptualization. **Maegan Dymarski:** Conceptualization, Writing – review & editing.

Declaration of competing interest

No conflict.

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