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Marital Quality and Diabetes: Results From the Health and Retirement Study

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Objective: Poor marital quality is associated with many different indicators of poor health, including immunologic and metabolic responses that have relevance for distal disease outcomes such as diabetes. We conducted this study to evaluate whether poor marital quality was associated with the prevalence of diabetes in a population-based sample of Americans over the age of 50. ***Method:*** Participants were married adults from the 2006 (N = 3,898) and 2008 (N = 3,452) waves of the Health and Retirement Study. Participants completed an interview and a self-report questionnaire, and current use of diabetes medication and glycosylated hemoglobin obtained from blood spot samples were used to index diabetes status. Marital quality was assessed with items regarding perceived frequency of positive and negative exchanges with partner. ***Results:*** Decreasing frequency of positive exchanges and increasing frequency of negative exchanges with one's spouse were associated with higher prevalence of diabetes among men, but not women at both waves; gender significantly moderated the associations between partner exchanges and diabetes status for the 2006 data. The association between frequency of partner exchanges and diabetes status generally remained significant in men after accounting for demographic characteristics and other risk factors (obesity, hypertension, low physical activity). ***Conclusion:*** Poor marital quality as operationalized by rates of positive and negative partner exchanges was associated with increased prevalence of diabetes in men. These results are consistent with prior work on marriage and health, and suggest that poor marital quality may be a unique risk factor for diabetes.

Keywords: diabetes, HbA_{1c}, marital quality, marital adjustment, marital satisfaction, glycosylated hemoglobin, health, spouse

Diabetes is a major public health problem that carries a significant disease burden, costing the United States more than $174 billion per year in 2007 (Boyle, Thompson, Gregg, Barker, & Williamson, 2010). This burden is projected to grow as the prevalence of diabetes increases from 14% of the adult population in 2010 to an expected 21% by 2050 (Boyle et al., 2010). Diabetes is associated not only with retinopathy, nephropathy, and neuropathy (Hanssen, Bangstad, Brinchmann-Hansen, & Dahl-Jørgensen, 1992), but also with increased risk of cardiovascular disease (Fox et al., 2007). We conducted the present study to evaluate whether poor marital quality was associated with the prevalence of diabetes in a large population-based sample of married adults over the age of 50.

A large literature has linked intimate relationships, such as marriage, with health (Robles, Slatcher, Trombello, & McGinn, 2013). Researchers commonly have focused on relationship quality, which is defined in terms of subjective evaluation of the relationship or in terms of patterns of interaction, such as companionship, conflict, and communication (Fincham & Rogge, 2010), and poor relationship quality is associated with a range of poor health outcomes (see Kiecolt-Glaser & Newton, 2001; Robles & Kiecolt-Glaser, 2003, for reviews). A recent meta-analysis of the association between marital quality and health yielded an effect size comparable in magnitude to existing associations between health behaviors (e.g., diet) and health outcomes (Robles et al., 2013).

There are a variety of ways in which poor health could contribute to poor relationship quality. For example, poor health may contribute to a loss in income (or a diversion of income from normal expenses to medical expenses), a change in the division of labor in the household, a change in the frequency of rewarding shared activities, or a change in the behavior and mood of the ill partner (Booth & Johnson, 1994). Furthermore, difficulties in adhering to treatment recommendations could be a source of

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conflict in the relationship. There also are a variety of pathways by which relationship quality could impact health, including social–cognitive and affective processes (e.g., emotion regulation in couple interactions), mental health outcomes, health behaviors, and biological mediators (e.g., allostatic processes involving cardiovascular, neuroendocrine, and immune systems) (Burman & Margolin, 1992; Robles & Kiecolt-Glaser, 2003; Robles et al., 2013).

One specific biological mechanism by which marital quality may impact health is through immunological responses that have direct relevance for distal health outcomes such as diabetes. For example, in middle-aged women, but not older women or men, greater frequency of support from one's partner was associated with lower levels of interluekin-6 (IL-6) (Whisman & Sbarra, 2012); IL-6 is a signaling molecule within the immune system (i.e., a proinflammatory cytokine) that plays an important role in coordinating inflammatory response (Maier & Watkins, 1998). Similarly, Uchino et al. (2013) found that compared with married individuals whose spouses were viewed as a source of positivity when they needed support, those individuals whose spouses were viewed as a source of both positivity and negativity reported higher levels of inflammation, as indicated by higher IL-6 and fibrinogen.

The findings that poor marital quality is associated with markers of inflammation is in line with evidence that has suggested chronic interpersonal stress is associated with inflammatory responses (Miller, Rohleder, & Cole, 2009) and in line with theoretical models that have proposed inflammation may mediate the association between relationship quality and health (Kiecolt-Glaser, Gouin, & Hantsoo, 2010). Poor marital quality is also associated with metabolic syndrome (MetS; Whisman, Uebelacker, & Settles, 2010), which refers to a clustering of characteristics that have individually been shown to be associated with elevated risk of several diseases, including diabetes (Alberti et al., 2009). In a 4-year prospective study, poorer marital quality at baseline significantly predicted increased risk for incident MetS for wives, and this effect persisted after statistically correcting for a range of objective risk factors at baseline (Whisman & Uebelacker, 2012). Because increased inflammation (Spranger et al., 2003) and MetS (Ford, Li, & Sattar, 2008) have been associated with risk of developing diabetes, the association between marital quality and diabetes warrants further exploration.

Several studies have examined the association between marital quality and glycemic control among people with diabetes. Trief, Himes, Orendorff, and Weinstock (2001) examined the association between marital quality and metabolic control (as measured by glycosylated hemoglobin [HbA_{1c}]) in a sample of 78 insulin-treated adults with diabetes who were between 18 and 55 years of age. Marital quality was not significantly associated with HbA_{1c} values treated as a continuous variable; there was, however, a nonsignificant trend between marital quality and a dichotomous measure of glycemic control (i.e., marital quality was higher for people who had HbA_{1c} values less than 7.4% than for people who had values of 7.4% or higher). Olson, Trevino, Islam, and Denner (2010) found no significant association between marital quality and HbA_{1c} values in a sample of 87 people with Type 2 diabetes mellitus (T2DM) who were 30 years of age and older. Finally, Trief et al. (2006) found that there was no significant cross-sectional or 1-year longitudinal association between positive measures of marital quality (i.e., marital cohesion and marital satisfaction) and HbA_{1c} levels in a sample of 134 elderly individuals with diabetes who received usual care or participated in a telemedicine case management intervention for diabetes; there was, however, a statistically significant and positive association between marital stress and HbA_{1c} levels at baseline. In summary, results from the studies that have evaluated the association between marital quality and glycemic control are mixed. However, each of these studies was conducted only among patients with diabetes and, consequently, the association between marital quality and diabetes in the general population has yet to be evaluated.

Given that marital quality is associated with health outcomes, including inflammatory response and MetS, a critical question is whether marital quality is significantly associated with diabetes status in the general population and, if so, whether the magnitude of this association is large enough to have clinical relevance. The present study was conducted to (a) examine the association between marital quality and diabetes in a representative population-based sample of community-dwelling adults 50 years of age and older; (b) evaluate whether this association holds when statistically accounting for other established risk factors; and (c) explore how the magnitude of this association compares with the association observed in the same sample between diabetes and other well known risk factors, such as obesity, hypertension, and low physical activity (van Dam, 2003). Furthermore, we examined the association between marital quality and diabetes in two independent samples, thereby allowing us to evaluate the replicability of any observed associations between these variables.

Method

Participants

Participants were drawn from the Health and Retirement Study (HRS), which is an ongoing, multistate probability cohort sample of households in the United States including at least one person over the age of 50. In 2006, a random half of HRS households were preselected not only to complete the core interview but also to participate in an Enhanced Face-to-Face Interview, which involved a set of physical performance measures, a Leave-Behind Questionnaire, and a collection of saliva and blood spot samples; the other half of HRS households completed a similar assessment in 2008. Because we wanted to exclude people with child- or adolescent-onset diabetes, whose diabetes would have predated their marriage, we excluded people who reported they had diabetes before age 16; this requirement excluded nine people from the 2006 sample and four people from the 2008 sample. The final samples examined in this study included 2,020 women and 1,878 men from the 2006 wave and 1,784 women and 1,668 men from the 2008 wave. Descriptive information for each sample is provided in Table 1.

Assessment of Diabetes

Participants were classified as having diabetes if they were currently taking diabetes medication or insulin or they had an HbA_{1c} value of 6.5% or higher. HbA_{1c} is a measure of chronic glycemic level and, therefore, reflects average blood glucose levels over a 2–3 month period of time; a value of 6.5% or higher is the threshold level of glycemia that is associated with moderate reti-

Table 1
Descriptive Characteristics of Study Participants

Variable	2006						2008					
	Women			Men			Women			Men		
	M	*SD*	%	*M*	*SD*	%	*M*	*SD*	%	*M*	*SD*	%
Age	63.51	8.56		64.74	9.43		64.74	8.25		65.77	8.65	
Race												
White			92.2			92.4			92.6			91.8
Black			5.5			5.5			4.6			5.4
Other			2.3			2.1			2.8			2.9
Ethnicity (Latino)			5.7			6.7			6.3			6.5
Education												
<12 years			13.2			15.6			12.7			14.9
12 years			36.7			29.0			37.0			28.5
13–15 years			25.6			20.9			26.8			22.3
16+ years			24.5			34.4			23.4			34.4
Obesity			38.3			40.7			39.6			41.6
Hypertension			57.3			61.9			26.7			35.0
Activity level	7.50	6.33		8.89	6.49		7.87	6.51		8.96	6.58	
Positive partner exchange	3.40	0.67		3.60	0.54		3.38	0.68		3.59	0.54	
Negative partner exchange	2.03	0.70		1.88	0.62		2.02	0.73		1.85	0.64	

nopathy characteristic of diabetes (The International Expert Committee, 2009). The HbA_{1c} cutoff of 6.5% has been widely adopted in diagnosing diabetes (American Diabetes Association, 2010). HbA_{1c} values were obtained from the analysis of the blood spots collected by HRS interviewers.

Marital Quality

Marital quality was assessed with two 3-item scales, one measuring perceived frequency of positive, supportive interactions with spouse (How much do they really understand the way you feel about things?; How much can you rely on them if you have a serious problem?; How much can you open up to them if you need to talk about your worries?) and the other measuring negative, unsupportive interactions (How often do they make too many demands on you?; How much do they criticize you?; How much do they let you down when you are counting on them?). These items, which were taken from a measure developed for the Midlife Development in the United States survey (Walen & Lachman, 2000), were rated on a 4-point scale, and Positive and Negative Partner Exchange scales were constructed by calculating the mean of the items, with higher scores reflecting higher standing on each scale. The scales were completed as part of the Leave-Behind Questionnaire. Good internal consistency was found for the Positive and Negative Partner Exchange scales for women ($\alpha = .83$ and .74) and men ($\alpha = .77$ and .69).

Covariates

Several variables that were collected as part of the HRS and that have been associated with diabetes in prior research were included as covariates.

Physical measures. Interviewers measured height and weight, which were used to calculate body mass index (BMI). Obesity was operationalized as having a BMI of 30 kg/m^2 or higher. Systolic and diastolic blood pressure was taken three times, and the mean of the three measurements was computed, with participants classified as having hypertension if their mean systolic blood pressure was 140 mm Hg or higher, diastolic blood pressure was 90 mm Hg or higher, or they were taking medication for hypertension.

Activity level. Self-reported physical activity was measured with single items asking how often respondents took part in sports or activities that were (a) moderately energetic, such as gardening, cleaning the car, walking at a moderate pace, dancing, floor or stretching exercise, and (b) vigorous, such as running or jogging, swimming, cycling, aerobics or gym workout, tennis, or digging with a spade or shovel. Consistent with other research in the HRS (Tucker-Seeley, Subramanian, Li, & Sorensen, 2009), an index of activity was created by calculating the sum of responses to the vigorous activity (coded as 0 = *hardly ever or never*, 2 = *one to three times a month*, 6 = *once a week*, and 12 = *more than once a week*) and moderate activity questions (coded as half of the vigorous codes; 0, 1, 3, and 6, respectively). The resulting scale ranged from 0–18, with higher scores reflecting greater physical activity.

Statistical Analysis

The association between marital quality and diabetes status was examined using logistic regression. First, we evaluated the association between diabetes status and the Positive and Negative Partner Exchange scales in separate analyses, statistically accounting for demographic variables (i.e., age, race [White, Black, other], ethnicity [Latino, non-Latino], and years of education [< 12 years, 12 years, 13–15 years, 16+ years]). If this association was statistically significant, we evaluated the covariation between marital quality and diabetes, additionally accounting for established risk factors for diabetes (i.e., obesity, hypertension, and low physical activity).

Logistic regression analyses were conducted using SPSS Complex Samples, which incorporates the sample design into the data analysis, thus rendering acceptable standard errors of parameter estimates. We used HRS sample weights for descriptive statistics and all analyses. The sample weights account for differential

selection probabilities, adjust for differential baseline (i.e., survey) and wave-specific nonresponse, and make the weighted sample representative of noninstitutionalized individuals in the U.S. population in the age-eligible range. The HRS biomarker sample weight was used, which is the product of the HRS core sampling weight and nonresponse adjustment factor, poststratified to closely match the HRS sample composition by age, gender, and race. For ease of interpretation, the exponential of each regression coefficient was computed and interpreted as an odds ratio (*OR*); the 95% confidence interval (CI) was also computed for each coefficient. Although persons who were not age eligible were interviewed as part of the HRS if they were a spouse or partner of an age-eligible respondent, the HRS is not a probability sample of persons younger than 50 years of age; therefore, respondents who were not age eligible were excluded from all analyses. Furthermore, because the sample included age-eligible spouses or partners of original sample members, all data are not independent. Consequently, we conducted analyses separately for women and men. We selected this option over the use of the actor–partner interdependence model (APIM; Kenny, 1996) that addresses issues of interdependence because the use of APIM would have excluded data from individuals whose partners (a) were not age eligible, (b) did not participate in the HRS at any point, (c) did not complete the core interview or Leave-Behind Questionnaire for the 2006 or 2008 wave, or (d) did not provide blood spot samples for the assessment of HbA_{1c}.[1] However, because we were interested in evaluating gender differences in the magnitude of the association between marital quality and diabetes status, we also randomly selected one spouse from each couple in which both partners were age eligible and participated in the study, and combined the data from these participants with the data from participants whose partners were not age eligible or did not participate in the study. To test for gender moderation, we then centered (i.e., mean deviated) the Positive and Negative Partner Exchange scales, created a series of Gender × Partner Exchange interaction terms, and entered these terms into the regression equations after entering the component terms (and other covariates) (Whisman & McClelland, 2005).

Results

The weighted point prevalence of diabetes (i.e., as indexed by medication usage or having an HbA_{1c} value of 6.5% or higher) was 15.3% for women and 19.9% for men in 2006 and 14.8% and 20.9% in 2008. Descriptive information for study measures is provided in Table 1. For women, the correlation between the Positive and Negative Partner Exchange scales was −.61 ($p < .001$) for the 2006 wave and −.62 ($p < .001$) for the 2008 wave; corresponding results for men were −.50 ($p < .001$) for both waves.

2006 Results

Results from the logistic regression analyses evaluating the association between marital quality and diabetes adjusting for demographic variables indicated that, for women, diabetes status was not significantly associated with positive partner exchange, $OR = 0.97$, 95% CI [0.81, 1.17], $p = .78$, or with negative partner exchange, $OR = 1.07$, 95% CI [0.84, 1.36], $p = .57$.

For men, after holding the demographic variables constant, the frequency of positive exchange was significantly and negatively associated with having diabetes, whereas the frequency of negative exchanges was significantly and positively associated with having diabetes (see Table 2, Model 1). The association between both Positive and Negative Partner Exchange scales and diabetes status were significant when additionally controlling for the other risk factors (see Table 2, Model 2).

2008 Results

Similar to 2006 results, results from the logistic regression analyses from the 2008 data adjusted for demographic variables indicated that, for women, diabetes status was not significantly associated with positive partner exchange, $OR = 1.04$, 95% CI [0.81, 1.32], $p = .76$, or with negative partner exchange, $OR = 0.98$, 95% CI [0.77, 1.26], $p = .87$.

For men, a lower frequency of positive partner exchanges and a greater frequency of negative partner exchanges were significantly associated with having diabetes, holding the demographic variables constant (see Table 3, Model 1). Furthermore, as can be seen in Table 3 (Model 2), the association between negative partner exchanges and diabetes status remained statistically significant when additionally controlling for other risk factors for diabetes.

Gender Interaction

We then examined potential gender differences in the magnitude of the associations between marital quality and diabetes status for the subsample of participants whose data were independent (i.e., for people whose spouse was not part of the age-eligible HRS sample and one spouse from each couple whose partner was part of the age-eligible HRS sample). After statistically adjusting for the component terms, demographic covariates, and other risk factors, diabetes status for the 2006 wave was significantly associated with the Gender × Positive Partner Exchange Scale interaction ($B = .43$, $SE = .18$, $p = .02$) and the Gender × Negative Partner Exchange Scale interaction ($B = -.54$, $SE = .21$, $p = .01$). For both interactions, the association between the partner exchange scale and diabetes was significantly greater for men relative to women. In comparison, results from parallel analyses for the 2008 wave suggested that gender was not a statistically significant moderator of the association between diabetes status and frequency of positive partner exchange ($B = .21$, $SE = .22$, $p = .36$) or negative partner exchange ($B = -.25$, $SE = .23$, $p = .29$).

[1] Although use of actor–partner interdependence model (APIM) on the subset of couples in the HRS would have allowed us to test for gender differences in the correlates of diabetes status, it would have resulted in a loss of generalization due to excluding people for such a large number of reasons. Specifically, there were 1,543 couples in the 2006 data and 1,410 couples in the 2008 data, which would have meant we would have to exclude data on 812 participants (20.8% of eligible participants) in the 2006 wave and 632 participants (18.3% of eligible participants) in the 2008 wave had we limited our sample to couples to be able to conduct APIM. In short, analyzing only the subset of couples in the HRS would have yielded results that would not have generalized to approximately 20% of the population of adults 50 years of age and older. We opted to leverage the representative nature of the data and include all participants, thereby maximizing the generalizability of the results.

Table 2
Predicting Diabetes Status From Demographic Variables, Partner Exchange, and Other Risk Factors for Men in 2006

	Positive partner exchange				Negative partner exchange			
	Model 1		Model 2		Model 1		Model 2	
Variable	*OR*	95% CI	*OR*	95% CI	*OR*	95% CI	*OR*	95% CI
Age	1.02*	[1.00, 1.04]	1.02**	[1.01, 1.04]	1.02*	[1.00, 1.04]	1.02	[1.00, 1.03]
White	1.19	[0.38, 3.70]	0.92	[0.28, 3.01]	1.15	[0.38, 3.49]	0.87	[0.24, 3.22]
Black	1.94	[0.58, 6.52]	1.36	[0.33, 5.56]	1.84	[0.56, 6.04]	1.05	[0.23, 4.76]
Latino	1.88*	[1.04, 3.39]	2.01*	[1.16, 3.49]	1.88*	[1.05, 3.34]	1.60	[0.82, 3.13]
Education								
<12 years	1.21	[0.82, 1.79]	0.95	[0.64, 1.40]	1.23	[0.83, 1.82]	1.13	[0.70, 1.81]
12 years	0.99	[0.71, 1.38]	0.78	[0.56, 1.08]	0.99	[0.71, 1.38]	1.06	[0.66, 1.72]
13–15 years	0.79	[0.53, 1.18]	0.64*	[0.44, 0.94]	0.79	[0.53, 1.17]	0.80	[0.46, 1.40]
Obesity			2.78**	[2.09, 3.69]			2.14**	[1.56, 2.95]
Hypertension			2.28**	[1.61, 3.23]			1.67**	[1.16, 2.41]
Activity level			0.96**	[0.93, 0.99]			0.96*	[0.93, 0.99]
Partner exchange	0.65**	[0.51, 0.83]	0.59**	[0.52, 0.82]	1.68**	[1.38, 2.04]	1.64**	[1.27, 2.12]

Note. *OR* = odds ratio; CI = confidence interval.
* $p < .05$. ** $p < .01$.

Interaction Between Positive and Negative Exchange

Finally, we were interested in evaluating whether the frequency of positive partner exchanges moderated the association between the frequency of negative partner exchanges and diabetes status. Therefore, we created a Positive Partner Exchange × Negative Partner Exchange term and regressed diabetes status on this interaction term, holding the component terms (and demographic variables) constant. The interaction terms were not significantly associated with diabetes status for women or men at either wave (*p*s > .35), suggesting that the association between the frequency of negative partner exchanges and diabetes did not vary as a function of the frequency of positive partner exchanges.

Absolute Risk Increase

In a final series of analyses, we computed the absolute risk increase (ARI) for poor marital quality among men in the 2006 and 2008 samples and compared these values to the ARI from these samples for established risk factors for diabetes. The ARI reflects the increase in risk for diabetes associated with the presence of the risk factor relative to the absence of the risk factor; the ARI is the inverse of the number needed to harm. To create a high-risk group of men on marital quality, we sought to identify a cutoff on the partner exchange scales that would correspond to the highest scoring 31% for negative partner exchange and the lowest scoring 31% for positive partner exchange, because the estimated base rate of marital discord is 31% (Whisman, Beach, & Snyder, 2008). A cutoff of 3.50 or lower on the Positive Partner Exchange scale for both the 2006 and 2008 data and a cutoff of 2.33 or higher on the Negative Partner Exchange scale for both the 2006 and 2008 data for defining the high-risk group most closely approximated this estimated base rate; the low-risk group consisted of the remaining participants.

For the 2006 data, the absolute risk (AR) for being diabetic for the Positive Partner Exchange scale was 40.4% in the high-risk

Table 3
Predicting Diabetes Status From Demographic Variables, Partner Exchange, and Other Risk Factors for Men in 2008

	Positive Partner Exchange				Negative Partner Exchange			
	Model 1		Model 2		Model 1		Model 2	
Variable	*OR*	95% CI	*OR*	95% CI	*OR*	95% CI	*OR*	95% CI
Age	1.03**	[1.01, 1.04]	1.03**	[1.02, 1.05]	1.03**	[1.01, 1.04]	1.03	[1.01, 1.05
White	0.66	[0.28, 1.53]	0.72	[0.33, 1.60]	0.67	[0.29, 1.53]	0.73	[0.33, 1.59]
Black	1.00	[0.38, 2.59]	1.00	[0.42, 2.39]	1.00	[0.39, 2.56]	0.99	[0.42, 2.36]
Latino	1.18	[0.74, 1.87]	1.31	[0.82, 2.08]	1.12	[0.71, 1.78]	1.25	[0.78, 1.99]
Education								
<12 years	1.88**	[1.27, 2.78]	1.56*	[1.00, 2.43]	1.94**	[1.32, 2.87]	1.60*	[1.03, 2.48]
12 years	1.22	[0.81, 1.86]	1.09	[0.71, 1.69]	1.23	[0.81, 1.87]	1.09	[0.70, 1.68]
13–15 years	1.69*	[1.11, 2.56]	1.48	[0.95, 2.30]	1.75**	[1.15, 2.65]	1.52	[0.98, 2.35]
Obesity			2.19**	[1.59, 3.02]			2.17**	[1.57, 2.99]
Hypertension			1.44*	[1.02, 2.05]			1.44*	[1.01, 2.04]
Activity level			0.96**	[0.94, 0.98]			0.96**	[0.94, 0.98]
Partner exchange	0.79*	[0.63, 1.00]	0.83	[0.66, 1.05]	1.34**	[1.09, 1.64]	1.28*	[1.03, 1.59]

Note. *OR* = odds ratio; CI = confidence interval.
* $p < .05$. ** $p < .01$.

group versus 28.0% in the low-risk group, yielding an ARI of 12.4% (i.e., 40.4-28.0%); the AR for being diabetic for the Negative Partner Exchange scale was 38.4% in the high-risk group versus 26.0% in the low-risk group, also yielding an ARI of 12.4%. For the 2008 data, the AR for the positive partner exchange scale was 38.6% in the high-risk group versus 32.3% in the low-risk group, yielding an ARI of 6.3%; the AR for being diabetic for the Negative Partner Exchange scale was 31.3% in the high-risk group versus 24.6% in the low-risk group, yielding an ARI of 6.7%. We used the HRS data to compute the ARI for obesity, hypertension, and low physical activity (i.e., the bottom 16% on the physical activity measure versus the remainder of the sample). The results for ARI for the partner exchange scales and these other factors are presented in Figure 1 for the 2006 and 2008 data. As can be seen in this figure, the ARI for men in the high-risk partner exchange groups was roughly comparable to the ARI for the high-risk groups for obesity, hypertension, and low physical activity.

Discussion

In this large, population-based sample of community-dwelling adults, we found that poorer marital quality (as operationalized in terms of perceptions of lower frequency of positive partner exchanges and higher frequency of negative partner exchanges with one's spouse) was associated with higher prevalence of diabetes among men, but not women. This association was found at both waves and remained statistically significant after accounting for a range of other predictors, including demographic characteristics and, with the exception of the 2008 Positive Partner Exchange scale data, objective biometric variables (e.g., obesity, hypertension) and physical activity. Therefore, men who viewed their partner as highly critical, demanding, and undependable were more likely to have diabetes, whereas men who viewed their partner as highly understanding, reliable, and supportive were less likely to have diabetes. A primary contribution of this study is that we examined the potential clinical significance of the association between marital quality and diabetes in men by computing the ARI (the inverse of the number needed to harm) for partner exchanges and comparing it with the ARI for several well known risk factors for diabetes in the HRS data. Results indicated that men's perceptions of the quality of the interactions with their spouses is an important correlate of diabetes, approximately comparable in magnitude to established risk factors for diabetes.

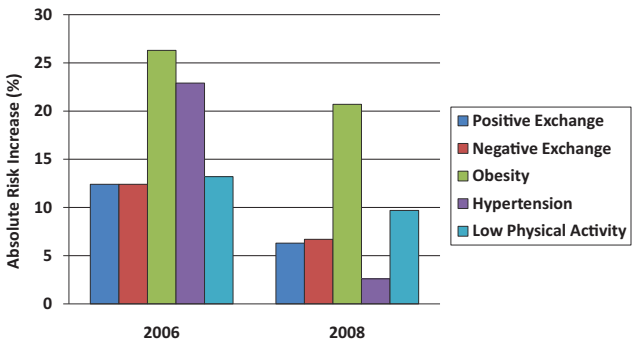

Figure 1. Absolute risk increase (ARI) for diabetes. This figure illustrates the ARI for data from the 2006 and 2008 waves of the Health and Retirement Study for partner exchange scales and established risk factors for diabetes.

There are a number of potential explanations for the observed association between positive and negative partner exchanges and diabetes in men. First, higher rates of negative partner exchanges (and lower rates of positive partner exchanges) can be conceptualized as a source of repeated or chronic interpersonal stress; indeed, measures of marital quality are correlated with perceived stress (e.g., Funk & Rogge, 2007). Repeated or chronic stress may increase levels of peripheral inflammatory biomarkers implicated in the development of MetS, insulin resistance, and diabetes (Black, 2003). Prior research has shown that poor marital quality is associated with markers of inflammation (Uchino et al., 2013; Whisman & Sbarra, 2012) and MetS (Whisman & Uebelacker, 2012; Whisman et al., 2010). Because both of these variables increase risk for diabetes, it may be that one or both of these pathways mediate the association between poor marital quality and diabetes. Second, it is well known that both diet and exercise play a critical role in the development of T2DM (Harding et al., 2008; Saito et al., 2011). Therefore, it may be that when marital quality declines, people may be at increased risk for diabetes because of changes in social processes that alter these important health behaviors. This perspective is also consistent with recent research that has demonstrated marital functioning is associated with eating behaviors and food consumption among couples (e.g., Burke, Randall, Corkery, Young, & Butler, 2012). Finally, it is possible that the presence of diabetes promotes poorer marital quality. Engaging in unhealthy behaviors (or not engaging in healthy behaviors) that are risk factors for diabetes, for example, may lead to higher rates of negative interactions or lower rates of positive interactions with one's spouse.

The association between poor marital quality and diabetes status was significant for men but not for women. Furthermore, the association between partner exchanges and diabetes status was statistically and significantly greater for men relative to women in the 2006 sample; in the 2008 sample, comparisons of the slopes of the associations between partner exchanges and diabetes status for men and women were not statistically significant. Though relatively few studies in the area of marital quality and health demonstrate associations only for men or associations that are significantly greater for men than for women, some studies have found differences between men and women that are consistent with the results we obtained. In their meta-analysis of the association between marital quality and health, Robles et al. (2013) reported that two of seven (29%) studies that found statistically significant gender differences found larger effects for men than for women.

What may contribute to the association between marital quality and diabetes status for men obtained in the current study? Data concerning the social control of health behaviors have suggested that women are much more likely to attend to men's heath behaviors than the other way around (Umberson, 1992). From this perspective, when marital quality declines, it is possible that husbands lose the benefits of having their wives remind them about their health and to engage in or avoid healthy or unhealthy behaviors, respectively. In support of this perspective, Wickrama, Conger, and Lorenz (1995) found that, among married men, husbands' and wives' ratings of the frequency of positive partner interactions (i.e., pleasurable activities) was significantly and negatively asso-

ciated with poor eating habits. Therefore, men may experience increased benefits in having support and reminders from a partner to engage in healthier behaviors (and/or reduce the frequency of unhealthy behavior), which may reduce their risk factors for diabetes.

Finally, we found no evidence that diabetes status was associated with the interaction between positive and negative partner exchanges (i.e., the association between the frequency of negative partner exchange and diabetes status was not moderated by the frequency of positive partner exchange). In comparison, Uchino and colleagues have evaluated the health-related consequences of both positive and negative aspects of relationships and found that ambivalent relationships, which are characterized by high levels of both positive and negative views of one's partner, are associated with poorer health outcomes compared with other relationship types (e.g., primarily positive or primarily negative) (see Uchino, 2013, for a review). For example, Uchino et al. (2013) found that perceived ambivalence in a support context (i.e., viewing one's spouse as a source of both positivity and negativity) was associated with higher IL-6 and fibrinogen than perceived positivity only. However, Uchino and colleagues defined ambivalence using cutoff scores on a measure—the Social Relationships Index (Campo et al., 2009)—that is based on ratings of how helpful and how upsetting respondents perceive their partners to be in particular contexts (e.g., when they need advice, understanding, or a favor), which differs from our use of continuous scores on a measure that assesses the frequency of positive and negative partner behaviors (i.e., exchanges) in general. Therefore, the strength of the association between ambivalence and health may depend on the assessment and definition of ambivalence.

Whereas results from the current study suggest that marital quality is associated with diabetes status in the general population, these results differ from findings from prior research, which generally have suggested that marital quality is unrelated to glycemic control (i.e., HbA_{1c} levels) among people with diabetes (e.g., Olson et al., 2010). There are several potential explanations for the differences between the current and prior studies. First, whereas we examined the association between marital quality and diabetes status in the general population, prior research has evaluated the association between marital quality and glycemic control among people receiving treatment for diabetes. There may be important differences in the association between marital quality and elevated HbA_{1c} among people for whom diabetes is not necessarily diagnosed or treated when compared with the association between marital quality and the management of diabetes once it has been diagnosed and treatment has begun. For example, partner influences on health behaviors, such as diet and exercise, may be greater for people who have not been diagnosed with diabetes, relative to once a person is diagnosed with diabetes and are following a physician's guidelines regarding such behaviors. Second, whereas we examined the association between marital quality and diabetes separately by gender, as well as evaluated whether gender moderated these associations, researchers have combined data for men and women in prior analyses. Consequently, it is unknown whether any of the significant associations obtained in this study would have similarly been obtained in the studies involving people receiving treatment for diabetes had analyses in the other studies been done separately by gender or included tests of gender moderation. It will be important for future research on marital quality and diabetes, therefore, to continue to evaluate potential gender differences in this association.

Finally, our measure of marital quality focused on perceptions of positive and negative partner exchanges, whereas prior studies have generally used global measures of marital quality. Perhaps differences between the current study and prior studies are due, at least in part, to differences between the studies in the measurement of marital quality. Indirect support for this perspective comes from research in diabetic patients that found that HbA_{1c} values were correlated with marital stress but not with marital cohesion or marital satisfaction, despite the fact that the three measures of marital quality were highly intercorrelated (i.e., correlations $\geq |.44|$) (Trief et al., 2006). Therefore, it may be useful to include multiple measures of marital quality in future research on diabetes, to continue to examine whether the associations between marital quality and diabetes outcomes vary depending on particular aspects of assessed marital quality.

The results of the study should be interpreted in light of several limitations. First, although the HRS is representative of older adults in the United States, it is unknown whether the current findings would generalize to younger adults, individuals in other types of intimate relationships (e.g., cohabiting relationships), or to individuals in other countries. Second, we relied exclusively on self-reports of marital quality. Moreover, the HRS data were not designed with the intention of studying marital quality per se and this leaves room for improved measurement of marital quality in future studies. Further, this study relies exclusively on cross-sectional data, which leaves open questions of causality and the direction of effect. Temporal precedence is required for establishing that a variable such as poor marital quality is a risk factor for and not just a correlate of an outcome such as diabetes (Kraemer, Stice, Kazdin, Offord, & Kupfer, 2001). Longitudinal research is needed, therefore, to evaluate whether poor marital quality is associated not only with the prevalence of diabetes but also with its incidence. Finally, the study found differences between the 2006 and 2008 samples in terms of gender moderation, which is unexplained. Therefore, further replication of this study among older adult populations is necessary to draw conclusions about the possibility of gender moderation.

If marital quality is prospectively associated with the incidence of diabetes, then health professionals may want to screen for poor marital quality and incorporate this information in their decision making regarding diabetes management. Support for this proposal comes from research that has shown, for married individuals living with diabetes, greater marital quality is associated with less diabetes-related distress (Trief, Wade, Britton, & Weinstock, 2002) and better dietary self-care and adherence to doctor's recommendations (Trief, Ploutz-Snyder, Britton, & Weinstock, 2004).

Conclusion

The current findings suggest that perceiving a greater frequency of negative exchanges and a lower frequency of positive exchanges with one's spouse was associated with a greater likelihood of diabetes in men, and that these associations were generally incremental to demographic characteristics and other risk factors for diabetes. These findings were replicated in two waves of data from a U.S. representative sample of middle-aged and older adults,

which suggests that the results are likely to be robust. By demonstrating an association between marital quality and diabetes status in the general population these results contribute to a large literature that has found that marital quality is associated with clinically relevant health outcomes (Robles et al., 2013).

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