Marital Quality and Diabetes in Later Life

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Abstract

We assess how marital quality is related to both the risk of developing diabetes and the management of diabetes after its onset over time based on data from the first two waves of the National Social Life, Health, and Aging Project. The analytic sample includes 1,228 respondents, among whom 389 are diabetic. Factor analysis is conducted to construct positive and negative marital quality scales. Respondents who either reported to have diagnosed diabetes or whose blood test of HbA1c >= 6.5% are identified as diabetic. Respondents who are diabetic are further categorized into: controlled, undiagnosed and uncontrolled diabetic groups. Results from logistic regression models suggest that an increase in positive marital quality may reduce the subsequent risk of diabetes for women. Surprisingly, for men, an increase in negative marital quality may decrease the subsequent risk of diabetes and also increase the chance of successful control of diabetes after its onset.

Diabetes is the fastest growing chronic condition in the U.S. According to the U.S. Centers for Disease Control (CDC), 25.8 million Americans, or 8.3% of the population had diabetes in 2010; these figures rose rapidly to 29.1 million and 9.3% in 2012 (Centers for Disease Control and Prevention, 2011; Centers for Disease Control and Prevention, 2014). The consequences of diabetes have been clearly recognized including serious complications and premature death (Centers for Disease Control and Prevention, 2014). In the U.S., diabetes remains the seventh leading cause of death (Centers for Disease Control and Prevention, 2014). Because diabetes can be controlled, the risk of complications lowered and the onset of diseases delayed, identifying relevant risk factors is extremely important in designing effective prevention strategies and management programs. Yet, previous research on diabetes has mostly focused on proximate behavioral risk factors (e.g., diet, exercise), ignoring upstream social factors that lead to the development of diseases. In this study, we assess specifically marital quality as one of the upstream causes of social factors that may shape both the risk and management of diabetes.

The marital relationship is a unique type of social relationship in which spouses share their space and resources, make investments together, and influence each other's health behaviors (Waite & Gallagher, 2000). Marital quality, which refers to subjective appraisal of the marital relationship including satisfaction, happiness, strain, and conflict, has a profound influence on individuals' life context and thus on health (Umberson et al., 2006). For example, marital quality influences how individuals manage their health and is especially important for diseases and conditions that rely on self-management. Diabetes is one of such diseases with a required day-to-day self-care regimen (Trief et al., 2006). The support from a good quality marriage or the conflict from a poor quality marriage may promote or disrupt adherence to diabetes care regimens (Trief et al., 2006).

To date, empirical evidence for the impact of marital quality on diabetes is limited and primarily based on cross-sectional studies and clinical or community samples (Robles & Kiecolt-Glaser, 2003). Moreover, although gender differences have been a central focus of research on health links to marriage, empirical evidence is quite mixed. Some studies suggest a stronger effect of marital quality on health for women, some report stronger effects on men, and still other studies find no significant gender differences (Whisman, Li, Sbarra, & Raison 2014; Kiecolt-Glaser & Newton, 2001). To fill in these research gaps, we analyze data from the first two waves of the National Social Life, Health, and Aging Project (NSHAP), a nationally representative longitudinal data set on older adults. We address two major research questions: (1) how is marital quality related to diabetes risk and management over time among older adults? and (2) do those patterns vary by gender?

MARITAL QUALITY AND DIABETES RISK

It has long been recognized that married people show better health than unmarried people and they also live longer (Waite & Gallagher, 2000). Recent research points to marital quality as more significant than marital status per se in shaping health (Umberson et al., 2006). Both the stress and support processes that flow from marital relationships shape an individual's life context, which in turn affect subsequent health (Robles & Kiecolt-Glaser, 2003). For example, heightened conflict from a marital relationship may expose one to excessive stress. Marital stress may directly cause the sympathetic nervous system to induce the release of stress hormones (e.g., catecholamines, cortisol), trigger physiological responses and metabolize glucose during the "fight-or-flight" process (Taylor et al., 2000). Marital stress may also tempt unhealthy behaviors (e.g., overeating, sedentary lifestyle, smoking, drinking) and in turn boost blood glucose levels (Trief et al., 2006). Consistent high blood glucose levels along with inadequate levels of insulin

or insulin resistance increases the risk of developing diabetes (American Diabetes Association, 2010). In contrast, involvement in a happy marriage provides social support and a safe haven, which reduce exposure to stress and promote a healthy lifestyle, and in turn enhance both emotional and physical health (Robles & Kiecolt-Glaser, 2003; Waite & Gallagher, 2000).

Empirical evidence on the association between marital quality and diabetes risk is limited. Studies have examined how marital quality is related to certain risk factors for diabetes, such as inflammation or metabolic syndrome (Whisman & Sbarra, 2012, Whisman, Uebelacker, & Settles, 2010). Yet, evidence on how marital quality is related to the onset of diabetes is limited. One of the very few national studies of diabetes risk in a population-based sample finds that more positive marital exchanges are related to decreased diabetes risk while more negative marital exchanges result in increased diabetes risk, and these relationships were only present among men but not women (Whisman et al., 2014). Not only was diabetes more common in men who reported lower levels of positive marital quality, but a higher level of negative marital quality is also associated with a greater risk of diabetes for men (Whisman et al., 2014). Note, although informative, Whisman and colleagues' study is based on a cross-sectional design. Given the limited evidence, especially from nationally representative population-based studies, further research on the relationship between marital quality and diabetes risk is clearly warranted. Previous literature together leads us to expect that:

Hypothesis 1: Those with higher levels of negative marital quality show greater diabetes risk over time than those with lower levels of negative marital quality, and those with higher levels of positive marital quality show lower diabetes risk over time than those with lower levels of positive marital quality.

MARITAL QUALITY AND DIABETES DIAGNOSIS AND MANAGEMENT

Diagnosis and management of diabetes largely depend on daily self-care regimen (Trief et al., 2006). Because most symptoms of diabetes are mild and may be unnoticed, diagnosis of diabetes relies heavily on regular medical examinations (Harris et al., 1992). A sportive spouse, especially wife, may take a primarily role in reminding the partner to do regular medical check, which then may help the diagnosis of diabetes. Diabetes diagnosis is the first step of the disease management process. Early detection of diabetes prompts timely treatment which is crucial for the management of diabetes development (Marshall & Flyvbjerg, 2006). Moreover, a supportive marital relationship may further promote the treatment of diabetes once diagnosed. Diabetes regulation and treatment includes medication, diet, glucose level monitoring, and lifestyle changes in terms of regular exercise, not smoking, and infrequent alcohol use (Lutfey & Freese, 2005). Marital support from a spouse may promote adherence to diabetes care regimen *indirectly* through spouses' regulation of health behaviors and thus increase the chance of controlled blood glucose (Trief, Ploutz-Snyder, Britton, & Weinstock, 2004). Moreover, better marital quality may also *directly* promote individuals' healthier diet, a more regular exercise routine, and stricter obedience of doctor's recommendations among diabetes patients (Trief et al.,2004). All of these factors promote blood glucose control. In contrast, martial stress may disrupt adherence to diabetes management either through affecting individuals' own behavior and decision making or through reducing spouses' involvement in their partners' diabetes management (August, Rook, Franks, & Stephens, 2013).

Although we know no nationally representative population-based studies that have assessed diabetes diagnosis and management in relation to marital quality, a few clinical studies based on unrepresentative samples provide supporting evidence for this relationship (Robles and Kiecolt-Glaser 2003; Schafer, McCaul, and Glascow 1986; Schwartz et al. 1991; Trief et al.

2001; Trief et al., 2002; Trief et al., 2006). For example, Trief and colleagues (2001) analyzed 78 diabetic patients ages 18-55 and found that those with better marital quality were more content with adjusting to the disease and had less stress from diabetes than those with worse marital quality. A similar study by Trief and colleagues (2002) followed up with 61 of the diabetic respondents two years later and found that better marital quality predicted more satisfaction with diabetes management and greater diabetes-related quality of life. Another study of 134 elderly diabetic patients showed that greater marital stress was related to worse control over blood glucose levels (Trief et al., 2006). These clinical studies generally conclude that marital quality is directly correlated with diabetes management and relevant health measures (Robles, Slatcher, Trombello, & McGinn, 2014), and diabetics who have better marital adjustment and higher levels of intimacy experience better adaption to the disease and less distress from managing diabetes (Trief et al.,2001; Trief et al., 2002). Taken together, we expect that:

Hypotheses 2: *Those with higher levels of negative marital quality are less likely to diagnose or control diabetes after its onset than those with lower levels of negative marital quality, and those with higher levels of positive marital quality are more likely to diagnose or control diabetes after its onset than those with lower levels of positive marital quality*.

GENDER DIFFERENCES

Gender has been a central focus of research on marriage and health. While married men on average receive more health promotion benefits (e.g., emotional support, regulation of health behaviors) from their marriages, married women's health seems to be more vulnerable to marital stress (Kiecolt-Glaser & Newton, 2001). We expect that women's metabolic system is more responsive to marital strain as women age: women are generally more sensitive to the quality of a relationship than are men, and therefore women in strained marriages are more likely to have a

greater number of symptoms of metabolic syndrome and/or a greater incidence of depression (Wu & DeMaris, 1996). A number of studies have established the linkage between depression and onset of diabetes (Carnethon et al. 2003; Everson-Rose et al. 2004). Indeed, depression is one of the most often proposed mediating mechanisms linking the marital relationship and physical health (Burman & Margolin, 1992; Graham et al., 2006). This link may be related to the different hormone levels and profiles that exist between men and women. Indeed, a handful of clinical studies confirm this view and conclude that marital conflict tends to evoke greater and more persistent physiological changes (e.g., increases glucose levels) in women than in men (Kiecolt-Glaser & Newton, 2001). However, a more recent population-based national study revealed different patterns, finding that marital quality is only related to men's risks of diabetes but is not related to women's (Whisman et al., 2014). The mixed gender evidence may reflect gender differences in the specific physiological mechanisms and health outcomes measured in the studies. To the extent that women appear to be both physiologically and psychologically more reactive to marital stress than men (Donoho et al., 2013), we expect that the relationships between marital quality and diabetes are stronger for women than for men. Taken together, we expect the following:

Hypothesis 3: The associations between marital quality and diabetes risk and management are stronger for women than for men.

DATA

We use the first two waves of national longitudinal data from the National Social Life, Health and Aging Project (NSHAP). NSHAP, one the first national-scale population-based studies of health and intimate relationships at older ages, was conducted by NORC at the University of Chicago. A nationally representative probability sample of community-dwelling

individuals ages 57–85 was selected from households across the U.S. and screened in 2004. African Americans, Latinos, men, and those 75–84 years old were over-sampled. All analyses are weighted and further adjusted for clustering and stratification of the complex sampling design using the survey data analysis commands in Stata (StataCorp, 2012).

The first wave of the NSHAP (Wave 1) included a sample of 3,005 adults ages 57–85 who were interviewed during 2005-2006 (Waite, Laumann, et al., 2014). Both in-home interviews and lab tests and assays were conducted. Wave 2 consisted of 2,261 Wave 1 respondents who were re-interviewed during 2010–2011 (Waite, Cagney, et al., 2014). We restricted the analysis to the 1,250 respondents who had remained married and who had been interviewed in both waves. Cases with missing values on key variables, including Wave 1 marital quality and Wave 2 diabetes, were further deleted in a list-wise fashion. Thus, we obtained a total sample of 1,228 respondents, among whom 389 are diabetic, in the final analyses.

MEASURES

Diabetes Risk and Management. To measure diabetes, we combine both the biological and self-reported measures collected by the NSHAP. The NSHAP measured glycosylated hemoglobin, or HbA1c, which has been shown to be a useful biological marker in diagnosis and treatment of diabetes (Gomero, McDade, Williams, & Lindau,2008). During the home interviews, blood was obtained via a single finger-stick using a retractable-tip, single-use disposable lancet and then applied to filter paper for transport and storage. Details about the procedures of NSHAP HbA1c measurement are described by Gomero et al. 2008. Following the recommendations of the American Diabetes Association and the World Health Organization, we identify respondents with diabetes when HbA1c is equal to or greater than 6.5% (American

Diabetes Association, 2010; The International Expert Committee, 2009). In addition, respondents were asked whether they had ever been told by a medical doctor that they had diabetes or high blood sugar. Based on responses to this question, along with the measures of HbA1c, we created two variables to measure diabetes risk and diabetes management separately.

Diabetes risk is measured as a dichotomous outcome with the value of 1 indicating respondents who either reported to have diagnosed diabetes or whose blood test of HbA1c >= 6.5% and the value of 0 indicating others. Among those who have diabetes (i.e., either self reports of having diagnosed diabetes or HbA1c >= 6.5%), we further measure *diabetes management* with three categories: (1) normal blood sugar reading but diagnosed with diabetes (referred as "controlled" diabetic group), (2) high blood sugar reading but no diagnosis of diabetes (referred as "undiagnosed" diabetic group), and (3) high blood sugar reading and diagnosed diabetes (referred as "uncontrolled" diabetic group). The controlled diabetic group is the reference group.

Marital Quality. Marital quality consists of both positive and negative dimensions, which are not opposite ends of a single dimension but distinct constructs. A marriage may be high, for example, on both positive and negative dimensions (Umberson et al., 2006). We follow Liu and Waite (2014) to calculate marital quality scales using the NSHAP data. These scales are composed of nine items, which are recoded in order to obtain consistent response categories across all items. First, respondents were asked how close they felt their relationship with the spouse was (item 1). Responses range from (1) not very close or somewhat close, (2) very close, to (3) extremely close. Respondents were also asked how happy they were in their spousal relationship (item 2: (1) very unhappy, to (7) very happy) and how emotionally satisfied they felt with their spousal relationship (item 3: (0) not at all, to (4) extremely). Because these two items

(i.e., items 2 and 3) were highly skewed, we collapsed the categories. For relationship happiness we collapsed the values to: 1 = Unhappy (1, 2, 3, 4), 2 = Happy (5, 6), and 3 = Very Happy (7). For emotional satisfaction we collapsed the values to 1 = Not Satisfied (0, 1, 2), 2 = Satisfied (3), and 3 = Very Satisfied (4) (see Galinsky & Waite, 2014).

Additionally, respondents were asked the extent to which they preferred to spend their free time doing things with their spouse (item 4). Responses ranged from (1) mostly together, (2) some together and some apart, to (3) mostly apart. We reverse-coded this item so that higher values indicate better marital quality. Finally, respondents were asked four questions about their spouse: how often they could open up to the spouse if they needed to talk about their worries (item 5), how often they could rely on the spouse for help if they had a problem (item 6), how often the spouse made too many demands on them (item 7), and how often the spouse criticized them (item 8). In Wave 2, NSHAP added an additional question: "How often does spouse gets on your nerves?" (item 9, not available in Wave 1). Responses to each question (items 5–9) are (1) never, hardly ever, or rarely, (2) some of the time, and (3) often.

Results from exploratory factor analyses suggest that these nine items form two different dimensions, which we refer to as positive and negative marital quality, respectively. We create two factor scores for positive and negative marital quality based on the iterated principle factor method and an oblique rotation. To make full use of the marital quality information offered by the measures available in NSHAP, we measure marital quality by using all available items in each wave. Our additional analysis (not shown but available upon request) using only the items shared in both waves suggested similar results as we report here. However, analyses of change in marital quality between waves use only the items available in both waves for comparability.

Table 1 shows the factor loadings of each item used to generate the factor scores for positive and negative marital quality, respectively.

Table 1 about here

Other Covariates. We include three types of covariates (all measured at Wave 1) that are related to both marital quality and diabetes: socio-demographic covariates, psychological distress and health-behavior-related covariates.

Socio-Demographic Covariates. We stratify all analyses by *gender*. *Age* is categorized into three groups: 57–64 (young-old, reference), 65–74 (middle-old), and 75–85 (old-old). *Race-ethnicity* includes non-Hispanic white (reference), non-Hispanic black, Hispanic, and other. *Education* is grouped into four categories: no diploma (reference), high school graduate, some college, and college graduate. *Family income* is derived from the question that asked respondents to self-assess their family income levels compared with other American families. Responses range from below average (reference), average, to above average. We create a "missing" indicator category for the 15% of the analytic sample without valid values on family income.

Psychological Distress. We control for *depression*, which is measured by an 11-question subset of the Center for Epidemiological Studies Depression Scale (CES-D) (Radloff, 1977). Respondents were asked how often in the past week they experienced any of the following: (1) I did not feel like eating; (2) I felt depressed; (3) I felt that everything I did was an effort; (4) My sleep was restless; (5) I was happy; (6) I felt lonely; (7) People were unfriendly; (8) I enjoyed life; (9) I felt sad; (10) I felt that people disliked me; and (11) I could not get "going". Response categories ranges from (0), rarely or none of the time, to (3), most of the time. The items are recoded such that higher values indicate higher levels of depression. The final scale is the sum of the 11 scores.

Health-Behavior-Related Covariates. Because respondents may take medications for diabetes, we include an indicator for *taking any diabetes medications* (1 = Yes, 0 = No). We also control indicators for *currently smoke* (1 = Yes, 0 = No), *currently drink alcohol* (1 = Yes, 0 = No), *physical exercise* (1= vigorous physical activity or exercise three times or more per week, 0 = others), and *Body Mass Index*—all are related to diabetes and marital quality. Body Mass Index (BMI) is calculated from measured height and weight, grouped into four categories: normal or underweight (BMI < 25), overweight (25 <= BMI < 30), obese (30 <= BMI < 40), and morbidly obese (BMI >= 40) (World Health Organization, 1995). Missing values on BMI (about 4%) were imputed with the mean. Excluding these cases or including them as a separate category showed similar results.

Table 2 about here

ANALYTIC APPROACH

We conduct two separate sets of analysis for diabetes risk and diabetes management respectively. For the analysis of diabetes risk, we use the total sample of 1,228 respondents. For the analysis of diabetes management, we restrict the analysis to 389 respondents who are diabetic. We estimate binary logistic regression models to assess diabetes risk and multinomial logistic regression models to assess diabetes management as predicted by marital quality. Because our preliminary results (not shown) revealed similar results by including positive and negative marital quality simultaneously or separately in the models, we report the final models including both measures of marital quality simultaneously. We use the lagged dependent variable approach to analyze the two waves of data. Specifically, we use Wave 1 marital quality along with change in marital quality between Waves 1 and 2 to predict Wave 2 diabetes controlling for Wave 1 diabetes and all other covariates.

We estimate a sequence of models. We start with examining the general relationship between marital quality and diabetes risk and management controlling for socio-demographic covariates only. Next, we add measures of health behaviors and psychological distress separately. This allows us to test the idea that health behaviors and psychological distress may mediate the relationship between marital quality and diabetes. Since preliminary results (available upon request) showed no evidence of mediation, we only report the final full model in which all covariates are controlled—including socio-demographic, health-behavior-related covariates and psychological distress. To better understand the potential gender differences, we stratify all analyses by gender.

Correction for Sample Selection Bias. Our analyses are restricted to married respondents in both waves so the samples are selective of those with relatively good marital quality; marriages of poor quality are more likely to have ended. Moreover, sample attrition between waves, due to mortality, poor health, refusal or inability to locate the respondent is not random. Therefore, we apply the approach, developed by Heckman (Heckman, 1979) to adjust the sample selection biases that are due to selection though marriage and mortality. See Liu (2012) and Liu and Waite (2014) for similar applications. This approach consists of modeling the probability that a respondent would die between Waves 1 and 2 and modeling the probability that a respondent would remain married at both waves, using logistic regression models, conditional on a set of predictors measured at Wave 1. Then, for individuals who did not die and who remained married at both waves, diabetes risk and management are modeled as a function of a set of independent variables, including the estimated probabilities of dying and of being married at both waves. Following this Heckman-type correction, estimates of diabetes risk and management

should be interpreted as being adjusted for factors that may affect that risk, as well as for the tendency to die and the tendency to remain married.

RESULTS

Table 2 shows the weighted descriptive statistics of all analyzed variables for both the total sample of analysis of diabetes risks (N=1228) and for the subsample of analysis of diabetes management (N=389). These results suggest that 18.55% of respondents were diabetic at Wave 1, and this proportion rises rapidly to 29.57% at Wave 2. There are also modest changes in marital quality over time.

Table 3 shows estimated regression coefficients from binary logistic regression models for diabetes risk predicted by marital quality for the total sample as well as by gender. For interpretation, the odds ratios are derived by exponentiation. Results from Table 3 suggest that after all covariates are controlled, both increases in positive and negative marital quality between Wave 1 and Wave 2 are significantly associated with lower odds of having diabetes at Wave 2 for the total sample. Yet, the results by gender further reveal that the relationship between positive marital quality and diabetes risk only presents for women while the relationship between negative martial quality and diabetes risk only presents for men. Specifically, for women with every one unit increase of positive marital quality between Waves 1 and 2, the odds of being diabetic decreases by 45% (i.e., 1-exp(-0.59)); while, surprisingly, for men, with one unit of increase in negative marital quality between Waves 1 and 2, the odds of being diabetic decreases by 32% (i.e., 1-exp(-0.39)).

Tables 4 shows estimated regression coefficients from multinomial logistic regression models for diabetes management predicted by marital quality for the total sample as well as by gender. For interpretation, the relative risk ratios are derived by exponentiation. Results from

Table 4 suggest that after all covariates are controlled, an increase in negative marital quality between Wave 1 and Wave 2 is significantly associated with lower risks of uncontrolled diabetes at Wave 2, but this is only true for men. Specifically, for men with one unit of increase in negative marital quality between Waves 1 and 2, the relative risk of uncontrolled diabetes decreases by about 52% (i.e., 1-exp(-0.73)).

DISCUSSION AND CONCLUSION

Although family and health scholars have long argued that marriage promotes health (Robles & Kiecolt-Glaser, 2003; Waite & Gallagher, 2000), this argument is highly contingent upon the quality of marriage (Umberson et al., 2006). This study highlights the importance of marital quality in particular for the development and management of diabetes. We provide one of the first nationally representative population-based evidence of this overall relationship, with a special emphasis on potential gender variation. We also contribute to the literature by considering both the risk and the management of diabetes. Below, we outline our major findings and implications from this study in relation to each research hypothesis.

It has long been recognized that married people show better health than the unmarried including a lower risk of disease development as well as better outcomes following the onset of diseases (Coyne et al. 2001; Zhang & Hayward 2006). Recent research posits that marital quality as one of the key factors that define life course contexts is more important than marital status for health (Umberson et al., 2006). We consider both positive and negative aspects of marital quality, which intervene in life contexts in different ways. Based on previous clinical evidence, we hypothesized that those with higher levels of negative marital quality would subsequently experience both greater diabetes risk and worse diabetes management than those with lower levels of negative marital quality; and those with higher levels of positive marital quality would

subsequently experience lower diabetes risk and better diabetes management than those with lower levels of positive marital quality (Hypotheses 1 and 2). Our results provide mixed evidence on these hypotheses, highlighting that the relationship between marital quality and diabetes risk and management highly depends on gender (Hypothesis 3).

For women, we find that an increase in positive marital quality may reduce the risk of subsequent diabetes over time. This result is different from one recent national study suggesting that more positive marital exchanges are only related to decreased diabetes prevalence for men but not women (Whisman et al., 2014). Note, Whisman and colleagues analyzed a cross-sectional sample while our study is based on a longitudinal design. Moreover, our finding is indeed in line with previous clinical evidence suggesting that martial quality has a greater impact on women's health than on men's (Kiecolt-Glaser &Newton, 2001). It may be that women are more sensitive to the quality of a relationship than men and thus are more likely experience the health boost from a good quality relationship. Although marriage and health scholars often contend that poor marital quality or marital loss are especially detrimental to women's health (Liu &Waite, 2014), our results show the positive side, suggesting that good marital quality may actually promote women's metabolic health. Future studies should examine the specific social, psychological, behavioral and biological mechanisms that positive marital quality promotes women's metabolic health.

Surprisingly, for men, we find that an increase in negative marital quality may decrease the chance of subsequent risk of developing diabetes and also increase the success of controlling diabetes after its onset. These results for men are unexpected. It is probable that wives are more likely than husbands to play the role of regulating the health behavior of a spouse especially if the husband is diabetic. Both the development and treatment of diabetes are highly affected by

individuals' lifestyle. Diabetes requires day-to-day (and even more frequent) monitoring, which the wives could nag the husband to do. This may increase the conflict between spouses but at the same time decrease the chance of developing diabetes and promote the success of controlling diabetes for the husbands. However, our results suggest that the association between negative marital quality and diabetes for men remains strong even after we control a number of health behaviors. Future research should consider different sources of negative marital quality for men and explore which aspects of negative marital quality as well as the mechanisms through which they affect men's diabetes risk and management.

Several study limitations should be considered. First, our study is based on two waves of longitudinal data. Although we attempt to tease out some selectivity issues and causal relationships, we were limited by sample size, especially for diabetes management and separate gender groups. To understand the role of selection and causal processes in the links between marital quality and diabetes, future studies should employ longitudinal data with larger sample size and more waves of follow-up. The NSHAP is currently collecting the third wave of data, which will provide opportunities to further untangle causality. Second, our samples are restricted to respondents who survived and were married in both waves. Therefore, conclusions in the present study may only apply to a selected population of older adults. However, we emphasize that although our conclusions are more relevant to the population of older adults who are not in very poor health, less likely to die, and more likely to stay married, this study is based on a random sample from that segment of the population. Finally, various social, biological, psychological, and behavioral mechanisms underlie the link between marital quality and diabetes. Future studies should seek to identify the precise mechanisms and processes through

which marital quality and diabetes affect each other, and to address how those mechanisms and processes vary by gender.

Despite such limitations, our study makes significant contributions to this line of literature. We build on clinical evidence on the importance of marital quality for metabolic health by using a nationally representative longitudinal data set. More importantly, results from this study add to the mixed evidence on gender differences in marital quality links to health. Although growing evidence suggests that women's health is especially vulnerable to poor marital quality or marital loss (Liu and Waite, 2014), our results show the positive side, with benefits to women's metabolic health from positive marital quality. Given that diabetes is the fastest growing chronic condition in the U.S., implementation of public policies and programs designed to promote marital quality should also reduce the risks of diabetes and thus promote longevity, especially for women at old ages. Surprisingly, we find that negative marital quality may to some extent slow down the development of diabetes as well as promote the treatment after its onset. These results challenge the traditional assumption that negative marital quality is always bad and encourage family scholars to further distinguish different sources that create negative marital quality as sometimes "nagging is caring".

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Table 1. Factor Loadings For Marital Quality

	Wave 1		Wave 2	
	PMQ	NMQ	PMQ	NMQ
How close do you feel is your relationship with spouse?	**0.58**	-0.11	**0.64**	0.03
How would you describe your marriage in terms of happiness?	**0.57**	-0.15	**0.60**	-0.10
How emotionally satisfying do you find your relationship with spouse?	**0.63**	-0.08	**0.57**	-0.07
Do you and spouse spend free time together or apart?	**0.38**	-0.02	**0.42**	0.02
How often can you open up to spouse?	**0.60**	0.08	**0.62**	-0.00
How often can you rely on spouse?	**0.61**	0.09	**0.50**	0.06
How often does spouse make too many demands on you?	-0.01	**0.64**	0.07	**0.60**
How often does spouse criticize you?	0.03	**0.71**	0.01	**0.70**
How often does spouse get on your nerves?	---	---	-0.32	**0.35**

--- Item not available at the specific wave.
PMQ: positive marital quality. NMQ: negative marital quality.

Table 2. Weighted Descriptive Statistics

Diabetes Risk (N=1,228)			
Marital Quality	Mean(SD)	Min	Max
Positive marital quality W1	0.05 (0.86)	-3.75	0.95
Negative marital quality W1	-0.05(0.79)	-0.96	2.56
Positive marital quality W2	0.00(0.71)	-3.91	3.56
Negative marital quality W2	0.00(0.75)	-2.64	2.93
Diabetes			
		Percent/mean(SD)	
Diabetes risk W1			
Nondiabetic			81.45
Diabetic			18.55
Diabetes risk W2			
Nondiabetic			70.43
Diabetic			29.57
Covariates W1			
Gender			
Female			37.87
Male			62.13
Age group			
57-64			54.05
65-74			31.61
75-85			14.34
Race-ethnicity			
Non-Hispanic white			84.33
Non-Hispanic black			6.24
Hispanic			6.98
Others			2.45
Education			
No diploma			12.25
High school graduate			23.35
Some college			32.53
College graduate			31.87
Relative family income			
Below average			16.72
Average			35.47
Above average			33.06
Missing			14.75
Smoke			
No			86.46
Yes			13.54
Drink			
No			34.00
Yes			66.00
BMI			
Normal or underweight			21.55
Overweight			41.93
Obesity			32.94
Morbidly obese			3.58
Physical activity			
< 3 times per week			32.59
>= 3 times per week			67.41
Medications			
Does not take diabetes medications			86.43
Takes diabetes medications			12.78
Missing			0.79
Psychological distress			4.28(4.33)
Probability of death between W1 and W2			0.09(0.08)
Probability of staying married in both waves			0.56(0.21)

Diabetes Management (N=389)			
Marital Quality	Mean(SD)	Min	Max
Positive marital quality W1	0.06(0.79)	-3.52	0.95
Negative marital quality W1	-0.03(0.76)	-0.94	2.39
Positive marital quality W2	-0.04(0.78)	-3.91	3.22
Negative marital quality W2	-0.02(0.73)	-2.32	2.93
Diabetes			
		Percent/mean(SD)	
Diabetes management W1			
Controlled diabetes			12.63
Undiagnosed diabetes			5.20
Uncontrolled diabetes			20.72
Missing			61.44
Diabetes management W2			
Controlled diabetes			34.28
Undiagnosed diabetes			34.41
Uncontrolled diabetes			31.31
Covariates W1			
Gender			
Female			33.35
Male			66.65
Age group			
57-64			54.86
65-74			29.26
75-85			15.89
Race-ethnicity			
Non-Hispanic white			79.62
Non-Hispanic black			10.33
Hispanic			7.25
Others			2.79
Education			
No diploma			13.81
High school graduate			24.21
Some college			30.31
College graduate			31.68
Relative family income			
Below average			16.95
Average			32.63
Above average			30.71
Missing			19.71
Smoke			
No			88.64
Yes			11.36
Drink			
No			43.27
Yes			56.73
BMI			
Normal or underweight			13.86
Overweight			36.57
Obesity			44.65
Morbidly obese			4.93
Physical activity			
< 3 times per week			43.19
>= 3 times per week			56.81
Medications			
Does not take diabetes medications			58.16
Takes diabetes medications			40.57
Missing			1.27
Psychological distress			4.91(4.70)
Probability of death between W1 and W2			0.10(0.08)
Probability of staying married in both waves			0.55(0.20)

W1: Wave 1. W2: Wave 2.

Table 3. Estimated Regression Coefficients from Binary Logistic Regression Models for Marital Quality to Predict Diabetes Risk

	Total Sample	Women	Men
W1 PMQ	0.04	-0.18	0.12
	(0.17)	(0.19)	(0.22)
Change PMQ W2-W1	-0.30*	-0.59*	-0.11
	(0.12)	(0.26)	(0.19)
W1 NMQ	-0.14	-0.53	-0.03
	(0.23)	(0.34)	(0.25)
Change NMQ W2-W1	-0.41**	-0.47	-0.39*
	(0.14)	(0.27)	(0.16)
Constant	-1.35	-2.01	0.19
	(0.80)	(1.21)	(1.14)
	N=1,228	N=474	N=754

*** p<0.001, ** p<0.01, * p<0.05

Standard errors in parentheses.

PMQ: positive marital quality. NMQ: negative marital quality. W1: Wave 1. W2: Wave 2.

All models control for age, race, education, income, diabetes risk at W1, probability of death between W1 and W2, probability of remaining married in both waves, smoking, drinking, BMI, physical activity level, taking diabetes medications, and psychological distress

Table 4. Estimated Regression Coefficients from Multinomial Logistic Regression Models for Marital Quality to Predict Diabetes Management

	Total Sample		Women		Men	
	Undiagnosed v. Controlled	Uncontrolled v. Controlled	Undiagnosed v. Controlled	Uncontrolled v. Controlled	Undiagnosed v. Controlled	Uncontrolled v. Controlled
W1 PMQ	-0.31	0.01	-0.52	-0.20	-0.15	0.04
	(0.26)	(0.28)	(0.43)	(0.45)	(0.48)	(0.39)
Change PMQ W2-W1	-0.23	-0.12	0.35	0.82	-0.46	-0.30
	(0.28)	(0.26)	(0.47)	(0.41)	(0.43)	(0.31)
W1 NMQ	-0.33	-0.52	-0.42	-0.34	0.03	-0.50
	(0.32)	(0.38)	(0.48)	(0.72)	(0.42)	(0.57)
Change NMQ W2-W1	0.05	-0.57*	0.59	0.38	-0.06	-0.73*
	(0.29)	(0.26)	(0.50)	(0.56)	(0.47)	(0.28)
Constant	-14.68***	-3.38*	-18.78***	-3.40	-12.42***	-1.36
	(1.04)	(1.42)	(3.55)	(2.99)	(1.46)	(2.00)
	N=389		N=136		N=253	

*** p<0.001, ** p<0.01, * p<0.05.

Standard errors in parentheses.

PMQ: positive marital quality. NMQ: negative marital quality. W1: Wave 1. W2: Wave 2.

All models control for age, race, education, income, diabetes risk at W1, probability of death between W1 and W2, probability of remaining married in both waves, smoking, drinking, BMI, physical activity level, taking diabetes medications, and psychological distress