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Using Marital Status and Continuous Marital Satisfaction Ratings to Predict Depressive Symptoms in Married and Unmarried Women with Systemic Sclerosis: A Canadian Scleroderma Research Group Study

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ABSTRACT

Background: Married persons have, on average, better mental health than non-married persons. Among married persons, marital satisfaction is associated with better mental health. Studies that have compared mental health among married and non-married persons and considered marital satisfaction have categorized patients as satisfied versus unsatisfied, which reduces statistical power and does not generate clinically useful information on mental health across the marital satisfaction spectrum.

Objective: To demonstrate a novel regression approach to evaluate mental health in women with systemic sclerosis (SSc), comparing married and unmarried women, accounting for continuously measured marital satisfaction.

Methods: Depressive symptoms were assessed using the Center for Epidemiologic Studies Depression Scale (CES-D) and marital satisfaction with the Dyadic Adjustment Scale-7. A single multiple linear regression model was used to predict CES-D scores from marital status and, among married women, continuously measured marital satisfaction, controlling for demographic and clinical characteristics.

Results: Of 725 women, 494 (68%) were married or living as married. On average, married women had CES-D scores 2.0 points (0.19 standard deviations [SDs]) lower than unmarried women (p=0.013). Among married women, 1.0 SD increases in marital satisfaction were associated with 2.2 point (0.21 SDs) decreases in CES-D scores (p<0.001). Married women below the 19th percentile of marital satisfaction had greater predicted depressive symptoms than unmarried women. Married women's predicted CES-D scores ranged from 6.7 points lower to 6.9 points higher than unmarried women, depending on marital satisfaction.

Conclusion: Comparisons of mental health in married and unmarried rheumatic disease patients should include continuously measured marital satisfaction.

SIGNIFICANCE AND INNOVATION

- Previous studies that have compared mental health between married and unmarried patients in multivariate prediction models have either ignored marital satisfaction or have dichotomized marital satisfaction, which reduces statistical power and minimizes clinically important differences in mental health across the martial satisfaction spectrum.
- This study demonstrates how to integrate a continuous predictor of marital satisfaction into models that include both married and unmarried patients in order to estimate influence on important mental health outcomes, which has not been done previously.
- On average, married women with systematic sclerosis (SSc) had significantly lower depressive symptom scores than unmarried women with SSc, but this magnitude was much smaller than the difference in depressive symptom scores across the spectrum of marital satisfaction.
- Married women with SSc below the 19th percentile of marital satisfaction had similar or greater predicted depressive symptom scores than unmarried women with SSc, something that could not be determined if satisfaction were dichotomized with a median split or another cut point, as has been done in previous studies.

INTRODUCTION

People who are married or in marriage-like relationships report, on average, better mental health than those who are not (1). In rheumatology settings, better self-reported mental health outcomes have been reported for married patients compared with unmarried patients in rheumatoid arthritis, lupus, chronic musculoskeletal pain, and systemic sclerosis (SSc), for example (2-5). In SSc, a rare multisystem connective tissue disease that affects the skin and internal organs and is associated with significantly reduced quality of life (6, 7), unmarried patients report significantly higher levels of depressive symptoms than married patients (4).

Among married people, poor marital quality and low marital satisfaction are consistently associated with worse mental health symptoms and reduced ability to cope with serious medical illnesses (8-12). Most studies of the association between marital quality and mental health, however, have focused only on individuals who are married or in marriage-like relationships (9). Few studies have integrated marital status with marital quality or satisfaction simultaneously in prediction models in order to compare mental health in people with different levels of marital quality to mental health in unmarried individuals.

We identified 3 studies that have used multivariate prediction equations to assess mental health outcomes in married and unmarried participants, including an assessment of marital satisfaction or quality among married participants (13-15). Two studies classified marital satisfaction dichotomously based on a sample-specific median split of relationship satisfaction scores (13, 14). In one (13), a population-based study of over 3,500 respondents from Australia, men and women in the top half of marital satisfaction scores had better mental health than single peers, but men and women in the bottom half did not. Similarly, in the second study (14), which included 251 women with chronic pain from osteoarthritis or fibromyalgia from the US, women

in the top half of relationship satisfaction scores had more adaptive affective and cognitive responses to pain than women in the bottom half of scores and patients without partners.

In the third study (15), which included 255 rheumatoid arthritis patients from the US, rather than dichotomizing based on a median split, the authors categorized married patients as "happily partnered" or "unhappily partnered" based on a cut point on the Locke-Wallace Marital Adjustment Scale (16). Although based on previous data, the cut point was derived from a sample of young, well-educated, husbands and wives who completed the scale in the 1950s, but has not been validated since or in any other population (16).

Simplicity is gained by dichotomizing continuous marital satisfaction variables for use in prediction models, but it comes at a substantial cost (17-21). One important cost is the loss of statistical power. Grouping patients by dichotomizing is essentially an extreme form of rounding (20), in which all patients above or below a cut point are treated as if their score was exactly the same as all others on the same side of the cut point. The loss of information inherent in doing this results in potentially substantial underestimation of the magnitude of associations, and, thus, of the importance of the dichotomized predictor variable (17-20). Thus, in the case of marital satisfaction, even when associations are identified, dichotomization artificially diminishes their magnitude.

A second major cost of dichotomization relates to the meaning of the cut point that is used. Predictor variables are often dichotomized at the median, but in the case of marital quality or satisfaction there is no inherent reason to assume that exactly half the people in a sample have satisfactory marital relationships, whereas the other half have polar opposite unsatisfactory relationships (17-20). A score below or above a median cut point cannot be interpreted clinically without more information. Adding to the problem, the use of median cut points has been shown

to lead to a wide range of different cut points for the same measure across different studies, rendering findings difficult or impossible to compare and underscoring the arbitrary nature of median-based cut points (20, 21). Even when cut points are based on some degree of evidence, as with the Locke-Wallace Marital Adjustment Scale (16), the meaning of the cut point is still not necessarily clear, and problems remain related to potentially substantial losses of information and the false assumption that all patients on one side of a cut point are equivalent to each other and polar opposites of all patients on the other side.

Ideally, rather than dichotomizing, we would compare mental health outcomes between married and unmarried patients in a way that evaluates the influence of marital satisfaction or marital quality continuously for married patients. This would be a more powerful method statistically that also provides more clinically relevant outcomes than dichotomizing. It would also provide an estimate of the degree to which mental health symptoms increase as marital satisfaction decreases and would use patient data to identify the point on the spectrum of marital satisfaction at which unmarried and married patients have similar levels of mental health symptoms. No studies, however, have demonstrated how to integrate a continuous predictor of marital satisfaction into models that include both married and unmarried patients in order to estimate influence on important mental health outcomes.

Rates of emotional distress are high in SSc (4, 22), and associated with marital status (4). Thus, the objective of this study was to demonstrate the use of a novel regression model to simultaneously assess the relationship between marital status, continuously measured marital satisfaction, and symptoms of depression among women with SSc. To illustrate the differences between this approach and categorical methods that have been used previously, we compared

results obtained using this approach to results obtained using a median split of marital satisfaction scores.

METHODS

Patient Sample

The study sample consisted of female patients from 14 Canadian Scleroderma Research Group (CSRG) Registry sites. Registry patients must be \geq 18 years of age, have a rheumatologist-confirmed diagnosis of SSc, and be fluent in English or French. Over 98% of Registry patients meet 2013 ACR/EULAR classification criteria for SSc (23). At annual Registry visits, patients undergo standardized clinical evaluations and complete a series of self-report questionnaires, including questions on marital satisfaction. For women who completed the questionnaires at more than one annual visit, we selected the earliest visit with complete data for all variables in our regression model. All patients provided informed consent, and the research ethics board of each participating center approved the data collection protocol. Overall, approximately 80% of patients approached consent to Registry enrolment.

Measures

Sociodemographic and clinical characteristics

Sociodemographic variables, including age, education level, and race/ethnicity were based on patient report. Clinical characteristics of SSc were recorded by a CSRG rheumatologist. SSc disease duration was defined as time since onset of a patient's first symptom (either Raynaud's or non-Raynaud's). Skin involvement was assessed using the modified Rodnan skin score (24), in which degree of skin thickening is scored from 0 (*no involvement*) to 3 (*severe thickening*) across 17 body areas (total score range 0-51). Limited SSc was defined as skin involvement distal to the elbows and knees only, whereas diffuse SSc was defined as skin involvement proximal to the elbows and knees, and/or trunk (25). Patients with sine SSc, defined as SSc without skin involvement, were grouped with patients with limited SSc (26). Number of tender joints was determined by summing the total number of joints with tenderness on pressure and/or pain on passive movement, using a 66-joint count. Extent of gastrointestinal involvement and extent of lung involvement were measured with the Medsger Scleroderma Disease Severity Scale (27, 28) with each organ system scored separately from 0 to 4 (*no involvement* to *end stage involvement*).

Marital status and satisfaction

Women were classified as married if they reported being married or living as married. Marital satisfaction was assessed among women married or living as married using the 7-item Dyadic Adjustment Scale (DAS-7) (29). The DAS-7 assesses 3 components of relationship satisfaction: dyadic consensus (degree to which a couple agrees on matters of importance to the relationship, 3 items, 0-5 item scoring, *always disagree* to *always agree*), dyadic cohesion (degree of closeness and shared activities, 3 items, 0-5 item scoring, *never* to *more than once a day*), and global dyadic satisfaction (1 item, 0-6 item scoring, *extremely unhappy* to *perfect*). Total scores range from 0 to 36, with higher scores indicating greater marital satisfaction. Cronbach's alpha was 0.84 in the present study.

Symptoms of depression

Symptoms of depression were assessed with the 20-item Center for Epidemiologic Studies Depression Scale (CES-D) (30). The frequency of each symptom during the past week is rated on a 0-3 Likert-type scale (*rarely or none of the time* to *most or all of the time*), and total scores range from 0 to 60, with higher scores indicating more depression symptoms. Cutoff scores that are sometimes used include ≥ 16 for "possible depression" and scores ≥ 23 for "probable depression" (30). Cronbach's alpha was 0.90 in the present study.

Data Analyses

Married women were compared to unmarried women on sociodemographic and disease variables using chi-square tests for categorical variables and two-tailed t-tests for continuous variables. Bivariate correlations of sociodemographic (age, education) and clinical characteristics (disease duration, disease classification, number of tender joints, extent of gastrointestinal involvement, extent of lung involvement) with depressive symptoms were assessed using Kendall's tau.

Multiple linear regression was used to model the association of marital status and, among married women, marital satisfaction, with depressive symptoms, controlling for sociodemographic (age, education) and clinical (disease duration, disease classification, number of tender joints, extent of gastrointestinal involvement, extent of lung involvement) characteristics. This model was chosen to be consistent with a previous study on predictors of depressive symptoms in SSc (4), adding only the continuous marital satisfaction score. Since marital satisfaction was assessed among married women only, it was entered as an interaction variable in the regression model that included both married and unmarried women. Thus, standardized z-scores from the DAS-7 were entered for married women, whereas for unmarried women, a score of 0 was entered. By constructing the interaction variable in this way, the regression coefficient of the interaction term reflected the change in CES-D outcome scores associated with a 1 standard deviation change in total DAS-7 scores among married women, controlling for sociodemographic and clinical characteristics.

The assumption of normal distribution of residuals in the regression model was tested using a normal probability plot. Additionally, correlations between independent variables and tolerances were calculated to check for multicollinearity. Linearity of the model was assessed using partial residual plots.

Based on the multiple regression equation, we estimated the level of marital satisfaction among married women at which married women and unmarried women had equivalent CES-D scores, controlling for sociodemographic and clinical characteristics. Two alternative methods were used to determine the percentage of married women who had equal or greater symptoms of depression than the average unmarried woman. First, we determined the proportion of married women who had DAS-7 scores below the value for which married and unmarried women had equivalent estimated CES-D scores. Second, we transformed the z-score at the intersection point into a percentile based on the normal curve.

To compare the results of our model to results obtained using a median split of marital satisfaction scores, we ran another model that compared (1) unmarried women, (2) married women with DAS-7 scores below the median, and (3) married women with DAS-7 scores equal to or greater than the median.

In post-hoc analyses, we evaluated results by comparing married women to (1) single women, (2) separated or divorced women, and (3) widowed women, separately. We also assessed the correlation of each of the 3 components of the DAS-7 (consensus, cohesion and satisfaction) and depressive symptoms, using Kendall's tau. All analyses were conducted using SPSS version 20.0 (Chicago, IL), and all statistical tests were 2-sided with a p < 0.05 significance level.

RESULTS

Sample Characteristics

Sociodemographics and disease characteristics for the entire sample and for married versus unmarried women are shown in Table 1. Among the 725 women included in the study, 494 (68%) were married or living as married and 231 (32%) were unmarried. Among unmarried women, 48 (21%) were single, 121 (52%) were separated or divorced, and 62 (27%) were widowed. Mean age was 57.4 years (standard deviation (SD) = 11.2, range = 18 to 83). Sociodemographic and clinical characteristics were similar between married and unmarried women. Only gastrointestinal severity was statistically significantly different, but the mean difference was minimal (0.1 points).

Mean CES-D score was 14.0 (SD = 10.5, range = 0 to 52) with 269 patients scoring 16 or higher (37%), including 148 scoring 23 or higher (20%). Married women (mean = 13.3) had significantly lower CES-D scores than unmarried women (mean = 15.4). Among married women, DAS-7 scores ranged from 2 to 36 (mean = 24.2, median = 25, SD = 5.6).

Association of Marital Status and Marital Satisfaction with Depressive Symptoms

In bivariate correlations, unmarried status (Kendall's tau $[\tau] = -0.08$, p = 0.014), less than a high school education ($\tau = -0.08$, p = 0.012), more tender joints ($\tau = 0.09$, p = 0.001), more gastrointestinal involvement ($\tau = 0.13$, p < 0.001), and more lung involvement ($\tau = 0.17$, p < 0.001) were significantly correlated with CES-D scores.

In the multivariate regression model, regression diagnostics found no evidence of deviation from the assumption of normal distribution of residuals. All tolerance values were between 0.85 and 0.99, and all correlations between variables were ≤ 0.29 , indicating that multicollinearity was not an issue. Partial residual plots did not show any violation of the linearity assumption for the model.

Controlling for sociodemographic and disease variables, married women on average had CES-D depressive symptom scores 2.0 (0.19 SDs) points lower than unmarried women (Table 2). However, among married women, every 1 SD increase in marital satisfaction was associated with a decrease of 2.2 points (0.21 SDs) on the CES-D, indicating that greater marital satisfaction was associated with fewer symptoms of depression. To put this in perspective, using average values for demographic and clinical covariates, the predicted CES-D score of a woman with the lowest DAS-7 score (poorest marital satisfaction) reported in this sample (score = 2) would be 22.2 versus 8.6 for a woman with the highest DAS-7 score (highest marital satisfaction) reported in this sample (score = 36). Compared to unmarried women, women with very poor marital satisfaction (score = 2) had predicted CES-D scores that were on average 6.9 points higher, whereas women with very high marital satisfaction (score = 36) had predicted CES-D scores that were on average 6.7 points lower. Thus, based on differences in individual marital satisfaction scores, predicted CES-D score differences between married and unmarried women differed by almost 14 points, depending on where on the spectrum of marital satisfaction they were assessed.

Based on our model, controlling for sociodemographic and clinical characteristics, the point where married and unmarried women had equivalent levels of predicted depressive symptoms occurred with DAS-7 scores of married women 0.88 SDs below the mean, which occurred with a DAS-7 score of 19.3. Based on raw DAS-7 scores, 19.1% of married women scored at least 0.88 SDs below the mean. Based on a z-score to percentile transformation, 18.6% of married women would be expected to have equal or greater symptoms of depression than the

average unmarried women. Estimated CES-D scores as a function of marital status and marital satisfaction are shown in Figure 1.

In post-hoc analyses, controlling for sociodemographic and clinical characteristics, there were no statistically significant differences between the CES-D scores of married women and classes of non-married women. CES-D scores of married women were, on average, 1.3 points (95% CI = -1.7 to 4.3) lower than among single, never-married women, 2.0 points (95% CI = 0.0 to 3.9) lower than among separated or divorced women, and 2.6 points (95% CI = -0.2 to 5.3) lower than among widowed women. Correlations between each of the 3 components of the DAS-7 (consensus, cohesion and satisfaction) and depressive symptoms were similar ($\tau = -0.14$, -0.16, -0.15, respectively).

Results Using Dichotomously Defined Marital Satisfaction

In our comparison model which dichotomized DAS-7 marital satisfaction scores based on a median split, married women at or above the median on the DAS-7 scored 3.4 points lower on the CES-D than unmarried women (95% confidence interval (CI) = -5.2 to -1.6). Married women who scored below the median on the DAS-7 did not have significantly different CES-D scores than unmarried women (0.5 points lower, 95% CI = -2.3 to 1.3).

DISCUSSION

This was the first study to demonstrate how continuously measured marital satisfaction scores can be incorporated into models that predict mental health outcomes in order to generate more robust and clinically relevant estimates of the relationship between marital satisfaction and mental health. The novel regression method used in this study showed that the variability of depressive symptoms between women with low and high levels of marital satisfaction was

substantially greater than the difference in depressive symptoms between married and unmarried women or between women classified dichotomously as satisfied with their marriages versus women classified as unsatisfied based on a median-split method.

Among married women, for every 1 SD increase in marital satisfaction, there was a 2.2 point decrease on the CES-D, which translated into a total difference in CES-D scores of almost 14 points across the range of marital satisfaction scores. In contrast, simply classifying women as satisfied or unsatisfied with their marriages dichotomously resulted in only a 3.4 point difference in predicted CES-D scores. Married women in the lowest 19 percent of marital satisfaction scores had similar or higher levels of depressive symptoms than the average unmarried woman.

Previous studies that have dichotomized marital quality or satisfaction in multivariate prediction models to estimate assolations with mental health outcomes (13-15) have all reported that people classified as being satisfied with their marriages have better mental health outcomes than people who are unsatisfied or people who are unmarried, but that there is no difference between people who are unsatisfied and those who are unmarried. In contrast, the present study, by incorporating continuous marital satisfaction ratings, was able to identify that approximately 80% of women who are married, on average, have lower depressive symptom scores than unmarried women. Furthermore, the variability in depression symptoms associated with marital satisfaction among married women was much greater than what could be attributed to marital status alone. In contrast to previous findings of similar mental health in unmarried people and married people with lower marital satisfaction (13-15), this study showed that some women with relatively low marital satisfaction are better off than unmarried women, whereas women with very poor marriage quality do substantially worse.

Clinically, the results from this study underline the strong association between access to social support via marriage or a married-like relationship and mental health, given that many marital relationships below the median were associated with similar or better mental health compared to women who were not married. On the other hand, they emphasize the individual nature of the association between marital status and mental health, as women with very poor quality marriages were predicted to have substantially worse mental health than unmarried women. In sum, less than ideal marriages may be in many cases associated with better mental health than not being married, but very poor marriages are often linked to dramatically worse mental health.

Ideally, future studies that include marital status as a predictor of mental health and other key outcomes should incorporate a measure of marital quality or satisfaction to the exent possible. Inclusive in this, future studies should replicate the present study in different settings to determine the degree to which findings are consistent or sample-specific. Furthermore, research is needed to determine if marital satisfaction can be improved in women with rheumatic diseases who are in distressed relationships and whether such intervention can improve mood.

Beyond marital status and quality, the regression model described in the present study could also be usefully applied to other research in rheumatology, as well as in health research more generally, in situations where two groups are compared and a continuous variable of interest applies to one of the groups, but not the other. For instance, in studies comparing patients with a disease to healthy controls, investigators could use similar interactions to examine the effect of a variable that is related to the disease, such as time since diagnosis, disease severity level, or other important aspects of disease that vary among patients, but are not relevant to non-patients (31).

There are a number of limitations that should be considered in interpreting the results of our study. First, it was cross-sectional and conducted with a convenience sample of women enrolled in the CSRG Registry. Patients with very severe SSc who were too sick to participate, as well as those who may have died earlier in their disease course, are not enrolled in the Registry, which may result in an over-representation of healthier patients. Although approximately 80% of approached patients enroll in the Registry, data on patients who do not participate are not available. Additionally, with a relatively small number of participants encompassing each of the non-married subgroups (widowed, divorced or separated and single) there was not enough power to formally compare these groups. Furthermore, we did not have data on time since partner loss for patients who were widowed or divorced. Nonetheless, our results from post-hoc analysis are similar to previous findings that widowed and divorced individuals show higher rates of depressive symptoms than those who are single (32). Future research should include subgroups large enough to perform statistical tests between non-married groups of participants (widowed, divorced or separated and single), preferably also taking into account time since partner loss in widowed and divorced persons, as grief or relief may be important, especially within the first two years after loss (33).

In summary, married women tend to have lower levels of depressive symptoms than unmarried women. Among married women, greater marital satisfaction is associated with fewer symptoms of depression, with those in the lowest quintile of marital satisfaction tending to have more depressive symptoms than the average unmarried woman. This study demonstrates that in addition to marital status, marital satisfaction also plays an important role in depression symptoms. Thus, studies examining social support should consider relationship quality in addition to relationship status and should consider relationship quality or satisfaction on a

continuous basis, using the interactions in the regression model that we demonstrated in the present study.

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	Total sample	Married	Unmarried	Significance
	(N=725)	(N=494)	(N=231)	(P-value)
Sociodemographic variables				
Age in years, mean (SD)	57.4 (11.2)	57.1 (10.4)	58.2 (12.8)	0.248
White, <i>n</i> (%)	652 ^a (92.9)	449 ^b (93.9)	203° (90.6)	0.112
More than high school education, $n(\%)$	368 (50.8)	252 (51.0)	116 (50.2)	0.842
DAS-7 score, mean (SD)		24.2 (5.6)		
Medical variables				
Disease duration in year, mean (SD)	17.6 (12.3)	17.5 (12.4)	17.8 (12.1)	0.813
Diffuse SSc, n(%)	295 (40.7)	206 (41.7)	89 (38.5)	0.418
Modified Rodnan Skin Score (0-51), mean (SD)	7.9 ^d (8.5)	8.0 ^e (8.4)	7.8 ^f (8.7)	0.749
Number of tender joints, mean (SD)	2.1 (7.0)	2.1 (7.4)	2.0 (6.1)	0.816
Disease severity: gastrointestinal tract (0-4), mean (SD)	1.9 (0.7)	1.9 (0.7)	2.0 (0.7)	0.027
Disease severity: lung (0-4), mean (SD)	1.4 (1.1)	1.3 (1.1)	1.4 (1.1)	0.862
CES-D score, mean (SD)	14.0 (10.5)	13.3 (10.2)	15.4 (11.0)	0.011

Table 1. Patient Demographic and Disease Characteristics

Due to missing values: ${}^{a}N = 702$, ${}^{b}N = 478$, ${}^{c}N = 224$, ${}^{d}N = 711$, ${}^{e}N = 487$, ${}^{f}N = 224$.

Abbreviations: CES-D = Center for Epidemiologic Studies Depression Scale; DAS-7 = Dyadic Adjustment Scale-7.

Variable	В	SE B	β	Р
			•	
Constant	17.05	2.77		< 0.001
Age (years)	-0.10	0.04	-0.10	0.007
More than high school education	-1.40	0.76	-0.07	0.065
Time since onset of first SSc symptom (years)	-0.03	0.03	-0.03	0.369
Diffuse SSc	-0.51	0.77	-0.02	0.510
Number of tender joints	0.11	0.05	0.07	0.049
Disease severity: gastrointestinal tract	1.86	0.52	0.13	< 0.001
Disease severity: lung	2.02	0.34	0.21	< 0.001
Married	-1.97	0.79	-0.09	0.013
zDAS*Married	-2.25	0.45	-0.18	< 0.001

Table 2. Multiple Linear Regression Predicting Symptoms of Depression as Measured by

CES-D Scores

 $R^2 = 0.153$; adjusted $R^2 = 0.124$.

zDAS = standardized Dyadic Adjustment Scale-7 scores.



Figure 1. Estimated CES-D Scores as a Function of Marital Status and Marital Satisfaction