Doing Good, Feeling Good, and Having More: Resources Mediate the Health Benefits of Altruism Differently for Males and Females with Lumbar Spine Disorders

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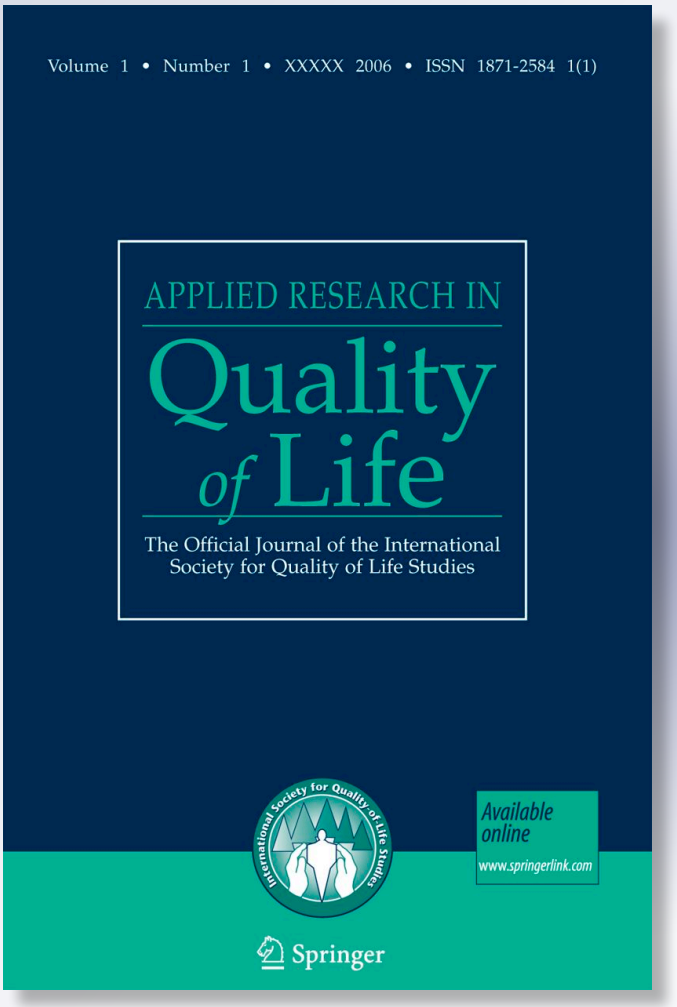

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Abstract We evaluated whether resources mediate and/or moderate the relationship between altruism and health outcomes in adults with lumbar spine disorders. Hierarchical regression modeling on 243 persons with lumbar spine disorders evaluated gender differences and whether physical, emotional, and

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economic resources mediated or moderated the relationship between altruism (Schwartz Altruism) and health (Rand-36, PROMIS Pain Impact). Men and women had similar altruism subscale scores, but there were gender differences in the altruism-health relationships. Both men and women had better mental health with higher levels of Community Connection, after adjusting for Community Pressure, and this effect was mediated by emotional resources. Women evidenced better physical health and less pain impact when they endorsed higher levels of Community Connection and/or General Helping aspects of altruism. Physical and economic resources partially but did not fully mediate women's altruism-physical health link. The altruism-pain impact link was not significant after adjusting for covariates. Men and women report similar levels of altruism but enjoy different benefits. Emotional resources explained the altruism-mental health link in both genders, but women experienced a physical health benefit of altruism that was not mediated by resources. Future research should test causal relationships.

Keywords Altruism · Quality of life · Resources · Spine

Introduction

There is a growing and solid body of evidence that positive behavioral factors can play an important role in health, and in particular, the health benefits of altruism. Research on populations representing a broad age range has documented that people who engage in altruistic activities are happier and healthier (Post 2007), and that these benefits extend as much as 50 years later (Wink and Dillon 2007). These activities might include volunteer work or spending time providing emotional support to others in their community. Even something as simple as committing regular acts of kindness to strangers has been shown to increase subjective well-being (Otake et al. 2006). Altruistic activities have also been associated with enhanced physical functioning and a lower morbidity rate (Li and Ferraro 2005; Luoh and Herzog 2002; Moen et al. 1992; Morrow-Howell et al. 2003; Thoits and Hewitt 2001; Van 2000; Wilson and Musick 1997), greater positive affect (Poulin et al. 2010) and reduced mortality among caregiving elderly spouses (Brown et al. 2009), and better mental health in a healthy adult sample (Schwartz et al. 2003).

While past research has not documented differences by gender in the prevalence of altruism (Byrne 2008), there is some evidence for gender differences in the motivation for (Byrne 2008), variety of (Cochran et al. 2009), and health benefits of altruistic behaviors (Fujiwara and Lee 2008; Schwartz et al. 2009). In one study evaluating the protective effect by gender against major depression, altruistic behaviors were protective for men but not for women (Fujiwara and Lee 2008). In another study evaluating both self-reported health and well-being, altruism was associated with well-being benefits in men and with both physical health and well-being benefits in women (Schwartz et al. 2009). Based on recent literature, one would thus expect gender differences in the relationship between altruism and well-being. It would be worthwhile to further examine the robustness of these gender-difference findings.

Theoretical Model Linking Altruism and Health

The model underlying this study posits that altruistic practice causes the individual to project outward by focusing on others (Schwartz and Sendor 1999). By so doing, the individual disengages from patterns of self-reference. That is, by getting outside of oneself, one gets a hiatus from the burden of one's everyday problems and challenges, after which one has a different perspective and these problems or challenges no longer seem too big, difficult, or burdensome. Altruistic practice is hypothesized to change a person's perspective on his/her illness, symptoms, or life situation by taking one out of oneself and getting one to focus on other people's needs or situation. The refreshed perspective individuals experience when they reconsider their own situation would attenuate their appraisal of physical and emotional symptoms, and result in higher levels of self-reported eudemonic well-being. This well-being would influence physical health by promoting better physical states (e.g., lower blood pressure (Burr et al. 2011) via better breathing and a sense of calm) and emotions (e.g., a more optimistic and hopeful perspective), leading to higher experienced levels of physical health.

Cause or Effect?

Although there has been some suggestive research documenting a benefit of helping others in chronically ill (Schwartz and Sendor 1999) and terminally ill people (Ironson et al. 2002), most research on the health benefits of altruism has addressed healthy samples (Post 2007). It is possible that the altruism-health connection is a correlational illusion: one must be well enough – physically, emotionally, and economically – to be able to help others. Thus, perhaps it is not that altruism causes wellness but rather that wellness is a necessary condition for altruism.

This logical conundrum is not easy to disentangle, but recent research using longitudinal data or evaluating mediator and moderator effects (Baron and Kenny 1986) has documented that volunteering appears to buffer the association between functional limitations and morbidity (Burr et al. 2011) and mortality in older adults (Okun et al. 2010), and that merely being better off physically or emotionally does not explain the relationship between volunteering and function (Ayalon 2008; Burr et al. 2011; Hao 2008). Being better off economically does, however, appear to buffer the impact of disability on subjective well-being (Smith et al. 2005), such that wealthier people who are diagnosed with a chronic illness experience less disability than less affluent patients. Research on prosocial behavior and wealth has suggested, however, that less affluent people are more generous, charitable, and trusting than wealthier people (Piff et al. 2010), and derive more personal benefits from volunteering than their higher SES peers (Tang et al. 2010). It would be worthwhile to continue to consider these alternative hypotheses in explaining a relationship between altruism and health. For example, are people with more physical, emotional or economic resources more likely to engage in prosocial or altruistic behavior? Does the heretofore documented link between altruism and health actually reflect the effect of having more of such resources rather than a

true health-benefit of altruism? One way to test these hypotheses would be to evaluate mediator and moderator relationships between altruism and health in a medically ill patient population that is heterogeneous in physical, emotional, and economic resources. We decided to test these hypotheses in a heterogeneous group of people with lumbar spine disorders recruited from a spine surgery clinic.

Why Lumbar Spinal Disorders?

Spinal disorders are prevalent and costly. Degeneration of the spine results in disability due to both back and leg pain (Weinstein et al. 2008). Spinal disorders are the second most common cause of visits to a health provider (after upper respiratory tract infections), and account for higher costs resulting from absenteeism from work and disability than any other disease category (van Tulder et al. 1995). Recent data on health expenditures documented that people with spine problems have age- and sex-adjusted medical costs 1.71 times higher than people without spine problems (Martin et al. 2008). While non-operative approaches can be effective at reducing pain and disability due to spinal disorders (Rainville et al. 2005), for some patients surgery is more beneficial. However, even if a patient's surgery is performed by a well-trained and competent surgeon in an established medical facility, outcome research in spine documents that many patients do not experience adequate resolution of low back pain and resulting disability (McGirt et al. 2009), and recurrent problems lead to the need for additional surgeries (Rampersaud et al. 2008; Vroomen et al. 2002; Weinstein et al. 2008). Thus, lumbar spinal disorders are chronic and costly, and have a strong impact on one's health-related quality of life. A better understanding of the psychosocial correlates of health outcomes in this patient population would be worthwhile, and would contribute to an existing and important literature (Block et al. 2003).

The purposes of the present work are: (1) to evaluate whether the associations between altruism and self-reported health are similar in magnitude and direction in men and women with lumbar spine disorders. We hypothesize that there are gender differences in the relationship between altruism and health in adults, as previous research has documented such gender differences in adolescents (Schwartz et al. 2009). (2) To investigate whether the altruism-health connection is mediated or moderated by physical, psychological or economic resources. We hypothesize that having more such resources will explain some but not all of the benefits of altruism (i.e., that resources is a mediator of the relationship between altruism and well-being). We do not expect that resources moderates the relationship between altruism and health (i.e., people high in resources engage in altruism and those who are low in resources do not engage in altruism), primarily because our personal experience as well as the scientific literature (Piff et al. 2010) does not support this hypothesis. We test for this moderation effect as a competing hypothesis We also hypothesize that that men and women will derive different health benefits from altruism (i.e., that gender moderates the relationship between altruism and well-being). This hypothesis derives from research documenting different patterns by gender of social connections and social capital (Baumeister 2007).

Methods

Sample and Design

Adults with lumbar spine disorders (n=243) were recruited from two active spine surgery practices. To achieve a heterogeneous sample, this cross-sectional study included people representing a broad range of time since surgery and number of spinal surgeries. Approximately half of the data were collected within a month of a planned spinal surgery, and half of the sample had an average of 2.05 (sd=2.51) years since surgery. Since many patients have had repeated spinal surgeries over the course of their lifetime, combining them into one analytic sample is a reasonable approach to enhancing the generalizability of the findings as well as maximizing the sample size. We did, however, adjust for whether patients were awaiting surgery in the statistical models ("Awaiting Surgery" indicator). As such, this sample would represent a general tertiary care orthopaedic population in a major metropolitan city in North America.

The study was reviewed and approved by the hospitals' Institutional Review Boards, and all patients provided written informed consent prior to completing the questionnaires. Data were collected online using a secure, HIPAA-compliant interface (SurveyGizmo 2011).

Outcome Measures

Altruism was measured by the Schwartz Altruism Questionnaire-Adult Version (Schwartz et al. 2009), a 16-item self-report measure adapted for use with adults from the Schwartz Teen Altruism measure (Schwartz et al. 2009) (see Table 1 for items). The scale assesses three aspects of altruistic social interest behaviors and one downside of altruism to be adjusted. The altruistic social interest behaviors include: 4 items assessed Community Connection (α=0.87), 8 items assessed General Helping Behavior (α=0.79), and 2 items assessed a general philosophy of valuing helping others (Helping Orientation) (α=0.78). The downside of altruism to be adjusted comprises a 2-item subscale that assesses feeling a strain due to the needs or demands of others in one's community (Community Pressure) (α=0.93). Community Pressure was considered a covariate for the altruism subscales, to adjust for feeling overwhelmed or over-extended by altruistic behaviors. A confirmatory factor analysis with an Eigenvalue cut-off of 1.0 confirmed that a four-factor model fit the data well (CFI=0.98, RMSEA=0.064; see Table 1 for factor loadings). Inter-subscale correlations were small to moderate (r range -0.0014 to 0.46; see Table 2 for inter-subscale correlations by gender). This measure has a Flesch-Kincaid Grade Level rating of 6.8 and a Lexile readability level of 1,700, indicating that 100% of people with an eighth grade education should be able to read and understand it without a problem.

Quality-of-Life (QOL) Outcomes. Two generic QOL measures were included in this study. The Medical Outcomes Study Short-Form (Rand-36) (Hays et al. 1993) was used to measure mental health via the mental component score (Rand-36 Mental Component Score) and physical health via the physical component score (Rand-36

Table 1 Confirmatory factor analysis loadings for adult altruism measure

Item	Factor 1 Community connection	Factor 2 Community pressure	Factor 3 Helping orientation	Factor 4 General helping behavior
[People in your community] made you feel loved and cared for	0.873			
[People in your community] listened to you talk about your private problems and concerns	0.762			
[You] made people in your community feel loved and cared for	0.901			
[You]y listened to people in your community talk about their private feelings and concerns	0.902			
[People in your community] made too many demands on you		0.801		
[People in your community] have been critical of you and the things you have done		0.905		
Enjoy doing things for others			1.048	
Try to help others even if they do not help me			0.876	
Given directions to a stranger				0.685
Given money to a charity				0.516
Done volunteer work for a charity				0.567
Helped carry a stranger's belongings				0.670
Delayed an elevator and held door open for a stranger				0.722
Allowed someone to go ahead of me in line				0.703
Pointed out a clerk's error in undercharging me				0.632
I have helped a colleague whom I did not know well with a work assignment when my knowledge was greater than his or hers.				0.593
Cronbach's Alpha Coefficient	0.87	0.78	0.93	0.79
Eigenvalue	3.24	2.92	2.02	1.72

Physical Component Score). The subscale scores are converted to T scores, with the component scores being the averages of the subscale scaled scores. Pain impact was measured using the PROMIS Pain Impact short-form (Cook et al. 2009) which contains 6 items. See www.nihpromis.org for details.

Covariates Co-morbidities were measured by the Self-Administered Comorbidity Questionnaire (Sangha et al. 2003). The close-ended version of the tool assesses 12 defined medical problems. An individual can receive a maximum of 3 points for each medical condition: 1 point for the presence of the problem, another point if he/she receives treatment for it, and an additional point if the problem causes a limitation in

Table 2 Altruism subscale inter-correlations by gender

Men n=109 (lower triangle shaded in blue) Women n=134 (upper triangle shaded in pink)	Community Connection	Community Pressure	Helping Orientation	General Helping Behaviors
Community Connection		-0.11	0.12	0.25**
Community Pressure	0.02		-0.05	0.22*
Helping Orientation	0.21*	-0.22*		0.11
General Helping Behaviors	0.40****	-0.03	0.46****	

* $p<0.05$, ** $p<0.01$, ***$p<0.001$, ****$p<0.0001$

functioning, yielding a maximum score of 36 points. We included as a covariate a summative score of co-morbidities. Additionally, demographic covariates included age in years, dummy variables for normal- and obese- body mass index, being a current smoker, being on worker's compensation, and whether the patient was awaiting surgery. Gender was included as a covariate in the univariate regressions to provide further empirical justification for the gender-stratified analyses.

Resource hypotheses were tested using proxies for the three types of resources hypothesized to influence the relationship between altruism and health outcomes. Physical Resources were tested using a sum of three dichotomous variables of endorsed engagement in aerobic, strength-building, and yoga exercise. Emotional Resources was tested using endorsement of the depression comorbidity item. Economic Resources was tested using the proxy of reporting being currently employed. Thus, the scores of the Physical and Economic resources indicate more of the resource whereas the reverse is the case for Emotional resource proxy.

Statistical Analysis

To confirm the existence of gender differences in the association of altruism and QOL outcomes in this sample, we examined the correlation matrices and found that the correlations between altruism subscales and outcomes differed for men and women (Table 2). As a result subsequent analyses were conducted separately by gender.

This study used a hierarchical modeling approach to investigate the association between altruism subscales and patient-reported outcomes, and to test mediation and moderation effects of physical, emotional, and economic resources. This framework began with univariate regressions of demographic and health status indicators on health outcomes (Rand-36 Physical Component Score, Rand-36 Mental Component Score, PROMIS Pain Impact). We then evaluated the statistical significance of the univariate regressions of resources proxies (i.e., physical, emotional, and economic resource proxies) on health outcomes, as a necessary step in testing for mediation (Baron and Kenny 1986). A Type I error rate of 0.10 was used for this initial phase of

analysis for covariate and resource proxy selection for subsequent models. We then built multivariable models to evaluate the relationship between altruism subscales and health outcomes, after adjusting for Community Pressure, significant demographic and health status covariates, and resource proxies. Each model began with the altruism subscales that were significantly associated with the health outcome of interest because we were interested in the raw (uncorrected) association between altruism and health. Significant demographic covariates were subsequently added as a second model, then health status indicators in a third model. This approach adjusted the altruism-health association so that the overlap (i.e., shared variance) with covariates was more transparent. The resulting Full Model, which consisted of those covariates that retained statistical significance when all significant univariate

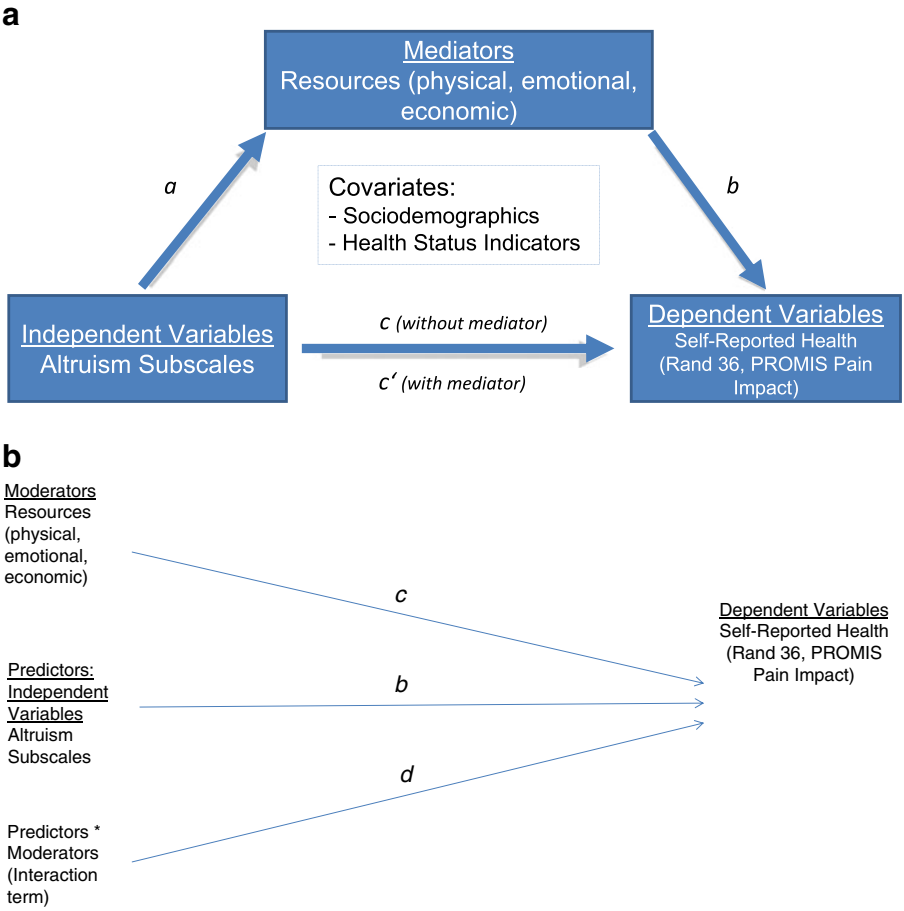

Fig. 1 Resources as mediators of the relationship between altruism and health. These schematic show the hypothesized mediational (**a**) and moderational (**b**) relationship that having more physical, emotional, and economic resources is expected to play on the association between altruism and health outcomes. If Resources are mediators of the altruism-health link, then the regression coefficients of altruism subscales in predicting health outcomes would be significantly attenuated when Resources are included in the model, and *c′* would be different than *c*. If Resources are moderators of this link, then a Resource-by-Altruism interaction term entered into the model would be a statistically significant predictor (*d*) of health outcomes

covariates were included, was then used for testing the Resources hypotheses. Each type of Resources proxy that was significant in the univariate regressions was added individually to the full model, and a *mediation hypothesis* (Fig. 1a) was tested by examining the beta coefficient(s) for the altruism subscale(s) when each type of Resource was added to the model (c'). If the statistical significance of the altruism subscale(s) changed from $p<0.05$ to $p>0.05$, mediation was confirmed. If the regression coefficients changed in magnitude and statistical significance, but the p-value did not exceed 0.05, then "attenuation" rather than "mediation" was used to describe the relationship between the resource proxy and the altruism-health link. A *moderation hypothesis* was tested by examining the significance of an interaction term (Fig. 1b). The interaction terms were created by multiplying the (statistically significant in univariate model) Resource proxies by the altruism subscales. In these multivariable models, a Type I error rate of 0.05 was used. Stata Release11 statistical software was used for all analyses (StataCorp, 2009).

Results

Descriptive statistics for the demographic variables and outcomes for the lumbar patients by gender are presented in Tables 3 and 4. In the interest of space, univariate models and hierarchical models by gender are available in an Online Appendix.

Women reported more co-morbidities ($p<0.001$) than men. Additionally, a higher prevalence of depression in women was found ($p=0.04$, Table 3). There was a trend

Table 3 Demographic sample characteristics by gender

Variable	Men ($n=109$)	Women ($n=134$)	F or chi-square statistic
Mean Age (sd)	55.7 (14.3)	57.7 (14.6)	0.27
Mean Body Mass Index (sd)	27.9 (4.6)	27.7 (5.9)	0.09
% underweight	4.5	6.7	9.95*
% normal weight	25.2	34.3	
% overweight	49.5	29.6	
% obese	20.7	29.1	
Marital:% married	73.7	63.1	4.82†
Race:% Caucasian	91.7	92.9	0.33
Katz Co-morbidity Score mean (sd)	2.75 (3.12)	4.09 (3.60)	11.41***
% Depression co-morbidity	17.0	26.9	4.07*
% Diabetes co-morbidity	5.9	9.6	1.35
Employment			
% currently working	43.5	31.1	4.61*
% worker's compensation	1.4	0.6	0.49
Smoking:% current smokers	15	9.4	2.24
% Awaiting Surgery	44.3	50.0	0.97

† $p<0.10$, * $p<0.05$, ** $p<0.01$, *** $p<0.001$, **** $p<0.0001$

Table 4 Patient-reported outcome scores and altruism subscale by gender

Variable	Men (n=109)	Women (n=134)	F statistic (p-value)
Mean Rand-36 Physical Component Score (sd)	40.49 (10.95)	36.66 (11.56)	7.69 (0.007)
Mean Rand-36 Mental Component Score (sd)	47.60 (12.71)	45.34 (13.30)	2.01 (0.158)
PROMIS Pain Impact Short-Form T score	60.09 (10.32)	61.69 (10.17)	1.73 (0.189)
Altruism Scale			
General Helping	16.50 (5.39)	15.77 (6.75)	0.82 (0.366)
Community Connection	8.09 (3.39)	8.32 (2.85)	0.34 (0.558)
Helping Orientation	8.87 (1.20)	9.15 (1.13)	3.43 (0.065)
Community Pressure	1.79 (1.58)	1.57 (1.65)	0.44 (0.51)

for women to be less likely to be married (p=0.09), and they were significantly less likely to be currently working (p<0.05). There were no differences in proportion currently smoking, worker's compensation status, or mean body mass index. There were, however, trend differences in body mass index categories, with more women in the normal weight and obese categories and more men in the overweight categories. Both men and women reported physical functioning and mental health levels below the population norms, as well as higher levels of pain than population norms (i.e., higher than a score of 50 on the Rand-36 Physical Component Score or Rand-36 Mental Component Score) (Table 4). Women reported significantly lower physical health than men (p<0.006), but there were no gender differences on other patient-reported outcomes. On the Altruism subscales, there were no differences between men and women in Community Connection, General Helping, or Community Pressure, but there was a trend toward women endorsing higher levels of Helping Orientation (p= 0.06).

Univariate Regressions: Correlates of Altruism

Results of the univariate regression models by gender revealed sufficient differences in the constellation of relevant covariates of the three health outcomes to merit separate modeling for men and women.

Mental Health For men, better mental health was associated with older age, not smoking, fewer medical comorbidities, and reporting higher Community Connection after adjusting for Community Pressure. For women, better mental health was related to not smoking, fewer medical comorbidities, higher reported Community Connection, after adjusting for reported Community Pressure.

Physical Health For men, better physical health was associated with having a normal body mass index, fewer medical comorbidities, and having had spine surgery in the past rather than awaiting surgery. For women, better physical health was associated with younger age, not being obese, fewer medical co-morbidities, having had spine surgery in the past rather than awaiting surgery, and higher reported General Helping behaviors.

Pain Impact For men, higher levels of pain impact were associated with not having a normal body mass index, having more medical comorbidities, and awaiting surgery. For women, higher levels of pain impact were also associated with not having a normal body mass index, having more medical comorbidities, and awaiting surgery. Additionally, pain impact among women was associated with lower reported levels of reported General Helping behavior.

Correlations between Resources and Outcomes

Rand-36 Physical Component Score was significantly associated with proxies for physical and economic resources (r=0.39, 0.42, $p<0.00001$ in both cases) but not for emotional resources (r=-0.10, $p=0.12$). Rand-36 Mental Component Score was associated with physical, emotional, and economic resources (r=0.17, -0.42, 0.23, $p<0.01$, 0.00001, and 0.0002, respectively). Pain Impact was associated with physical, emotional, and economic resources (r=-0.27, 0.17, and -0.27, $p<0.00001$, 0.01,

Table 5 Final models predicting Rand-36 mental component score, Rand-36 physical component score, and PROMIS Pain Impact by gender

PREDICTORS	β	Coef	S.E.	t	P	95% CI	
Predictors of Rand-36 Mental Component Score for Men (Model adjusted R^2=0.21)							
Community Connection	0.09	0.299	0.37	0.81	0.417	-0.43	1.03
Community Pressure	-0.23	1.773	0.84	2.12	0.037	0.113	3.43
Comorbidity Score	-0.19	-0.78	0.42	-1.9	0.066	-1.62	0.05
Emotional Resource Proxy: Depression Comorbidity	-0.59	-17.20	9.96	-1.7	0.088	-37.00	2.61
Interaction: Community Connection * Depression Comorbidity	0.29	1.00	0.73	1.37	0.174	-0.45	2.46
Interaction: Community Pressure * Depression Comorbidity	0.06	0.46	1.89	0.24	0.808	-3.30	4.22
Predictors of Rand-36 Mental Component Score for Women (Model adjusted R^2=0.22)							
Community Connection	0.13	0.618	0.46	1.33	0.185	-0.299	1.54
Community Pressure	-0.09	0.81	0.87	0.94	0.351	-0.905	2.53
Current Smoker	-0.136	-5.41	3.53	-1.5	0.128	-12.39	1.58
Comorbidity Score	-0.09	-0.32	0.33	-1	0.328	-0.976	0.33
Emotional Resource Proxy: Depression Comorbidity	-0.62	-18.14	9.52	-1.9	0.059	-37.00	0.72
Interaction: Community Connection * Depression Comorbidity	0.20	0.71	0.86	0.83	0.409	-0.985	2.41
Interaction: Community Pressure * Depression Comorbidity	-0.07	0.438	1.54	0.28	0.776	-2.609	3.49
Predictors of Rand-36 Physical Component Score for Women (Model adjusted R^2=0.49)							
General Helping	0.2896	0.527	0.18	2.88	0.005	0.005	0.89
Comorbidity Score	-0.269	-0.88	0.25	-3.6	0.001	-1.368	-0.4
Awaiting Surgery	-0.212	-5.44	1.83	-3	0.004	-9.058	-1.82
Physical Resource Proxy: Currently Exercising	0.1852	2.212	2.72	0.81	0.418	-3.18	7.6
Economic Resource Proxy: Currently Working	0.56	14.61	5.56	2.63	0.010	3.58	25.64
Interaction: General Helping * Exercise	-0.039	-0.02	-0.4	-0.2	0.880	-0.312	0.27
Interaction: General Helping * Currently Working	-0.266	-0.36	0.31	-1.2	0.248	-0.967	0.25
Predictors of PROMIS Pain Impact for Women (Model adjusted R^2=0.30)							
General Helping	-0.141	-0.21	0.12	-1.85	0.066	-0.444	0.01
Comorbidity Score	0.1951	0.537	0.26	2.1	0.039	0.371	1.04
Awaiting Surgery	0.4966	10.63	1.93	5.52	0.000	6.81	14.4

and 0.00001, respectively). Thus, testing the mediational hypothesis was grounded for 8 of the 9 possible relationships.

Multivariable Regression Models: Are the Salutogenic Effects of Altruism Explained by Having More Resources?

Table 5 presents results of the final multivariable regression models by gender (see Online Appendix for univariate regressions by gender, as well as hierarchical multivariable models, illustrating the changing patterns in associations between the Altruism subscales and health outcomes after adjusting for covariates, and each resource proxy separately). Table 5 shows the gender-specific models that include covariates and resources meditators which were statistically significant in earlier models, as well as moderator interaction terms for those proxies and altruism subscales that were statistically significant in earlier models. Standardized beta estimates are provided to facilitate comparison of the effect size across independent variables, as well as interpretation of changes in the beta estimate as tests of mediation hypotheses.

Mental Health Men evidenced only a mental health benefit when they endorsed higher levels of Community Connection, after adjusting for Community Pressure. This effect was not influenced by age or smoking status, but was attenuated by having fewer medical comorbidities. Emotional resources shared all of the variance between Community Connection and mental health, and some of the variance between Community Pressure and mental health (i.e., the former is no longer statistically significant, and the latter's statistical relationship is attenuated). The model explained a moderate amount of variance (model adjusted R^2=0.21). These models suggest that having more emotional resources mediates the relationship between Community Connection and mental health among men (see Online Appendix for all the steps in the model, illustrating the mediation and attenuation effects). There was no effect of the physical or economic resources tested. None of the interaction terms was statistically significant, suggesting that the relationship between altruism and mental health in men was not moderated by emotional resources.

Similar to men, women who reported higher Community Connection also reported better mental health, even after adjusting for reported Community Pressure (see Online Appendix). This association was strengthened after adjusting for smoking status and medical comorbidities, and unaffected after adjusting for physical resources. The association among Community Connection with mental health was completely explained by emotional resources, supporting mediation in women (adjusted R^2=0.22). None of the interaction terms was statistically significant, suggesting that the relationship between altruism and mental health in women was not moderated by emotional resources.

Physical Health Since none of the altruism subscales was associated with physical health among men, no multivariable modeling was done to evaluate mediator or moderator effects. Among women, General Helping behavior was associated with better physical health, an effect that was attenuated by younger age, having more medical comorbidities and awaiting surgery. In the full model, only medical comorbidities and Awaiting Surgery were statistically significant covariates and attenuated the relationship between General Helping and physical health. Physical and Economic resources both attenuated the relationship between General Helping and physical health

but did not mediate or moderate it (i.e., General Helping remained a statistically significant predictor of physical health in women; the interaction terms were not significant) (adjusted R^2=0.49). In the final model that included both physical and economic resources, there appeared to be shared variance between the two resource proxies such that the physical resources proxy was no longer a significant predictor when economic resources were also included. This finding may reflect the fact that people have to be well enough (able to exercise) to work (economic resource proxy). Emotional resources did not influence the relationship between altruism and physical health in women.

Pain Impact Similar to above, since none of the altruism subscales was associated with pain impact among men, no multivariable modeling was done to evaluate mediator or moderator effects. Among women, General Helping behavior was associated with lesser pain impact, an effect that was substantially explained by medical comorbidities and Awaiting Surgery (General Helping $p>0.05$ after adjusting for comorbidities and awaiting surgery). The hierarchical modeling was thus not continued for this outcome since the relationship between altruism and pain was no longer statistically significant (see Online Appendix for all hierarchical models).

Summary

In summary, several mediational relationships were detected. Having more emotional resources mediated the relationship between Community Connection altruism and mental health in both men and women, after adjusting for Community Pressure. General Helping altruism was associated with better physical health in women, and partially but not fully mediated by physical and economic resources. General Helping altruism was also associated with less pain impact in women, but this relationship was no longer significant after adjusting for relevant covariates.

Discussion

This study is the first to our knowledge to investigate the link and mediators thereof between altruism and health in adults with a history of lumbar spine disorders. We found that there were gender differences in these relationships, although men and women had similar altruism subscale scores. Men evidenced only a mental health benefit when they endorsed higher levels of Community Connection. In contrast, women evidenced better emotional and physical health and less pain impact when they endorsed higher levels of Community Connection and/or General Helping aspects of altruism.

Our modeling also suggested that having more resources explains some but not all relationships among altruism and health. In men, the apparent relationship between Community Connection and mental health was eliminated when we adjusted for having more emotional resources. For women, the apparent relationship among mental health and Community Connection was entirely explained by having more emotional resources. In contrast, however, the relationship between the General Helping aspect of altruism and physical health among women was partially but not fully mediated by physical and economic resources, suggesting that although female altruists may be more

energetic and financially able, their health benefit of prosocial behavior is independent of their resources. Thus, females who are generally helpful to others in their day-to-day life in the greater world (e.g., holding an elevator for a stranger, helping a stranger to carry something, helping a colleague at work to complete a task, etc.) are more likely to report higher levels of physical health. Additionally, for women low levels of general helping behavior were associated with less pain, suggesting a threshold effect of helping on health. This threshold effect has been observed in studies of volunteering and health, including mortality (Onyx and Warburton 2003). None of the altruism-health relationships was moderated by resources, but clear gender differences in the relationships between altruism and health support a moderation hypothesis.

The bottom line of these hypothesis tests is that men and women report similar levels of altruism but enjoy different benefits from this prosocial behavior. For both genders, the altruism-mental health link is completely explained by covariates and resources. In contrast, women appeared to enjoy a physical health benefit of Community Connection and General Helping behavior. Although the mental health benefit was mediated by resources, the physical health benefit was independent of sociodemographic factors, health status, and physical, emotional, and economic resources. Previous research has shown that there is a reciprocal causality between helping and health, but that the biggest impact appears to be from helping to health and not vice versa (Thoits and Hewitt 2001; Li and Ferraro 2005).

The limitations of this work are related to the cross-sectional study design, the relatively small sample, and the use of relatively weak proxies that may have low specificity in operationalizing resource proxies and thus not be an ideal measure of resources. The sample also may have miscellaneous underlying pathology, adding to the heterogeneity of the sample but not affecting our research objective. Although our analyses are suggestive that altruism causes better health in women, they should be interpreted cautiously. Future work should attempt to replicate these analyses using data collected prospectively over a clinically meaningful period of time to allow less cautious causal inference and use operationalizations of physical, emotional and economic resources that are more nuanced and informative, and have less overlap with the outcome (e.g., history of depression related to mental health, and working currently is related to physical functioning). For example, physical resources might include a more comprehensive measure of physical activity; emotional resources might include measures of self-efficacy, personality, or self-esteem/self-confidence; economic resources might include a more comprehensive measure of level of income vs. fixed expenses, home ownership, and other financial assets. Future research might also include measures of higher levels of well-being (e.g., Ryff's measure of psychological well-being (Ryff 1989)), as past research has documented numerous benefits at a more existential level (Schwartz et al. 2009).

This study has several important strengths, and is a first step towards advancing the cause-effect conundrum in research on altruism and health. The study builds on and replicates other work on altruism and health that documented a significant association between altruism and physical health among women but not men (Schwartz et al. 2009), and mental health benefits in both genders (Schwartz et al. 2003). This other work was done with healthy individuals, however, and it was not possible to tease apart whether people who engaged in altruistic social interest behaviors differed from those who did not on the basis of better physical and mental health. A strength of the

present work is that it included a heterogeneous patient population with a significant and chronic clinical problem, and adjusted for relevant demographic and medical covariates. Importantly, it also tested several resource-based hypotheses aimed at teasing apart whether altruism was a cause or an effect of better HRQOL. This hypothesis-testing supported the idea that women who were more altruistic also had more resources, but despite these greater resources, there was still an independent effect of altruism on physical health outcomes for women. Resources were clearly important mediators of mental health for both genders, but they were not moderators in any model looking at altruism and health. Thus, altruism appears to be a likely cause of better health outcomes in women, rather than an effect of being in better health. Future research should test a putative causal relationship between altruism and better health outcomes in women using longitudinal data.

Our findings are intriguing and suggest that the altruism-health connection is relevant for people with a chronic health condition and that, like healthy adults, these people may benefit from engaging in altruistic behaviors and attitudes. It is arguable that people who engage in regular acts of kindness create a stronger and broader social network. Indeed, social connectedness may be a key benefit of altruistic behaviors and attitudes (Schwartz 2010). There is a substantial body of research suggesting that social isolation has significant health consequences (House et al. 2003), and that older adults who are embedded in a social network have a lower risk of activities-of-daily-living disability (Mendes de Leon et al. 1999). Even if one's social network is irrevocably changed by the death of a spouse, providing instrumental help to others has a documented buffering effect on depression (Brown et al. 2008). The notable rise in recent years in the prevalence of depressive disorders among Americans (Bloom 2004; Simon et al. 2004) may reflect a problematic lifestyle that has become the norm. If more people regularly engaged in altruistic social interest behaviors, would the prevalence of depression decrease?

This research may also have substantial implications for how we understand the concept of "community," what it provides to people, and what the most effective therapeutic strategies might be for improving subjective well-being (see (Ferrucci 2006). When one engages in altruistic social interest behaviors, one is reaching out and weaving a connection to other individuals and eventually to a larger community. As this behavior pattern goes on, the helper finds him- or herself touching more people in a way that is at the same time personally significant (i.e., providing help that is targeted to others' very personal needs) and non-specific (i.e., motivated by a general orientation of benevolence or generosity of spirit). Over time, this reaching out and weaving of benevolent connections would likely lead to a sense of a benevolent net that links the helpers to a broader community/world extending beyond themselves, their families, or even their known friends (Fowler and Christakis 2008). This net catches the needy and protects or buffers them from isolation and health threats. One wonders whether physical, emotional, or economic resources could be the focus of intervention prospectively to evaluate the robustness of our preliminary conclusion.

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