ESC European Society of Cardiology

European Heart Journal Open (2023) **3**, 1–12
https://doi.org/10.1093/ehjopen/oead018

ORIGINAL ARTICLE
Coronary artery disease

Association of marital/partner status and patient-reported outcomes following myocardial infarction: a systematic review and meta-analysis

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Received 9 January 2023; revised 7 February 2023; accepted 24 February 2023; online publish-ahead-of-print 28 February 2023

Handling Editor: Magnus Bäck

Aims

Little is known about the relationship between marital/partner status and patient-reported outcome measures (PROMs) following myocardial infarction (MI). We conducted a systematic review/meta-analysis and explored potential sex differences.

Methods and results

We searched five databases (Medline, Web of Science, Scopus, EMBASE, and PsycINFO) from inception to 27 July 2022. Peer-reviewed studies of MI patients that evaluated marital/partner status as an independent variable and reported its associations with defined PROMs were eligible for inclusion. Results for eligible studies were classified into four pre-specified outcome domains [health-related quality of life (HRQoL), functional status, symptoms, and personal recovery (i.e. self-efficacy, adherence, and purpose/hope)]. Study quality was appraised using Newcastle–Ottawa Scale, and data were synthesized by outcome domains. We conducted subgroup analysis by sex. We included 34 studies ($n = 16\,712$), of which 11 were included in meta-analyses. Being married/partnered was significantly associated with higher HRQoL {six studies [$n = 2734$]; pooled standardized mean difference, 0.37 [95% confidence interval (CI), 0.12–0.63], $I^2 = 51\%$} but not depression [three studies ($n = 2005$); pooled odds ratio, 0.72 (95% CI, 0.32–1.64); $I^2 = 65\%$] or self-efficacy [two studies ($n = 356$); pooled β, 0.03 (95% CI, −0.09 to 0.14); $I^2 = 0\%$]. The associations of marital/partner status with functional status, personal recovery outcomes, and symptoms of anxiety and fatigue were mixed. Sex differences were not evident due to mixed results from the available studies.

Conclusions

Married/partnered MI patients had higher HRQoL than unpartnered patients, but the associations with functional, symptom, and personal recovery outcomes and sex differences were less clear. Our findings inform better methodological approaches and standardized reporting to facilitate future research on these relationships.

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Graphical Abstract

Meta-analysis and systematic review of 34 studies on 4 outcome domains				
Is marital/partner status associated with patient-reported MI outcomes?	HRQoL	Functional Status	Symptoms	Personal Recovery
	Discrepancy between actual and desired functional status, overall impact of health on well-being.	Physical, mental, emotional, and/or social functional limitations	Burden of angina, dyspnea, fatigue, dizziness, weakness, depression.	Changing of one's attitudes, values, feelings, goals, skills and/or roles.
Studies in review	18	4	8	9
Patients	5245	5902	4354	3771
Studies in meta-analysis	6	0	3	2
Findings	Married/Partnered patients had higher HRQoL. Pooled SMD, 0.37 [95% CI, 0.12-0.63], I^2=51%	Null association between marital/partner status and functional outcomes.	Null association between married/partner status and depression symptoms. Pooled OR, 0.72 [95% CI, 0.32-1.64], I^2=65%	Null association between marital/partner status and self-efficacy. Pooled β, 0.03 [95% CI, -0.09-0.14], I^2=0%
Are there sex differences?	Limited studies that reported sex-specific results suggested no sex differences. Efforts needed to enrol and retain female cardiac patients in epidemiological studies.			
Recommendations for future research	Greater clarity in the methods used to measure patient-reported outcomes. Provide both unadjusted and bias-adjusted results. Present sex- and/or gender-specific results whenever possible.			

CI, confidence interval; HRQoL, health-related quality of life; MI, myocardial infarction; OR, odds ratio; SMD, standardized mean difference; *β*, regression coefficient.

Keywords Marital status • Myocardial infarction • Patient-reported outcomes • Systematic review • Meta-analysis

Introduction

Marital/partner status is an important social factor that influences myocardial infarction (MI) outcomes. Being married/partnered has been associated with lower mortality and higher event-free survival following MI in studies varying in design, setting, and scale.[1–4] However, little is known about the impact of marital/partner status on patient-centred outcomes.

Patient-reported outcome measures (PROMs) are defined by the Food and Drug Administration and National Quality Forum as outcomes that derive directly from the patient about the patient's health condition without amendment or interpretation of the patient's response by a clinician.[5] Multiple PROMs have been developed, validated, and used in clinical studies to quantify treatment benefits with regard to improvements in symptoms, functional outcomes, and health-related quality of life (HRQoL).[6] These measures also independently predict subsequent cardiovascular events, hospitalizations, costs of care, and mortality, and they have the potential to inform clinical decision-making and targets for risk adjustment.[7]

Results of prior studies assessing associations between marital/partner status and PROMs have been inconsistent.[8,9] No systematic review has investigated and synthesized the association of marital/partner status with PROMs among individuals who had an MI. Further, although women may not benefit from marriage to the same extent as men regarding outcomes such as mortality and major adverse cardiac events,[2,10] less is known about potential sex differences in the degree of 'protection' conferred by marriage/partnership during MI recovery as assessed with PROMs.

Accordingly, we conducted this systematic review to summarize existing evidence on the association between marital/partner status and PROMs that evaluate different aspects of MI recovery, including physical, mental, and bio-psycho-social well-being. Sex differences in these outcomes were also explored.

Methods

Protocol and registration

This systematic review was reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-analyses guideline (see Supplementary material online, *Table S1*).[11] The review protocol was registered a priori at the International Prospective Register of Systematic Reviews database (ID: CRD42022295975) and published in a peer-reviewed journal.[12]

Search strategy and study eligibility

Five databases (Medline via Ovid, Web of Science Core Collection as licensed by Yale University, Scopus, EMBASE via Ovid, and PsycINFO via Ovid) were searched to identify publications from inception to 27 July 2022. Search terms were developed by the first author with the assistance of a medical librarian and encompassed the following concepts: (i) marital/partner status, (ii) MI, and (iii) PROM. Detailed search strategy and terms can be found in Supplementary material online, *Tables S2 and S3*.

Peer-reviewed studies that evaluated marital/partner status as an independent variable and reported their associations with one or more defined PROMs were eligible for inclusion. Study participants were individuals aged 18 years and older who were diagnosed with an MI by a medical professional. Studies that had no clearly indicated reference group, no defined PROMs, only reported unadjusted associations without controlling for age and sex, or not written in English were excluded.

Records identified from the bibliographic database search were uploaded into a Covidence project (Veritas Health Innovation). After deduplication, two reviewers (C.Z. and P.T.) independently screened titles and abstracts of all records for eligibility. Next, both reviewers independently assessed full texts of the included studies, with documentation of the reasons for any exclusions (see Supplementary material online, *Table S4*). For each included article that met the eligibility criteria, forward citation chaining in The Lens via Citation Chaser was performed. Disagreement was resolved through discussion with co-authors.

Data extraction and quality assessment

Relevant data of included studies were recorded independently and in duplicate by two reviewers (C.Z. and P.T.) using a standardized data extraction form that was developed and piloted prior to the review (see Supplementary material online, *Figure S1*).

Quality was assessed independently by C.Z. and P.T. using the Newcastle–Ottawa Scale. The scale output was converted to the Agency for Healthcare Research and Quality standard (good, fair, and poor quality) based on previously defined thresholds.[13] Because the exposure (marital/partner status) and outcome (PROMs) were usually collected via self-report, no included study had a score indicating good quality. Therefore, studies of fair quality were considered at low risk of bias, and studies of poor quality were considered at high risk of bias in this review.

Data synthesis and analysis

An outcome framework (*Figure 1*) based on prior research[6,14] was designed to classify PROMs, with detailed design and rationale described in the published protocol.[12] Results from the included studies were classified according to the framework, and data were synthesized by each outcome domain.

Meta-analyses were conducted if there were two or more studies reporting effect measures [odds ratio (OR), risks ratio (RR), or regression coefficient (β)] and precision [standard error (SE), 95% confidence interval (CI), or *P*-value] for the same PROM or if there were two or more different PROMs measuring a specific construct. Effect sizes from studies using the same PROM were pooled using a random-effects model with inverse-variance weighting if heterogeneity was evident (measured with I^2 statistics, with $I^2 \geq 25\%$ indicating moderate heterogeneity) and a fixed-effect model if heterogeneity was not present. To pool effect measures from different scales, effect sizes were converted into standardized mean differences (SMD) and combined using a random-effects model with inverse-variance weighting. Effect measures were converted, if necessary, to reflect unmarried/unpartnered as the reference group (e.g. for estimates using married/partnered as reference group, take the opposite of β or the reciprocal of OR/RR).

To assess potential differences of changes in the PROM measures and perception of QoL over time, we classified studies into two approximately equal groups by the year of collection and performed sensitivity analyses on studies that collected data after 2005. We also performed sensitivity analyses that excluded studies with high risk of bias and that separately examined studies using generic and cardiovascular disease (CVD)-specific measures.

All quantitative analyses were conducted in R using the meta library. Studies not included in meta-analyses were compared in a narrative synthesis, with a summary table constructed for each outcome domain. Pre-specified subgroup analysis by sex was also performed. Studies that reported sex-specific associations were compared and summarized qualitatively.

Results

Of the 1783 unique records identified, 34 studies were included in this review (*Figure 2*). The included studies were conducted between 1993 and 2022, representing 16 712 participants [mean (standard deviation) age, 62.6 (12.0) years; 5919 (35.3%) were female; mean sample size of 491 participants, median of 275 participants, and range of 85–2002 participants]. Among the 34 studies, 25 were observational studies, and nine were derived from randomized controlled trials. Seven studies were conducted in the USA; five in China; three in Sweden; three in Iran; two in Australia; two in Spain; two in Korea; one each in Italy, Poland, the UK, Germany, Canada, Norway, Turkey, Malaysia, and Ethiopia; and one in multiple countries, including Australia, Canada, New Zealand, and the USA. Overall, 26 (76.5%) studies were of 'fair' quality (low risk of bias), and eight (23.5%) were of 'poor' quality (high risk of bias). Details on study characteristics and quality appraisal are presented in Supplementary material online, *Tables S5–S7*. A summary of the results for included studies can be found in *Table 1*.

Marital/partner status and health-related quality of life

Eighteen studies ($n = 5245$)[15–32] reported associations between marital/partner status and HRQoL, as measured by ten different scales. Among them, eight (44.4%) studies[16–18,21–23,27,28] reported higher HRQoL among married/partnered participants compared to those who were not married/partnered after covariate adjustment. Among the 10 HRQoL scales, four were designed for cardiac conditions (Seattle Angina Questionnaire, Ferran and Powers' index Cardiac Version, QoL after MI, and MI Dimensional Assessment Scale), and six were generic HRQoL measures. The most frequently used generic HRQoL measures were EuroQol-5 Dimension (EQ-5D) and Short Form Survey-36 (SF-36).

Six studies ($n = 2673$) could be pooled (five had low risk of bias, and one had high risk).[15,16,18,22,25,26] In the overall analysis including both CVD-specific and generic HRQoL measures, being married/partnered was significantly associated with higher HRQoL [pooled SMD, 0.37 (95% CI, 0.12–0.63), $I^2 = 51\%$] (*Figure 3*). The association remained significant in the sensitivity analysis excluding one study with high risk of bias [pooled SMD, 0.44 (95% CI, 0.13–0.75), $I^2 = 38\%$]. In the sensitivity analysis limited to studies collected after 2005, the association remained significant [pooled SMD, 0.38 (95% CI, 0.05–0.72), $I^2 = 52\%$] (see Supplementary material online, *Figure S2*).

In the subgroup analyses, the association between marital/partner status and HRQoL was significant in studies using generic HRQoL measures [pooled SMD, 0.35 (95% CI, 0.06–0.65), $I^2 = 42\%$] but not in studies using CVD-specific measures [pooled SMD, 0.43 (95% CI, −0.42 to 1.29), $I^2 = 60\%$] (see Supplementary material online, *Figure S2*). Publication bias was not evident among the six included studies (Egger test $P = 0.103$, Supplementary material online, *Figure S3*).

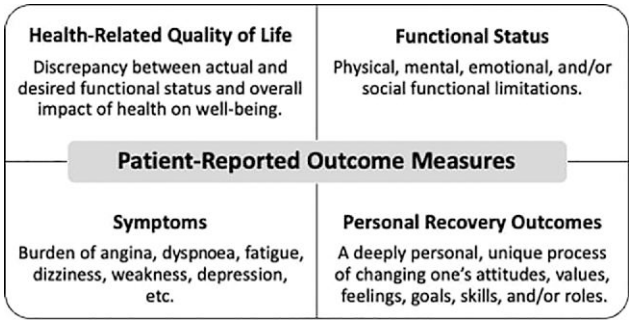

Figure 1 Outcome framework.

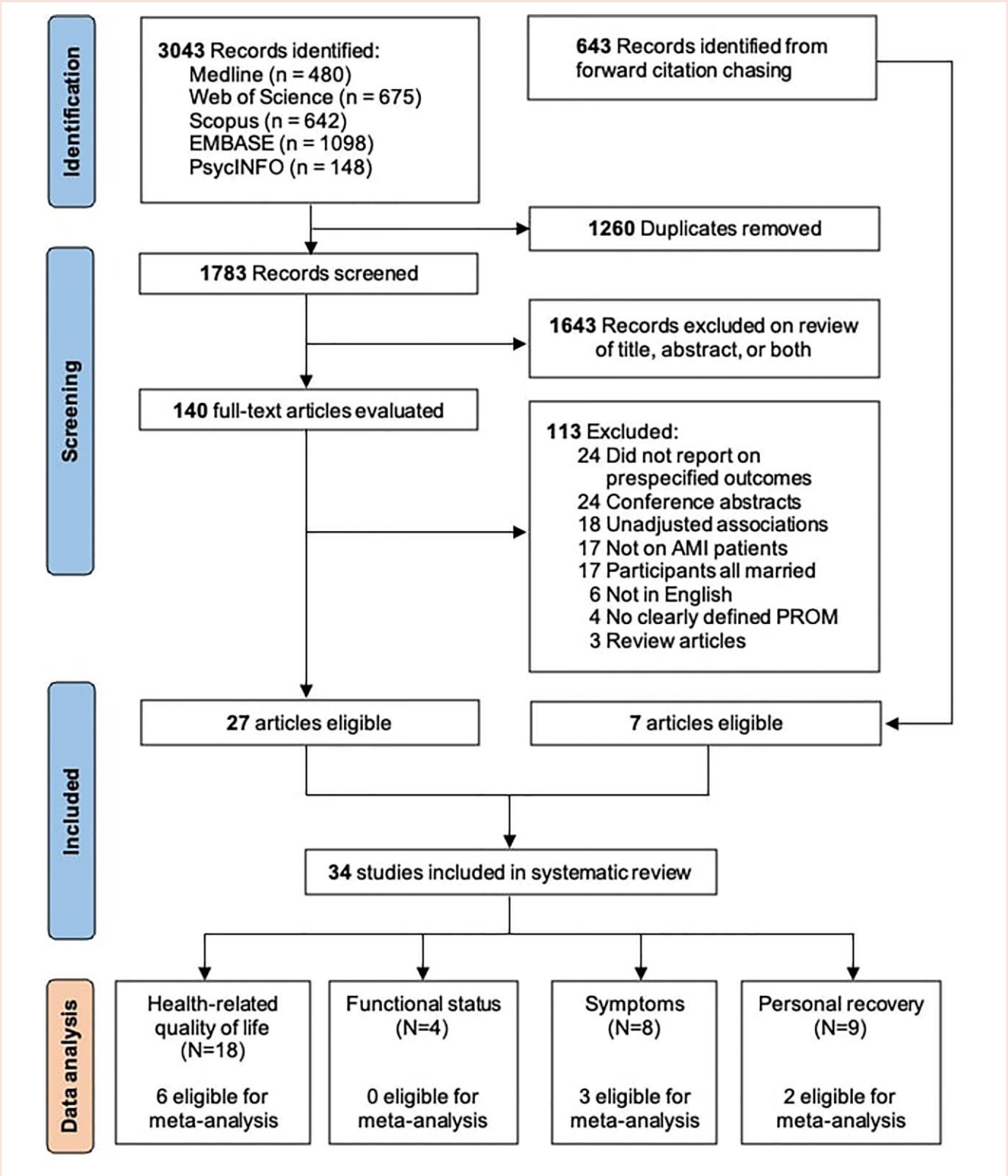

Figure 2 Preferred Reporting Items for Systematic Reviews and Meta-analyses flowchart of literature search and study selection.

Because the pooled effect across different scales used unadjusted estimates, we conducted a secondary analysis that compared adjusted effect estimates from the same measurement scales (i.e. EQ-5D and SF-36 physical component summary). In a pooled analysis of four studies ($n = 2507$)[18,24–26] reporting bias-adjusted associations between marital/partner status and HRQoL measured by EQ-5D, the association was significant overall [pooled β, 0.05 (95% CI, 0.01–0.08), $I^2 =$ 0%] and after excluding one study at high risk of bias [pooled β, 0.07

Table 1 Associations between marital/partner status and health-related quality of life, functional status, symptoms, and personal recovery outcomes

Study country, sample size, female %	Type (O/I)[a]	Risk of bias	Outcome/scale	Cardiac-specific measure	Time measured[b]	Estimates (ref: unmarried)	Direction[c]	Significance[d]
Health-related quality of life								
Heller *et al.*,[15] Australia, 300, 28%	O	Low	QoL after MI	Y	6 m	NR	NR	NS
Durmaz *et al.*,[16] Turkey, 85, 34%	O	Low	Ferran and Powers' QoL index Cardiac Version—IV	Y	NR	$\beta = 0.4$, $P = 0.002$	(+)	S
Kim *et al.*,[17] Korea, 210, 26%	O	Low	Seattle Angina Questionnaire QoL subdomain	Y	1 m	β (SE): 4.46 (2.17), $P = 0.041$	(+)	S
Dou *et al.*,[18] China, 305, 49.5%	O	Low	Seattle Angina Questionnaire	Y	NR	β (SE): 2.829 (2.612), $P = 0.28$	(+)	NS
			EQ-5D	N		β (SE): 0.085 (0.04), $P = 0.034$	(+)	S
Wang *et al.*,[19] China, 192, 23%	O	High	MI Dimensional Assessment Scale—Chinese version	Y	1 m	$\beta = 0.047$	(+)	NS
			SF-36 physical component summary	N		$\beta = -0.051$	(−)	NS
			SF-36 mental component summary			$\beta = 0.004$	(+)	NS
Yeng *et al.*,[20] Australia, 246, 21%	O	Low	SF-36 physical component summary	N	1 m	β (SE): 1.25 (1.135), $P = 0.26$	(+)	NS
			SF-36 physical component summary		6 m	β (SE): 1.54 (1.015), $P = 0.12$	(+)	NS
Lie *et al.*,[21] Norway, 185, 10%	I	Low	SF-36 physical component summary	N	6 m	β (SE): 3.21 (1.47), $P = 0.031$	(+)	S
Jankowska-Polańska *et al.*,[22] Poland, 140, 50%	O	Low	SF-36 physical component summary <46.45	N	6 m	OR (95% CI): 0.31 (0.19–0.49)	(+)	S
			SF-36 mental component summary <43.55			OR (95% CI): 1.32 (0.85–2.04)	(+)	NS
Soto *et al.*,[23] Spain, 132, 23%	O	High	SF-36 physical component summary	N	NR	NR	NR	NS
			SF-36 mental component summary			β (SE): 9.743 (2.848), $P = 0.001$	(+)	S
Pirhonen *et al.*,[24] Sweden, 199, 28%	I	Low	EQ-5D index	N	1 y	β (SE): 0.03 (0.002)	(+)	NS
Mei *et al.*,[25] China, 1247, 64%	I	High	EQ-5D index	N	NR	β (SE): 0.024 (0.025)	(+)	NS
			EQ-5D Visual Analogue Scale			β (SE): 0.961 (1.484)	(+)	NS
Zhang *et al.*,[26] China, 756, 19%	O	Low	EQ-5D index	N	>1 y	β (SE): overall: 0.08 (0.05), $P = 0.068$; male: 0.1 (0.06), $P = 0.066$; female: 0.06 (0.08) $P = 0.496$	(+)	NS
Tye *et al.*,[27] Malaysia, 205, 72%	O	High	AQoL-8D	N	NR	$\beta = 0.033$, $P = 0.004$	(+)	S
Lane *et al.*,[28] the UK, 288, 25%	O	Low	Dartmouth COOP charts	N	4 m	$\beta = 3.01$, $P = 0.002$	(+)	S
Kulik *et al.*,[29] the USA, 85, 0%	O	Low	A 7-point scale (1 = poor/ 7 = excellent) of overall QoL.	N	1 y	$\beta = 0.04$	(+)	NS
Endalew *et al.*,[30] Ethiopia, 421, 57%	O	Low	WHOQoL-BREF	N	NR	β (SE): single as the reference group; married: 0.067 (1.57); divorced: −1.92 (2.77), widowed: −5.19 (3.89)	(+)	NS
			Physical domain of WHOQoL-BREF			Married: −1.50 (1.78); divorced: −4.40 (3.12); widowed: −7.30 (4.4)	(−)	NS
			Psychological domain of WHOQoL-BREF			Married: −1.10 (1.76); divorced: −2.13 (3.1); widowed: −5.20 (4.34)	(−)	NS
			Environmental domain of WHOQoL-BREF			Married: −1.94 (1.89); divorced: −1.71 (3.32); widowed: −6.55 (4.67)	(−)	NS
						Married: 4.82 (2.81);	(+)	NS

Continued

Table 1 *Continued*

Study country, sample size, female %	Type (O/I)[a]	Risk of bias	Outcome/scale	Cardiac-specific measure	Time measured[b]	Estimates (ref: unmarried)	Direction[c]	Significance[d]
			Social domain of WHOQoL-BREF			divorced: 563 (4.94); widowed: −1.72 (6.96)		
Salazar *et al.*,[31] Spain, 250, 31%	O	Low	General health (SF-36 subscale)	N	Baseline, 3 m, 6 m (as covariate)	Married vs. single: β (SE): 14.5 (6.28) Married vs. widowed: β (SE): 2.2 (4.52)	(+)	S (married vs. single) NS (married vs. widowed)
			Mental health (SF-36 subscale)			Married vs. single: β (SE): 23.3 (10.69) Married vs. widowed: β (SE): 2.0 (7.47)	(+)	
			Social functioning (SF-36 subscale)			Married vs. single: β (SE): 14.1 (6.45) Married vs. widowed: β (SE): 29.8 (5)	(+)	S for both
Christian *et al.*,[32] the USA, 160, 100%	I	Low	Physical functioning (SF-36 subscale)	N	6 m	$\beta = 4.11$	(+)	S
			Role physical (SF-36 subscale)			$\beta = 4.28$	(+)	S
			Bodily pain (SF-36 subscale)			$\beta = 1.66$	(+)	NS
			General health (SF-36 subscale)			NR	NR	NS
			Vitality (SF-36 subscale)			NR	NR	NS
			Social functioning (SF-36 subscale)			$\beta = 5.03$	(+)	S
			Role emotional (SF-36 subscale)			$\beta = 6.65$	(+)	S
			Mental health (SF-36 subscale)			$\beta = 3.5$	(+)	NS
Functional status								
Brummett *et al.*,[33] the USA, 948, 15%	O	Low	Change in functional status/ Duke Activity Status Inventory	Y	1 y, 3 y	β (SE): −0.94 (1.01)	(−)	NS
Dodson *et al.*,[34] the USA, 2002, 32%	O	Low	Independence loss/EQ-5D	N	1 y	RR (95% CI): 0.83 (0.71–0.95)	(+)	S
			Physical Function Decline/ SF-12 physical component summary	N		RR (95% CI): 0.93 (0.8–1.04)	(+)	NS
Kirchberger *et al.*,[35] German, 1943, 22%	O	Low	Disability/WHODAS 2.0	N	>1 y	β (SE): overall: 0.0141 (0.0227), $P = 0.5346$; men: 0.0175 (0.0267), $P = 0.5115$; women: 0.0062 (0.0463), $P = 0.8934$	(+)	NS
Pirhonen *et al.*,[24] Sweden, 199, 28%	I	Low	Physical activity/Grimby Scale	N	1 y	β (SE): 0.199 (0.178)	(+)	NS
			Returned to work (yes/no)	N		β (SE): −0.007 (0.1)	(−)	NS
Symptoms								
Rejai *et al.*,[36] the USA, 198, 31%	O	Low	Depression/Beck Depression Inventory ≥10	N	6 m	OR (95% CI): 0.44 (0.22–0.88)	(+)	S
Kulik *et al.*,[29] the USA, 85, 0%	O	Low	Emotional upset/combining 6 items from Mental Health Inventory, 2 from Zung Depression Inventory	N	1 and 13 m (average)	$\beta = 0.18$	(+)	NS
Smolderen *et al.*,[37] the USA, 481, 33%	O	High	Depression/Patient Health Questionnaire-9 ≥ 10	N	2–3 days after AMI	RR (95% CI): 0.93 (0.74–1.16)	(+)	NS
Marzolini *et al.*,[38] Canada, 1326, 50%	O	Low	Depression/Center for Epidemiologic Studies—Depression Scale ≥16	N	1 m	OR (95% CI): overall: 0.678 (0.504–0.914); men: 0.519 (0.31–0.868); women: NS so NR	(+)	S in men, NS in women and overall
Modica *et al.*,[39] Italy, 1323, 30%	O	High	Anxiety/Hospital Anxiety and Depression Scale—anxiety subscale	N	2–3 days after AMI	NR	NR	NS
			Depression/Hospital Anxiety and Depression Scale—depression subscale			NR	NR	NS

Continued

Table 1 *Continued*

Study country, sample size, female %	Type (O/I)[a]	Risk of bias	Outcome/scale	Cardiac-specific measure	Time measured[b]	Estimates (ref: unmarried)	Direction[c]	Significance[d]
Blom *et al.*,[40] Sweden, 105, 100%	I	Low	Depression/Beck Depression Inventory	N	2 m	NR	NR	NS
Saeidi *et al.*,[41] Iran, 574, 21%	O	High	Increase in anxiety before and after CR/Beck Anxiety Inventory	N	NR	OR (95% CI): 0.38 (0.05–3.03)	(+)	NS
Ai *et al.*,[42] the USA, 262, 38%	O	Low	Mental fatigue/Fatigue Scale mental subscale	N	30 m	β (SE): −0.088 (0.075)	(+)	NS
			Physical fatigue/Fatigue Scale physical subscale			β (SE): −0.078 (0.073)	(+)	NS
Personal recovery outcomes								
Roohafza *et al.*,[43] Iran, 148, 47%	O	Low	Self-regulation under Cardiac Patient Competence	Y	>1 y	$\beta = 0.243$, $P = 0.016$	(+)	S
			Being assertive under Cardiac Patient Competence			$\beta = 0.265$, $P = 0.003$	(+)	S
Kohler *et al.*,[44] Sweden, 157, 22%	I	Low	SWE-CES-10 Patient Empowerment Questionnaire	Y	6–12 m	β (SE): 0.088 (0.106)	(+)	NS
			General Self-Efficacy Scale	N		β (SE): 0.111 (0.105)	(+)	NS
Pirhonen *et al.*,[24] Sweden, 199, 28%	I	Low	General Self-Efficacy Scale	N	6 m	β (SE): −0.012 (0.072)	(−)	NS
Son *et al.*,[45] Australia/ Canada/New Zealand/the USA, 460, 15%	I	Low	The Family Crisis Oriented Personal Evaluation Scale (FCOPES) total score	N	>1 y	$\beta = 2.877$	(+)	NS
			Acquiring social support subscale of FCOPES			$\beta = 2.294$	(+)	NS
			Reframing subscale of FCOPES			$\beta = -0.211$	(−)	NS
			Seeking spiritual support subscale of FCOPES			$\beta = -1.4$	(−)	NS
			Mobilizing family to acquire help subscale of FCOPES			$\beta = 0.438$	(+)	NS
			Passive appraisal subscale of FCOPES			$\beta = 1.018$	(+)	NS
Lee *et al.*,[46] Korea, 417, 17%	O	Low	Adherence to lifestyle modification measured by the Morisky Scale	N	1 y	OR (95% CI): 1.63 (0.99–5.66)	(+)	NS
Lu *et al.*,[47] China, 662, 31%	O	Low	Sustained/Declined medication adherence/ Morisky Scale	N	3 m	OR (95% CI): 0.4 (0.19–0.85)	(+)	S
			Improved medication adherence/Morisky Scale			OR (95% CI): 2.1 (0.92–4.78)	(+)	NS
			Sustained/Declined adherence to heart-healthy lifestyle behaviors/Medical Outcomes Study Specific Adherence Scale			OR (95% CI): 0.32 (0.14–0.77)	(+)	S
			Improved adherence to heart-healthy lifestyle behaviors/Medical Outcomes Study Specific Adherence Scale			OR (95% CI): 0.63 (0.30–1.31)	(−)	NS
Soleimani *et al.*,[48] Iran, 300, 57%	O	High	Templer Death Anxiety Scale	N	NR	β (SE): −0.477 (1.693)	(−)	NS
			Spiritual Well-Being Scale			β (SE): 1.038 (0.937)	(+)	NS
Modica *et al.*,[39] Italy, 1323, 30%	O	High	Disease conviction under Illness Behaviour Questionnaire	N	2–3 days	NR	NR	NS
			Dysphoria under Illness Behaviour Questionnaire			NR	NR	NS
			Denial under Illness Behaviour Questionnaire			NR	NR	S
Blom *et al.*,[40] Sweden, 105, 100%	I	Low	Availability of Social Integration under Interview Schedule for Social Interaction	N	2 m	NR	NR	NS

Continued

Table 1 *Continued*

Study country, sample size, female %	Type (O/I)[a]	Risk of bias	Outcome/scale	Cardiac-specific measure	Time measured[b]	Estimates (ref: unmarried)	Direction[c]	Significance[d]
			Availability of attachment under Interview Schedule for Social Interaction			NR	NR	NS
			Everyday Life Stress Scale			NR	NR	NS

[a]O, observational study; I, interventional study.
[b]m, month; y, year; NR, not reported.
[c](+), married have better outcomes; (−), married have worse outcomes.
[d]S, significant at $\alpha = 0.05$; NS, not significant at $\alpha = 0.05$.

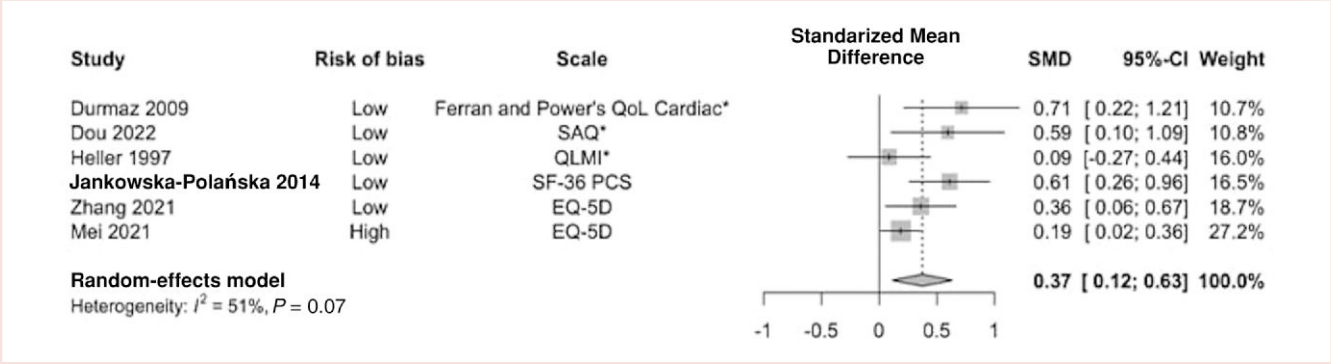

Figure 3 Random-effects meta-analysis of the association between marital/partner status and health-related quality of life among patients with acute myocardial infarction. EQ-5D, EuroQol-5 Dimensions Index; QLMI, QoL after MI; SAQ, Seattle Angina Questionnaire; SF-36 PCS, Short Form-36 physical component summary. * indicates cardiovascular disease-specific health-related quality of life scale.

(95% CI, 0.02–0.13), $I^2 = 0\%$] (see Supplementary material online, *Figure S4*). After pooling two studies ($n = 431$)[20,21] reporting bias-adjusted associations between marital/partner status and HRQoL measured by SF-36 physical component summary, there was a significant positive association between being married/partnered and better HRQoL [pooled β, 2.08 (95% CI, 0.44–3.72), $I^2 = 0\%$] (see Supplementary material online, *Figure S5*).

Marital/partner status and functional status

We identified six functional outcomes measured by six distinctive PROMs across four studies[24,33–35] with low risk of bias (5902 participants; *Table 1*). Due to heterogeneity in the functional aspects measured by different scales, only qualitative synthesis was conducted. Overall, study results suggested more favourable functional outcomes for married/partnered individuals, with three studies reporting positive associations[24,34,35] and two studies reporting negative associations.[24,33] However, only one of these associations was statistically significant—Dodson *et al.*[34] reported a 17% lower risk of independence loss in married/partnered participants 1-year post-MI. Most studies used generic measurement scales. The sole CVD-specific functional PROM was the Duke Activity Status Inventory, which was used in a study by Brummett *et al.*[33] that found a null association between marital status and change in functional status.

Marital/partner status and symptoms

Eight studies with a total of 4354 participants[29,36–42] reported symptoms of depression, anxiety, and/or fatigue measured by six unique PROMs (*Table 1*). Three studies ($n = 2005$)[36–38] reporting depression outcomes could be pooled (two had low risk of bias, and one had high risk). In the meta-analysis, being married/partnered was not significantly associated with lower risk of depression [pooled OR, 0.72 (95% CI, 0.32–1.64); $I^2 = 65\%$] (*Figure 4*). The sensitivity analysis restricted to studies with low risk of bias showed similar results [pooled OR, 0.61 (95% CI, 0.06–6.13); $I^2 = 21\%$] (see Supplementary material online, *Figure S6*).

Results from the remaining five studies were summarized qualitatively in *Table 1* due to different outcome constructs and measurements. Two studies did not report the direction of the association due to non-significant results.[39,40] The other three studies reported fewer symptoms of emotional upset and less anxiety and fatigue among married/partnered MI patients compared to their unmarried/unpartnered counterparts, but these associations were not statistically significant.[29,41,42]

Marital/partner status and personal recovery outcomes

Nine studies with a total of 3771 participants reported on 12 different PROMs under the personal recovery domain (*Table 1*).[24,39,40,43–48]

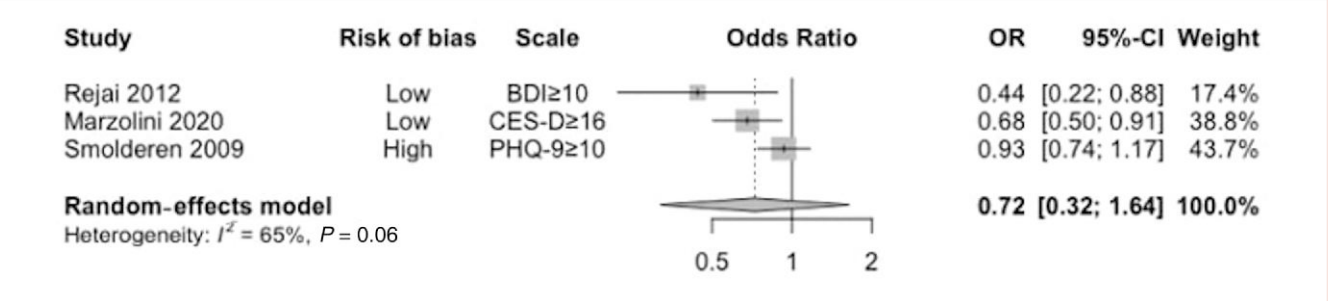

Figure 4 Random-effects meta-analysis of the association between marital/partner status and depression among patients with acute myocardial infarction. Married/partnered vs. unmarried (reference group). BDI, Beck Depression Inventory; CES-D, Center for Epidemiologic Studies Depression Scale; PHQ-9: 9-item Patient Health Questionnaire.

Outcomes included patient competence, self-efficacy, lifestyle adherence, and spiritual well-being. Two studies[24,44] assessing self-efficacy could be pooled but suggested no significant association between marital/partner status and higher self-efficacy as measured by the General Self-Efficacy Scale [pooled β, 0.03 (95% CI, −0.09 to 0.14), $I^2 = 0\%$] (see Supplementary material online, *Figure S7*). Qualitative synthesis was conducted on the remaining studies due to differences in outcome construct. Among these studies, only three found independent associations between marital/partner status and personal recovery outcomes.[39,43] Roohafza *et al.*[43] found that after adjusting for age and sex, married/partnered individuals had higher scores in self-regulation and being assertive when measured by the Cardiac Patient Competence Scale. Modica *et al.*[39] found that marital status was associated with denial, but not disease conviction or dysphoria, after adjustment for sex, age, education, and type of surgery (coronary artery bypass or valve replacement); however, no magnitude or direction of the association was reported. Lu *et al.*[47] found that married/partnered individuals were less likely to report a decline in adherence to medication and heart-healthy lifestyle behaviours. Another four studies reported null associations between being married/partnered and personal recovery, though most of the associations were in a positive direction.

Sex difference in the association between marital/partner status and patient-reported outcome measures

Two studies ($n = 265$)[32,40] included only women, and one study included only men ($n = 85$).[29] Christian *et al.*[32] found that married/partnered women performed better in certain subdomains of HRQoL at 6 months (SF-36 physical functioning, role limitations due to physical problems, social functioning, and role limitations due to emotional problems) compared to their unpartnered female counterparts. Conversely, Blom *et al.*[40] found null associations of marital/partner status with depression, social integration, and everyday stress among women 2-month post-MI. A study by Kulik *et al.*[29] of 85 men found null associations of marital/partner status with HRQoL and emotional upset within 1-year post-MI.

Three studies reported sex-specific associations ($n = 4025$; *Table 2*).[26,35,38] Two of these studies found similar associations between marital/partner status and HRQoL and disability outcomes between female and male participants,[26,35] while the third found a significant association between being married/partnered and lower risk of depression among men but not among women.

Discussion

In this systematic review and meta-analysis of 34 studies including 16 712 participants with MI, we found that married/partnered individuals had higher HRQoL compared to their unpartnered counterparts. Results were consistent after restricting analyses to studies at low risk of bias. However, no association was found between being married/partnered and improved functional status; symptoms of depression, anxiety, and fatigue; and personal recovery outcomes. Sex differences in the association between marital/partner status and PROMs were less clear. Findings from this comprehensive review provide insights about the impact of marital/partner status on PROMs and may inform better methodological approaches and standardized reporting to facilitate future research.

The impact of marital status on major adverse cardiovascular events such as hospitalization or death has been supported by prior evidence-based research,[1,2,4,10] but less is known about the association between marital/partner status and PROMs despite their fundamental significance. Consistent with prior reviews that found better survival outcomes among married individuals,[1,2,4,10] our review demonstrated significantly higher self-reported HRQoL among married/partnered MI survivors compared to unpartnered individuals. Although HRQoL was measured using different scales across studies, results were robust in analyses combining all scales and scale-specific analyses with bias adjustment. The findings may follow similar mechanisms proposed to explain the 'marital protection' effect, including marital selection (individual with better health may be more likely to get and stay married) and social causation (individuals benefit from shared resources afforded by marriage, such as economic and societal network).

Our review found no association between marital/partner status and functional status, depression, anxiety, fatigue, and personal recovery outcomes. The lack of association may be partly explained by potential heterogeneity in marriages/partnerships. First, there is evidence suggesting mixed effects of unpartnered status on MI prognosis, where partner loss or separation had stronger effects on poor health outcomes compared to being single.[30] Because most of the studies screened in this review dichotomized marital status into married and unmarried, we were unable to investigate the impact of change in marital status (i.e. divorce or widow) on PROMs. Second, among married/partnered individuals, the quality of the relationship may play a role in disease recovery. Studies have suggested that the mechanisms by which marital status may influence health are distinct from those by which marital quality may influence health.[49] Specific to MI populations, prior qualitative studies suggested there is an 'identity shift' during a patient's recovery process, manifested in both strengthened relationships and

Table 2 Studies that reported sex-specific results

Study country, sample size, female %	Type (O/I)[a]	Risk of bias	Outcome/ Scale	Cardiac-specific measure	Time	Estimates (ref: unmarried)	Direction[b]	Significance[c]
Zhang *et al.*,[26] China, 756, 19%	O	Low	HRQoL/ EQ-5D index	N	>1 y	β (SE): overall: 0.08 (0.05), $P = 0.068$; male: 0.1 (0.06), $P = 0.066$; female: 0.06 (0.08), $P = 0.496$	(+)	NS
Kirchberger *et al.*,[35] German, 1943, 22%	O	Low	Disability/ WHODAS 2.0	N	>1 y	β (SE): overall: 0.0141 (0.0227), $P = 0.5346$; male: 0.0175 (0.0267), $P = 0.5115$; female: 0.0062 (0.0463), $P = 0.8934$	(+)	NS
Marzolini *et al.*,[38] Canada, 1326, 50%	O	Low	Depression/ CES-D ≥ 16	N	1 m	OR (95% CI): overall: 0.678 (0.504–0.914); male: 0.519 (0.31–0.868); female: NS so not reported	(+)	S in male, NS in female and overall

[a]O, observational study; I, interventional study.
[b](+), married have better outcomes; (−), married have worse outcomes.
[c]S, significant at $\alpha = 0.05$; NS, not significant at $\alpha = 0.05$.

increased emotional presence between the patient and their partner.[14] The respective influences of marital quality and transition on health is beyond the scope of the current review but may be important for future research in the field.

Our detailed review highlights opportunities to strengthen the collection of evidence linking marital/partner status and PROMs. The strong associations for CVD-specific PROMs may indicate their value in future assessments for cardiac patients. Greater clarity in the methods used to evaluate PROMs, especially the timing, format (e.g. interview, survey, and proxy response), and categorization of PROMs, would enhance comparisons across studies and inform better harmonization of assessments. Moreover, it would be informative to provide both unadjusted and bias-adjusted results, as well as to present sex- and/or gender-specific results whenever possible. Despite guidelines emphasizing the need to report results by sex and gender, our review identified only three studies reporting sex-specific results.[50] We also identified an overall under-representation of female participants in the included studies (35.6%), suggesting a need for enhanced efforts to enrol and retain female cardiac patients in epidemiological research. Finally, additional research is needed to understand the role of changes in married/partnered status (i.e. divorce and widowhood) as well as the duration and quality of married/partnered relationships on PROMs among cardiac patients.

Clinical implications

Findings from this comprehensive review enhance our understanding of the role personal relationships have on outcomes for cardiac patients. Assessing whether cardiac patients are in a married/partnered relationship may be a relatively simple way to assess groups at potentially higher risk for poorer patient-reported outcomes during recovery. The finding that individuals who are unpartnered have lower quality of life after MI supports the consideration of this easily measured indicator of social support along with other social factors when personalizing care. Clinicians may need to recognize the role of personal and social factors that influence recovery beyond conventional risk factors such as high blood pressure, inactivity, and smoking. More resources to facilitate participation and adherence to secondary prevention activities may be helpful, especially for unpartnered individuals.

Limitations

This review has several limitations. The quality of all included studies was fair to poor because both PROMs and the assessment of marital/partner status may differ across studies. Only a small number of studies were identified for each specific outcome construct. Meta-analysis was only feasible on three outcomes, and other studies were synthesized qualitatively. In the meta-analyses, pooled SMD was based on unadjusted estimates and pooled β and pooled OR from the multiple-adjusted effect estimates. While we selected estimates that minimized the risk of bias due to confounding, residual confounding cannot be ruled out. We restricted our review to studies of MI populations, but study differences in MI definitions or changes over time may complicate the interpretation of this review. Lastly, the design of the current review limits causal inference.

Conclusions

Married/partnered MI survivors had higher HRQoL compared to their unpartnered counterparts. However, no association was found between being married/partnered and improved functional status; symptoms of depression, anxiety, and fatigue; and personal recovery outcomes. Sex differences in the associations between marital status and PROMs were less clear. Findings from this study inform the impact of marital/partner status on PROMs, which could improve the development of care for MI patients. Our detailed review also identifies opportunities to harmonize and improve methodological approaches for data collection to enhance future research on these relationships and potential sex differences.

Lead author biography

Cenjing Zhu is currently a PhD candidate at the Department of Chronic Disease Epidemiology, Yale School of Public Health. She is interested in understanding risk factors and outcomes of cardiovascular disease and stroke, with a particular focus on investigating the impact of psychosocial factors on the recovery of younger adults who have suffered from acute myocardial infarction. Before coming to Yale, she obtained a Bachelor of Medicine (Preventive Medicine) degree with honour from Shanghai Jiao Tong University in 2018.

Data availability

The data underlying this article are available in the article and in its online supplementary materials.

Supplementary material

Supplementary material is available at *European Heart Journal Open* online.

Acknowledgements

None.

Funding

None declared.

Conflict of interest: None declared.

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