



The physiology of marriage: pathways to health

Theodore F. Robles^{a,*}, Janice K. Kiecolt-Glaser^b

^a*Department of Psychology, Ohio State University, 245 Townshend Hall, 1885 Neil Avenue, Columbus, OH 43210, USA*

^b*Department of Psychiatry and the Institute for Behavioral Medicine Research, College of Medicine, Ohio State University, Columbus, OH, USA*

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Abstract

Marriage is the central relationship for most adults and has beneficial effects for health. At the same time, troubled marriages have negative health consequences. This review outlines the physiological pathways through which marital relationships influence health based on a stress/social support model. In addition, we review recent findings suggesting that unhappy marriages are associated with morbidity and mortality. We then turn to studies of marital interaction that include assessment of physiological pathways through which marital functioning influences health: the cardiovascular, endocrine, and immune systems. Across these studies, negative and hostile behaviors during marital conflict discussions are related to elevations in cardiovascular activity, alterations in hormones related to stress, and dysregulation of immune function. Using recent conceptualizations of the physiological impact of chronic stress, we illustrate how physiological changes associated with marital functioning in these studies have long-term implications for health outcomes. Finally, we discuss future implications of current research for understanding the relationships among marital functioning, physiology, and health.

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1. Introduction

For humans and a wide variety of animal species, social relationships have important physiological consequences, often with implications for health [1,2]. Social relationships are also important contributors to health and well-being. Epidemiological studies suggest that social isolation is a major risk factor for morbidity and mortality, comparable to well-established health risk factors such as cigarette smoking, blood pressure, blood lipids, obesity, and physical activity [3]. Although both the quality and quantity of social ties have been related to morbidity and mortality, the support provided by certain relationships may be more important than others. The central relationship for most adults is marriage; 56% of adults in the United States are married and living with their spouse [4].

Across a number of surveys, married individuals report greater happiness and life satisfaction [5] and have a lower risk of depression [6] than their unmarried counterparts.

Moreover, findings from the National Longitudinal Mortality Study illustrate the scope of impact that marital status has on mortality [7]. Across all causes of mortality and across different nonmarried populations (never married, divorced/separated, and widowed), nonmarried individuals had elevated rates of mortality compared to married individuals. Although elevated risk was observed for cardiovascular disease and cancer, significant risk was also observed for other causes, notably pneumonia and influenza, chronic obstructive pulmonary disease, and liver disease and cirrhosis. The relationship between marital status and mortality exhibits a generally consistent pattern in longitudinal studies, with marital status affording greater protection from mortality for men compared to women (50% higher among women, 250% higher among men [8–10]).

What are the processes by which marriage promotes health and well-being? Several explanations have been proposed, including cohabitation, economic well-being, and social support [10]. Research supports the two latter explanations, as cohabiting adults are more likely to report poorer health than married adults [11], and are as likely to report distress as adults living alone [12]. In terms of economic well-being, married persons have higher median household incomes than the nonmarried (US\$54,300 vs.

* Corresponding author. Tel.: +1-614-292-0077; fax: +1-614-292-0038.

E-mail address: robles.8@osu.edu (T.F. Robles).

62 US\$23,400 [13]), but after controlling for income, married
63 persons still have lower rates of mortality than nonmarried
64 persons [7].

65 The prevailing explanatory framework proposed to ac-
66 count for the protective benefits of marriage is the *stress/
67 social support hypothesis*, which accounts for both protec-
68 tive and deleterious health correlates of marriage [14]. Stress
69 and support in the marital relationship influence health
70 status through a number of pathways. These include influ-
71 ences on the marital relationship itself, on the individual's
72 cognitions, emotions or affect, health-related behaviors,
73 coping behaviors, and physiology [14,15].

74 This paper focuses on physiological pathways through
75 which marital relationships influence health. In addition to
76 informing marriage and health research, studies of marriage
77 and physiology offer important insights into biobehavioral
78 aspects of human social relationships. We briefly review
79 recent evidence of the health consequences of marital
80 relationships, with a focus on consequences of distressed
81 and unhappy marriages, as negative aspects of marital
82 functioning have traditionally received greater emphasis
83 compared to positive aspects. We then turn to physiological
84 pathways through which marital functioning influences
85 health: the cardiovascular, endocrine, and immune systems
86 [2]. Evidence for the influence of marital functioning on
87 physiological pathways is primarily derived from paradigms
88 used by marital interaction researchers. Finally, we discuss
89 future implications of current research for understanding the
90 relationships among marital functioning, physiology, and
91 health.

92 2. Marital strain and health outcomes

93 Burman and Margolin [14] termed their explanatory
94 framework as the *stress/social support hypothesis*, noting
95 that marital factors may be a source of stress. Distressed
96 marriages are a major source of stress, and in general,
97 unhappily married persons are worse off in well-being than
98 unmarried persons [16]. Given the centrality of the marital
99 relationship for most adults, it is likely that marital stress
100 would have consequences for physical health as well.

101 Several prospective longitudinal studies strongly suggest
102 that marital strain is related to self-reported and objective
103 health outcomes. One of the most intensive assessments
104 involved 364 wives and husbands who provided data on
105 marital quality and illness symptoms annually for 4 years
106 [17]. Participants with higher initial levels of marital quality
107 reported fewer physical illness symptoms at study entry.
108 Moreover, improvements in marital quality over the 4-year
109 period were accompanied by decreases in self-reports of
110 physical illness symptoms. Among 174 patients with end-
111 stage renal disease treated with hemodialysis, greater dyadic
112 satisfaction was associated with a 29% decrease in risk for
113 mortality, and an increase in relationship negativity was
114 associated with a 46% increase in risk for mortality at a 3-

year follow-up [18]. The relationship between marital strain 115
and mortality was significant even after controlling for 116
demographics and disease-related variables (e.g. severity, 117
treatment). 118

119 Several recent studies have provided compelling evi-
120 dence for a relationship between marital strain and morbidity
121 and mortality from cardiovascular disease. At a 5-year
122 follow-up of 292 female patients admitted for an acute
123 coronary event from 1991 to 1994, marital status was not
124 associated with increased risk of recurrent coronary events
125 (including cardiac death, acute myocardial infarction, and
126 revascularization procedures [19]). However, women who
127 reported moderate to severe marital strain at baseline were
128 almost three times more likely to experience a recurrent
129 coronary event, even after controlling for demographic,
130 health behavior, and disease status variables. The risk of
131 recurrent events was twice as high for marital stress com-
132 pared to work stress. In terms of mortality, marital quality in
133 189 congestive heart failure patients predicted 4-year sur-
134 vival rates [20]. Moreover, the effect size for marital quality
135 predicting mortality was similar to the effect size for disease
136 severity, and controlling for disease severity did not atten-
137 uate the effect of marital quality. Patients with the highest
138 disease severity and poorer marriages had the highest risk
139 for mortality, with a 4-year survival rate of 42%, compared
140 to 78% among patients with mild severity and good mar-
141 riages.

142 These studies provide strong and compelling evidence of
143 a relationship between marital strain and health outcomes. A
144 broad range of outcomes was encompassed in these studies,
145 including self-reported symptoms, verified coronary events,
146 and actual mortality. Indeed, across a number of health
147 domains, marital strain is related to health [15]. Importantly,
148 several studies found that marital strain afforded risk for
149 negative outcomes equivalent to health-related variables
150 such as disease severity. As such, marital strain joins social
151 isolation as a psychosocial risk factor for negative health
152 outcomes that is similar in magnitude to more "traditional"
153 risk factors, such as physical activity and smoking [21].

154 3. Physiological pathways

155 In their stress/social support framework, Burman and
156 Margolin [14] proposed several interrelated pathways from
157 marital status to health, including interpersonal mediators,
158 intraindividual variables, psychological processes, coping
159 strategies, and physiological consequences. In their review
160 of more recent research on marriage and health, Kiecolt-
161 Glaser and Newton [15] refined this model, focusing on
162 affective, behavioral, and physiological pathways from
163 marital factors to health outcomes. There is ample evidence
164 that intimate relationships can impact illness processes or
165 outcomes indirectly through alterations in mood and
166 through their influence on health habits. Our focus is on
167 the three primary physiological pathways that mediate the

168 relationship between stress, social relationships, and health:
169 cardiovascular function, neuroendocrine function, and im-
170 mune function [2]. In particular, evidence for the role of
171 these pathways comes from marital interaction studies that
172 include physiological assessments.

173 Marital interaction studies describe the relationships
174 between behavior during spouse or partner interactions
175 and marriage-related outcomes, including satisfaction and
176 distress [22]. Interactions are typically 10–15 min discus-
177 sions of areas of conflict within the relationship. Such
178 discussions occur with regular frequency among married
179 couples, with community samples reporting an average of
180 one to two conflict discussions per month [23]. Although
181 the majority of studies observes interaction in a clinic or
182 research setting, the external validity of this paradigm has
183 been well established [22], and if anything, such interactions
184 underestimate negativity during problem-solving/conflict
185 interactions in natural settings, such as the home [24]. In
186 these studies, behavior is recorded through systematic
187 observation using behavioral coding systems [22].

188 Of primary interest in these studies are the physiological
189 concomitants and consequences of marital conflict interac-
190 tions. Marital conflict is a primary source of marital distress
191 [25] and is linked with increased psychological distress and
192 depressive symptoms [26]. In addition, marital conflict is
193 associated with poorer health, including objective indicators
194 of health, such as symptomatology or degree of recovery,
195 self-reported health, and pain [15]. Specifically, negative
196 behaviors (e.g. hostility and criticism) during marital con-
197 flict have been linked to underlying physiological mecha-
198 nisms related to health. The next sections consider evidence
199 for the influence of marital interaction on the three physi-
200 ological pathways.

202 3.1. Cardiovascular function

203 Marital quality has consequences for cardiovascular
204 disease outcomes, with poorer marital quality associated
205 with increased morbidity and mortality. Psychosocial re-
206 search on cardiovascular disease has been guided by the
207 “reactivity hypothesis,” the premise that excessive cardio-
208 vascular reactivity to stress is a risk factor for the develop-
209 ment of hypertension and cardiovascular disease, particu-
210 larly if responses occur more frequently and at high
211 intensity [21]. Marital conflict is reliably associated with
212 heightened blood pressure and heart rates [27–34]. For
213 instance, in 43 hypertensive patients, a marital problem-
214 solving task produced clinically significant increases in
215 blood pressure that were specifically associated with hostile
216 marital interactions; neither supportive nor neutral behaviors
217 were significantly associated with change [35]. Indeed, the
218 effects were sizable; hostile interactions and marital dissat-
219 isfaction accounted for 50% of the variance in women’s
220 systolic blood pressure. Similarly, behaviorally coded neg-
221 ative affect accounted for 20% of the variance in women’s
222 systolic blood pressure during a 10-min marital conflict

discussion and 53% of the variance in self-reported marital
223 distress [27]. Differences in cardiovascular arousal during
224 conflict discriminated wives (but not husbands) in physi-
225 cally violent marriages from those in distressed but nonvi-
226 olent marriages [36].
227

228 Other studies involving married couples and cardiovas-
229 cular physiology have involved impersonal topics, not
230 relationship issues [37–39]. In these studies, parameters
231 of the marital discussions are manipulated, such as induc-
232 ement to influence the other spouse [37,38], agreement
233 versus disagreement [39], and evaluative threat [39]. In
234 general, interpersonal demands, such as discussions where
235 couples are asked to disagree, elicited heightened heart rates
236 and blood pressure among wives, but not husbands [39]. In
237 contrast, evaluative threat and incentive to influence the
238 spouse had no effects on women’s cardiovascular responses,
239 while men under the same conditions displayed larger heart
240 rate and blood pressure compared to low-threat or no
241 incentive conditions [38,39]. Moreover, when there was
242 an inducement to influence the spouse, husbands’ elevations
243 in systolic blood pressure were correlated with husbands’
244 hostile and controlling behavior [38]. Importantly, these
245 differences were also observed while couples were prepar-
246 ing for the discussion, not just during the time when they
247 were actually talking.

248 In addition to parameters of the discussion, individual
249 differences play an important role in moderating cardiovas-
250 cular responses. Higher cynical hostility in husbands was
251 associated with greater blood pressure reactivity in their
252 wives, while wives’ hostility was not related to either their
253 own or their husbands’ reactivity [37]. Among husbands,
254 only their own hostility predicted their blood pressure
255 changes. Under conditions of evaluative threat, high levels
256 of hostility were associated with greater systolic blood
257 pressure reactivity in husbands [40]. Moreover, although
258 hostility was not associated with wives’ cardiovascular
259 reactivity, wives disagreeing with high hostile husbands
260 exhibited greater cardiovascular reactivity.

261 These data suggest that qualitatively different interper-
262 sonal demands may differentially activate husbands’ and
263 wives’ cardiovascular responses. Studies in which spouses
264 discuss areas of marital disagreement showed that negative
265 or hostile behavior during conflict was clearly associated
266 with physiological alterations, with larger differences
267 among women than men. The fact that wives respond to
268 spousal disagreements, even on impersonal topics, with
269 larger cardiovascular responses than husbands [39] is con-
270 sistent with those studies.
271

272 3.2. Endocrine function

273 Catecholamines and glucocorticoids have a wide range of
274 effects on homeostatic processes, including metabolic regu-
275 lation and stress responses. These hormones are also
276 important in regulating cardiovascular, metabolic, and im-
277 mune functions [41,42]. Moreover, these hormones are

278 influenced by the presence and quality of social relation-
279 ships [2,43].

280 Studies from our laboratory have shown consistent
281 relationships between marital conflict and endocrine func-
282 tion. We assessed autonomic, endocrine, and immune func-
283 tions over a 24-h period in 90 newlywed couples who met
284 stringent mental and physical health criteria [30]. Couples
285 also engaged in a 30-min conflict resolution task in which
286 they discussed current marital problems. Newlywed couples
287 exhibiting higher levels of hostile and negative behavior
288 during conflict showed elevated levels of epinephrine,
289 norepinephrine, adrenocorticotropin hormone (ACTH) and
290 growth hormone, and lower levels of prolactin [44]. More
291 negative and hostile couples showed elevations in epineph-
292 rine, norepinephrine, ACTH, and growth hormone during
293 the conflict discussion, which persisted for 15 min after the
294 discussion had ended. In addition, these elevations were
295 more pronounced in women compared to men.

296 Behavior during marital conflict also accounted for a
297 significant proportion of variance in endocrine measures
298 pooled over 24 h, accounting for 24% of the variance in
299 changes in epinephrine and cortisol, 29% of the variance in
300 norepinephrine, and 37% of the variance in prolactin [45].
301 For wives, higher probabilities of husbands' withdrawal in
302 response to wives' negative behavior were associated with
303 higher norepinephrine and cortisol levels over 24 h. The
304 "wife demand/husband withdraw" sequence has been asso-
305 ciated with greater marital distress in a number of marital
306 studies [46,47]. In addition, wives who showed higher
307 frequencies of positive behaviors during conflict had lower
308 epinephrine levels.

309 Older couples display less negative behavior and more
310 affectionate behavior than younger couples during conflict
311 [48], and might therefore be expected to display a different
312 pattern of endocrine changes. However, effects similar to
313 those observed in newlywed couples were found in older
314 couples between the ages of 55 and 75, with negative
315 behaviors and negative escalation accounting for 16–21%
316 of the variance in rate of change in cortisol, ACTH, and
317 epinephrine during marital conflict, in addition to the linear
318 effects of time [49].

319 3.3. Immune function

320
321 In addition to cardiovascular and endocrine changes,
322 marital conflict is linked to immune dysregulation. Similar
323 to the cardiovascular data, immune data from our newlywed
324 couples suggested that physiological changes were signifi-
325 cantly related to hostile behavior, and not to avoidant,
326 positive, or problem-solving behaviors [30]. In particular,
327 hostile and negative behavior was associated with declines
328 in natural killer (NK) cell lysis and blastogenic responses to
329 two mitogens (concanavalin A and phytohemagglutinin
330 [PHA]), and increased antibody titers to latent Epstein–
331 Barr virus (EBV). The latter result suggested that individ-
332 uals experiencing greater negative behaviors exhibited

poorer control of a latent herpesvirus by the adaptive
immune system. Similar to the cardiovascular and endocrine
results discussed above, the magnitude of immunological
change was greater for women compared to men.

333
334
335
336
337 In our older adult sample, individuals who demonstrated
338 a pattern of relatively poorer immunological responses (NK
339 cell lysis, blastogenic responses to mitogen, EBV antibody
340 titers) displayed more negative behavior during conflict. In
341 addition, couples with poorer immunological responses
342 characterized their usual marital disagreements as more
343 negative than individuals who showed better immune
344 responses across assays [49]. In work from another lab,
345 wives responded to marital conflict with greater increases in
346 depression, hostility, and systolic blood pressure than hus-
347 bands; in addition, women's lymphocyte proliferative
348 responses to PHA decreased following conflict, while those
349 of the men increased [31]. Following conflict, decreases in
350 proliferative responses to PHA were significantly correlated
351 with increases in self-reported hostility.

352 A central question throughout much literature on phys-
353 iological change and health has been the extent to which
354 stress-induced immune changes have consequences for
355 morbidity and mortality [50]. Stress-induced immune
356 changes have consequences for a number of health out-
357 comes, particularly responses to infectious disease and
358 wound healing [51]. As shown by studies in the last decade,
359 marital conflict, which could also be classified as a social
360 stressor, results in immune changes. Importantly, the effects
361 of marital conflict on immune function may actually be
362 underestimated, as studies of marriage and health typically
363 include couples who have relatively satisfied marriages [15].

364 4. Behavior and physiology in marriage: longitudinal 365 implications

366 4.1. Physiological responses and health

367
368 The past decade of research has yielded important
369 evidence for the influence of behaviors during marital
370 interaction on physiological functioning, providing solid,
371 mechanistic evidence of how marital functioning can have
372 direct physiological consequences. Cardiovascular, endo-
373 crine, and immune pathways are critically important for
374 the organism's adaptation to changing environmental
375 demands. Thus, they play a central role in the ability of
376 the organism to maintain physiological stability through
377 change [52]. McEwen [42] extended this conceptualization
378 to broader health outcomes, describing the cumulative long-
379 term effects of physiological responses to stress. In this
380 conceptualization, these pathways play central roles in a
381 variety of adaptive processes and deleterious physiological
382 outcomes.

383 McEwen [42] described four plausible processes through
384 which psychosocial influences on physiology can lead to
385 detrimental health consequences. They are listed below

386 along with their relevance to marital functioning, and each
387 of these processes is of interest in the context of marriage
388 and health.

389

390 4.1.1. Repeated “hits” by novel stressors

391 Marital conflict is a common occurrence, with an average
392 frequency of one to two times per month [23]. The topic of
393 conflict discussions can vary widely (e.g. in-laws, sex,
394 parenting, finances, etc.) over time, akin to repeated hits.

395

396 4.1.2. Lack of adaptation to the same stressor

397 Spouses may not readily adapt physiologically to the
398 same conflict discussion or topic over time. That is, rather
399 than a gradual decline in physiological activation with each
400 conflict discussion, certain marriages could be characterized
401 as chronic social stressors composed of repeated hits and a
402 lack of physiological adaptation.

403

404 4.1.3. Failure to shut off physiological responses following 405 exposure to a stressor

406 The ability to shut off physiological responses after
407 exposure to a stressor is also described as “recovery.”
408 Marital interaction studies in the past decade indicate that
409 hostile and negative conflict behaviors are related to longer
410 recovery following exposure to the conflict stressor. Shorter
411 recovery periods allow the organism to “demobilize” phys-
412 iological resources more quickly, diminishing physiological
413 strain that persists beyond the transient stressor [42,53].

414

415 4.1.4. Inadequate responses to stressors

416 Chronic and repeated physiological activation as the
417 result of marital stress may impair important physiological
418 processes. For instance, chronic stress is associated with
419 impaired responses to biological “stressors” in the form of
420 infectious disease [50].

421 The studies reviewed in this paper suggest that the degree
422 of negativity during marital conflict may be related to the
423 persistence of physiological changes. The key implication of
424 this conceptualization is that physiological responses to
425 stress have cumulative, long-term effects on health, includ-
426 ing effects on tissue and organ systems, and progression and
427 development of disease. If abrasive interactions and rela-
428 tionships provoke larger and more frequent immunological,
429 endocrinological, and cardiovascular changes in relatively
430 healthy couples, then individuals in troubled relationships
431 could be at greater risk for a variety of health problems over
432 time. Distressed families experience roughly twice as many
433 tensions per day as nondistressed families [54,55]. More-
434 over, distressed couples are more likely to experience
435 continuance of tensions, particularly those that repeat in
436 ritualized patterns at the same time on subsequent days [55].

437 In contrast to stressors without an interpersonal compo-
438 nent, those that involve conflict have an increasing emo-
439 tional impact as stressors occur over days, and they account
440 for a large portion of the variance in daily mood [56]. This
441 failure to emotionally recover following the termination of a

442 stressor could plausibly correspond to a failure to physio- 442
443 logically recover. Elevated cortisol among wives throughout 443
444 the course of the day following a 30-min conflict was 444
445 associated with increased likelihood of husbands withdraw- 445
446 ing from conflict [45]. This may reflect the enduring 446
447 physiological and emotional impact of husbands’ withdraw- 447
448 al during the conflict discussion on wives. Indeed, as 448
449 MacLean [57] noted in his classic *The Triune Brain in* 449
450 *Evolution*, “it deserves emphasis that, short of induced 450
451 physical activity, emotional mentation represents the only 451
452 psychological process that may lead to profound, and often 452
453 prolonged, autonomic activity” (p. 30). 453

454

455 4.2. Longitudinal effects of marital functioning: preliminary 456 evidence

457 Preliminary evidence for an association between marital 457
458 distress and a cumulative, long-term impact on health comes 458
459 from a prospective study of patients with mild essential 459
460 hypertension [58]. Marital quality, ambulatory blood pres- 460
461 sure, and left ventricular mass index (LVMI; increased 461
462 LVMI reflects left ventricle hypertrophy, which is associated 462
463 with poorer cardiovascular health) were assessed in 103 463
464 subjects, and cardiovascular measures were measured again 464
465 at 3-year follow-up. After controlling for health variables 465
466 including baseline LVMI, decreased marital quality, as 466
467 measured by the Dyadic Adjustment Scale (DAS) [59], 467
468 predicted increased LVMI, with a one-point decrease in 468
469 the DAS total score associated with 0.3 g/m² increase in 469
470 LVMI. Moreover, subjects who reported poor marital qual- 470
471 ity had an elevated 24-h diastolic and systolic ambulatory 471
472 blood pressure at follow-up. Marital quality also moderated 472
473 the relationship between spousal contact and ambulatory 473
474 blood pressure, such that increased daily spousal contact 474
475 was associated with lower diastolic blood pressure (DBP) in 475
476 satisfied couples and elevated DBP in dissatisfied couples at 476
477 follow-up. 477

478 Although the studies reviewed above suggest that marital 478
479 functioning has long-term consequences for physiological 479
480 function, does physiological function indicate anything 480
481 about long-term outcomes for the marriage? Data from a 481
482 10-year follow-up study of our newlywed sample suggest 482
483 this may be the case. We assessed marital status and 483
484 satisfaction at follow-up in every couple that participated 484
485 in our initial newlywed study (Time 1) and examined the 485
486 extent to which marital dissolution and dissatisfaction at 486
487 follow-up was associated with neuroendocrine function 487
488 during the first year of marriage [60]. Levels of epinephrine 488
489 were elevated during the Time 1 conflict discussion and 489
490 throughout the entire day among couples who eventually 490
491 divorced compared to those who remained married. More- 491
492 over, levels of epinephrine and norepinephrine were elevat- 492
493 ed among divorced couples compared to married couples. 493
494 Among the couples who were still married, levels of ACTH 494
495 during Time 1 conflict were twice as high among wives who 495
496 reported dissatisfaction with their marriages at 10-year 496

497 follow-up, and levels of norepinephrine during Time 1
498 conflict were elevated in dissatisfied couples compared to
499 satisfied couples at follow-up. In contrast to findings for
500 endocrine function, individual difference variables such as
501 negative affect did not distinguish between divorced and
502 intact couples, although they were related to marital satis-
503 faction at follow-up.

504 Marital interaction research incorporating cardiovascular,
505 endocrine, and immune measures has yielded important
506 insights into the proximal physiological consequences of
507 marital strain. A chronic stress perspective on physiological
508 processes points to mechanisms through which chronic
509 marital strain can contribute to negative long-term health
510 consequences [42]. Preliminary evidence for a long-term
511 effect of marital strain on physiology and health was
512 demonstrated by the relationship between baseline marital
513 quality and LVMI at 3-year follow-up. More provocatively,
514 physiological changes may be a harbinger of things to come,
515 as evidenced by marital outcomes at 10-year follow-up of
516 our newlywed sample. Overall, there is clear evidence for
517 the importance of incorporating physiological measures in
518 marital interaction research, and further application of this
519 approach will be a key empirical component in understand-
520 ing biobehavioral aspects of marriage and social relation-
521 ships, and relationships between marital functioning and
522 health.

523 5. Conclusion

524 This review described relationships between marital
525 functioning and health outcomes, and the physiological
526 pathways that may mediate these relationships. In particular,
527 evidence from marital interaction studies suggests that
528 marital strain has deleterious effects on cardiovascular,
529 endocrine, and immune functions. Marital strain can be
530 viewed as a repeated, perhaps even chronic, social stressor.
531 As such, in spouses who fail to physiologically recover
532 following a marital disagreement, or fail to adapt physio-
533 logically to repeated disagreements, chronic activation
534 resulting from continual marital strain may have negative
535 long-term consequences for health. Of the types of stressors
536 studied in psychoneuroimmunology research, chronic social
537 stressors show strong relationships with objective health
538 outcomes, including responses to infectious disease and
539 wound healing. Volunteers who reported chronic interper-
540 sonal stressors were more likely to develop a cold, following
541 inoculation with a rhinovirus [61]. Data from several studies
542 suggest that spousal dementia caregivers are less likely to
543 show clinically significant responses to influenza virus
544 vaccine [62,63], and diminished antibody titers in response
545 to a pneumococcal vaccine compared to noncaregivers [64].
546 Spousal dementia caregivers also showed delayed wound
547 healing compared to control subjects, taking 24% longer to
548 completely heal a standardized wound [65]. At this point,
549 assessing objective health outcomes has not been extended

to marital interaction studies. As such, empirical studies
have not yet directly linked cardiovascular, endocrine, and
immune changes observed during marital interaction to
health outcomes. This is one key challenge for future
research in marriage, physiology, and health, and more
broadly, future research on social relationships and health.
In addition to including objective health outcome assess-
ment, a number of important suggestions for such work can
be gleaned from research to date.

Research to date considers cardiovascular, endocrine, and
immune system pathways separately, without examining
their influences on one another in the context of marital
interaction. For example, stress-induced alterations of en-
docrine function are related to heightened cardiovascular
reactivity and immune dysregulation [66,67]. Recent empir-
ical work suggests that physiological responses in one
pathway have important implications for other pathways
(e.g. cortisol and heart rate reactivity [68], and cortisol and
lymphocyte proliferation [69]). Future work should consider
the effects of marital factors on interactions among different
physiological pathways.

Studies of marital interaction and physiological pathways
are typically conducted with relatively healthy couples.
Although this limits the generalizability of research findings
in this domain, it is likely that such findings underestimate
the impact of marital functioning on physiology and health.
However, unhappy couples are less likely to volunteer for
marital research projects than those who are more satisfied
with their spouse [70]. In addition, poor marital functioning
may be related to poorer health habits [15], such as
excessive alcohol use and smoking, which may confound
physiological measurements [71]. As such, future work
must strike a balance between considerations of ecological
validity (including distressed couples) and internal validity
(reducing potential confounds for physiological measures).

Marital interaction research clearly suggests that behav-
ioral data enhance prediction of physiological measures
[30,35,45,49]. However, a dearth of data exists on the
relationship between marital support processes, physiology,
and health outcomes. Recent behavioral data emphasize the
importance of assessing both conflict and support behaviors
in the marital relationship [72]. Incorporating positive and
supportive aspects of the marital relationship into studies of
marriage, physiology, and health is an important avenue for
the next decade of relationship research [15,73]. Finally,
studies of conflict interactions, in which real problems in the
marriage are discussed, have considerably greater ecological
validity compared to experimental or impersonal discus-
sions, which have been used in studying the psychophysiol-
ogy of marriage [40]. However, experimental approaches,
despite decreased ecological validity, enable greater and
more precise control over specific aspects of marital inter-
action (e.g. level of disagreement) that may be important to
isolate.

Understanding the physiology of marriage and how it
relates to health outcomes requires the convergence of

606 multiple methods at multiple levels of analysis. Describing
 607 relationships between interpersonal behavior and physiolo-
 608 gy requires sampling across the behavior spectrum, exam-
 609 ining overt behaviors, including covert behaviors such as
 610 cognitions, evoking negative and positive behaviors, and
 611 using both systematic and ecologically valid discussions. In
 612 terms of physiology, future work requires identifying the
 613 important physiological mechanisms within the cardiovas-
 614 cular, endocrine, and immune systems that are relevant to
 615 health and responsive to marital functioning. Moreover,
 616 given the importance of physiological recovery, future
 617 studies must adequately and accurately delineate the param-
 618 eters of physiological change affected by marital function-
 619 ing and behavior. In concert with subjective and objective
 620 assessments of health outcomes, the next decade of research
 621 will provide important data on the specific physiological
 622 mechanisms through which marital functioning affects
 623 health.

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