

Association of Sexual Functioning and Quality of Partnership in Patients in Cardiovascular Rehabilitation—A Gender Perspective

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ABSTRACT

Introduction. In the general population, studies indicate a strong association between sexual dysfunction and partnership quality. Despite a high prevalence of sexual problems in patients with cardiovascular diseases, this association has not yet been examined in this sample.

Aim. The central task of this paper is to determine the association between sexual dysfunction and quality of partnership under a gender-specific view.

Methods. A written survey was handed out to all newly admitted patients in five participating inpatient rehabilitation centers for cardiovascular diseases in Germany. The survey included a gender-specific questionnaire to assess sexual functioning (International Index of Erectile Function for men, and Female Sexual Function Index for women), and a Partnership Questionnaire.

Main Outcome Measures. Correlations were calculated between sexual function and relationship satisfaction, and differences between groups (cardiovascular diseased men and women with and without sexual problems) were tested using covariance analyses.

Results. Overall, 44.3% of 98 female participants and 52.7% of 395 male participants stated to have at least one sexual problem. Patients with sexual problems showed significantly more quarrelling ($P = 0.001$), significantly less tenderness ($P < 0.001$), communication ($P < 0.001$), as well as significantly lower overall quality of partnership ($P < 0.001$), compared with cardiac men and women without sexual problems. Suffering from a sexual problem impaired partnership quality for women to a significantly greater extent than for men.

Conclusions. Possible shortcomings of our study are selection bias, i.e., it is unknown whether all newly admitted patients received the questionnaire by their physician, as well as an overall low response rate, probably because of the private character of questions. This study suggests for the first time that men and women who suffer from cardiovascular diseases and sexual problems show a significantly decreased partnership satisfaction compared with those without sexual dysfunction. Further longitudinal studies might confirm the causal nature of found correlations. **Günzler C, Kriston L, Harms A, Berner MM, and the members of the Sexuality of Patients in Rehabilitation of Cardiovascular Diseases study group. Association of sexual functioning and quality of partnership in patients in cardiovascular rehabilitation—A gender perspective. J Sex Med 2009;6:164–174.**

Key Words. Sexual Dysfunction; Quality of Partnership; Cardiovascular Diseases; Rehabilitation

Introduction

Cardiac patients often suffer from sexual dysfunction [1–3]. The Men's Attitudes to Life Events and Sexuality study points out that the risk of experiencing an erectile dysfunction (ED) triples when men also have cardiovascular diseases [4] and conversely, cardiovascular diseases have a high prevalence in patients with erectile dysfunction [5].

Studies in the general population suggest that sexual problems often interfere with the quality of partnerships. A German study investigated 105 men with ED and their partners [6]. Half of the men were treated with sildenafil, the other half were still waiting for medical treatment. The results clarify that treated men and their partners reported a significantly better quality of partnership than untreated men and their partners.

Erectile functioning correlated significantly with tenderness and communication/togetherness. In a current study by Kelly et al., couples in which women suffered from an orgasmic disorder were compared with couples in which women had no sexual dysfunction, as well as with couples in which either partner suffered from a chronic disease like diabetes mellitus with regard to their communication pattern [7]. All couples were asked to discuss three topics (5 minutes each) while being observed: intercourse, direct genital stimulation, and being ill. One minute of every discussion was rated by blinded and independent raters. Results suggested that couples in which women suffered from anorgasmia showed a higher tendency to blame, as well as poor receptivity (eye contact, acceptance of one's partner's viewpoint, etc.), compared with both other groups when discussing sexual topics.

The poor communication regarding sexual problems in the case of dysfunction is also shown in two studies, which demonstrate that persons with sexual problems often avoid discussing them with their partner [8,9].

Men who are dissatisfied with their health and report somatoform complaints have often decreased sexual and partnership satisfaction (the terms "partnership" and "relationship" as well as "quality" and "satisfaction" are used synonymously in the following section) [10].

Aims

Although there is evidence that somatic disorders like Parkinson's disease or multiple sclerosis lead to an increased probability to develop sexual dysfunctions and to a decrease of sexual satisfaction, as well as to changes in partnership [11–13], there is yet no evidence for the association between cardiovascular diseases, sexual dysfunction and partnership quality.

The Sexuality of Patients in Rehabilitation of Cardiovascular Diseases (SPARK) study examines this association. Because there is no knowledge regarding gender differences concerning the association between sexual dysfunction and partnership satisfaction in cardiac patients, the SPARK study provides first results in this yet unexplored field.

Methods

Procedures

Between November 2004 and January 2006, a written survey was completed by patients in five

participating inpatient rehabilitation centers for cardiovascular diseases in Germany. The cardiac centers were recruited via a German expert council on the rehabilitation of cardiovascular diseases (Deutsche Gesellschaft für Prävention und Rehabilitation von Herz- Kreislauferkrankungen e.V.). Before the patients were questioned, a survey among the medical staff in these centers had been performed concerning subjectively assessed epidemiology and management of sexual dysfunctions [14]. Subsequently, the health care professionals were trained in the topic and were informed about study procedures.

All newly admitted rehabilitation patients were handed an open study envelope in the first days of their hospital stay. This envelope included one sheet with study information, two informed consent sheets and a gender-specific questionnaire. Typically, the physician delivered it while consulting with the patients about clinical issues. In two centers the package was distributed by the nurse at hospital admission or by a psychologist during the first group session. All patients were informed about the procedure by medical staff: they should fill out the informed consent and the questionnaire anonymously in the course of their stay and put it into the envelope. Upon closing the envelope they placed it in a special study box that was in the rehabilitation center.

In every center one local staff person was responsible for conducting the study. He or she was responsible for sending back the closed envelopes to the study center.

In Freiburg the envelopes were opened by a scientific assistant and the informed consent sheet was immediately separated from the questionnaire to ensure anonymity. Three medical students, who were blinded to informed consent, entered the survey data in an MS Access database. Quality of data input was controlled by a scientific assistant, who was not involved in data entry, by checking 30 randomly selected questionnaires (10 from every student).

Overall, 1,475 male questionnaires and 700 female questionnaires were handed out in the rehabilitation centers.

Instruments

The questionnaire consisted of items about socio-demographic characteristics, the cardiac problem, depression, alcohol consumption, quality of life, as well as a wide range of questions with regard to sexual functioning and satisfaction.

To examine sexual problems, self-assessment items concerning arousal problems, retarded or missing orgasm, premature orgasm, pain during intercourse, and lack of desire (multiple choices possible) were administered. Furthermore, two validated instruments that measured sexual dysfunction were included: the German version of the International Index of Erectile Function (IIEF) [15–17] in the male survey and the German version of the Female Sexual Function Index (FSFI-d) [18,19] in the female survey. The IIEF consists of 15 questions measuring the following aspects of sexual function: erectile function, orgasmic function, sexual desire, intercourse satisfaction, and overall satisfaction. The FSFI-d consists of 19 questions that measure desire, arousal, lubrication, orgasm, satisfaction, and pain. In addition to these subscales, a general score for female sexual function can be calculated.

To assess the partnership quality, the Partnership Questionnaire (PFB) was used [20]. It consists of 30 questions that measure the three subscales tenderness, communication/togetherness, and quarrelling. A general score (quality of partnership) can also be calculated. In the manual, data of 235 control persons exist for all subscales and the main scale of PFB.

Statistical Analyses

Descriptive statistical analyses were performed including the generation of frequency tables. When patients reported at least one sexual problem, they were grouped into the category “patients with sexual problems”. For calculating associations between sexual function and relationship satisfaction, only patients living in a partnership and patients who reported to be sexually active were included in the analyses. Differences between groups (cardiovascular diseased men and women with and without sexual problems) were tested using covariance analyses. Gender, indicating any sexual problem (vs. indicating none), and the interaction effect of these terms were defined as independent variables. Age and severity of physical disease were included in the model as covariates. All partnership quality (PFB) scales were considered as dependent variables. Means of aspects of the partnership quality of the external control group (listed in the PFB manual) were not included in statistical analyses and are only presented in the figures for visual comparison. The association between dimensions of sexual function, as measured by IIEF and FSFI-d, and aspects of

partnership satisfaction were tested using partial correlation with severity of cardiovascular disease as control variable.

Statistical analyses were performed with SPSS v11.5 (SPSS Inc., Chicago, IL, US).

Ethical Considerations

The study was approved by the ethics committee of the Albert Ludwigs University of Freiburg, and was registered in the Clinical Trial Registry of the University Medical Center Freiburg (http://www.uniklinik-freiburg.de/zks/live/ukregister_en.html; trial-ID: UKF000343).

Main Outcome Measures

The main outcome measures were overall sexual dysfunction (self-assessed and measured by psychometrically sound questionnaires), quality of partnership, their subscales, and the extent of association between these constructs.

Results

Response

Of 2,175 questionnaires handed out to the cardiac patients, 824 (37.9%) were sent back to the study center in Freiburg. Of those, 493 (59.8%) patients filled out the survey and could be included in the analyses. Of all 1,475 men receiving the questionnaire, 395 (26.8%) men filled it out. In women, 98 (14%) of 700 questionnaires that were handed out were returned filled out. For more detailed information regarding returned questionnaires, e.g., gender-specific details and reasons for refusing, see Figure 1.

Socio-demographic Variables

The socio-demographic variables for all men and women, as well as for the subsample women (83.7% of all women) and men (88.9% of all men) living in a partnership, are presented in Table 1. Both genders had similar age, education and marital status. Both were mainly married and had full- or part-time jobs. A higher proportion of women were housewives (13.9%) than men were househusbands (0.8%). Every third woman and over 40% of men came to rehabilitation because of a long-standing heart disease. Almost half of all men (44.5%) had a first myocardial infarction, and in women this rate was nearly 30% (multiple choices for rehabilitation reasons were possible).

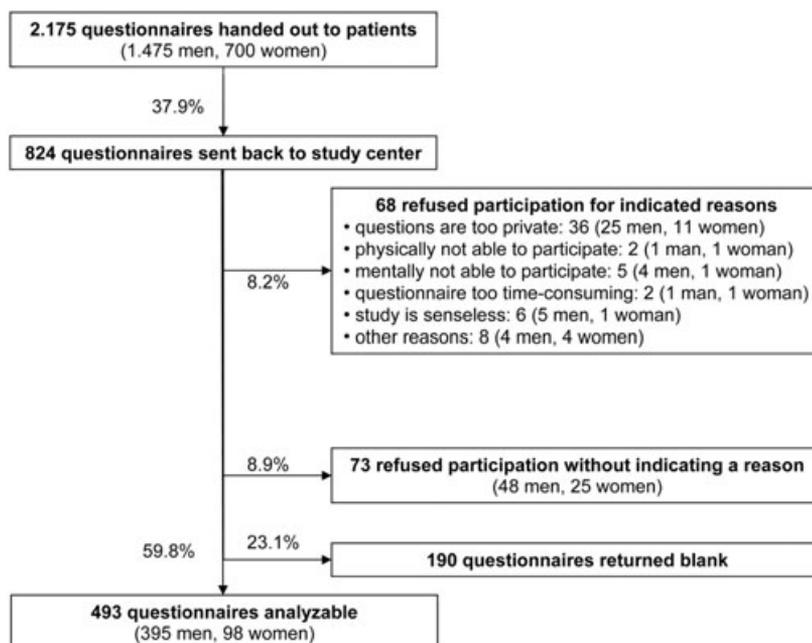


Figure 1 Patient flow chart.

Sexual Dysfunction in Cardiac Patients

In this study, it was found that 44.3% of women and 52.7% of men stated to have at least one sexual problem. In women the main problem was the lack

of desire and in men more than 30% had arousal problems (see Figure 2).

According to FSFI-d, 46.8% of all cardiac female patients had a sexual dysfunction. Accord-

Table 1 Sociodemographic and clinical characteristics of the sample

	Whole sample		Subsample of women and men in a relationship	
	Women (N = 98)	Men (N = 395)	Women (N = 82)	Men (N = 351)
Age in years (mean \pm SD)*	55.8 \pm 12.5	55.7 \pm 10.4	53.7 \pm 12.1	55.4 \pm 10.2
Education (%)				
Lower/middle education	81.5	80.6	81.5	79.6
Higher education	18.5	19.4	18.5	20.4
Profession (%)				
Full-time or part-time job	50.6	59.1	55.7	60.0
Apprenticeship	1.1	0.0	1.2	0.0
Homemaker	13.9	0.8	16.5	0.6
Retired	32.2	32.5	24.1	32.1
Unemployed	2.2	7.6	2.5	7.3
Marital status (%)				
Never married	5.2	6.9	3.7	4.3
Divorced or living apart from partner	14.4	11.9	12.4	8.6
Widowed	11.3	3.3	2.5	1.4
Married	69.1	77.9	81.5	85.7
Reason for rehabilitation† (%)				
Long-term heart disease	30.6	40.6	32.9	40.5
Acute: first myocardial infarction	29.4	44.5	31.5	45.2
Acute: Recurrent myocardial infarction	2.4	5.7	1.4	5.9
Recovery from heart surgery	27.1	21.4	24.7	22.3
Endocrine disorder	16.5	12.5	16.4	11.7
Pulmonary disorder	8.2	6.5	8.2	5.6
Other reasons	28.2	21.4	28.8	20.5

*Mean \pm standard deviation.

†Multiple choices possible.

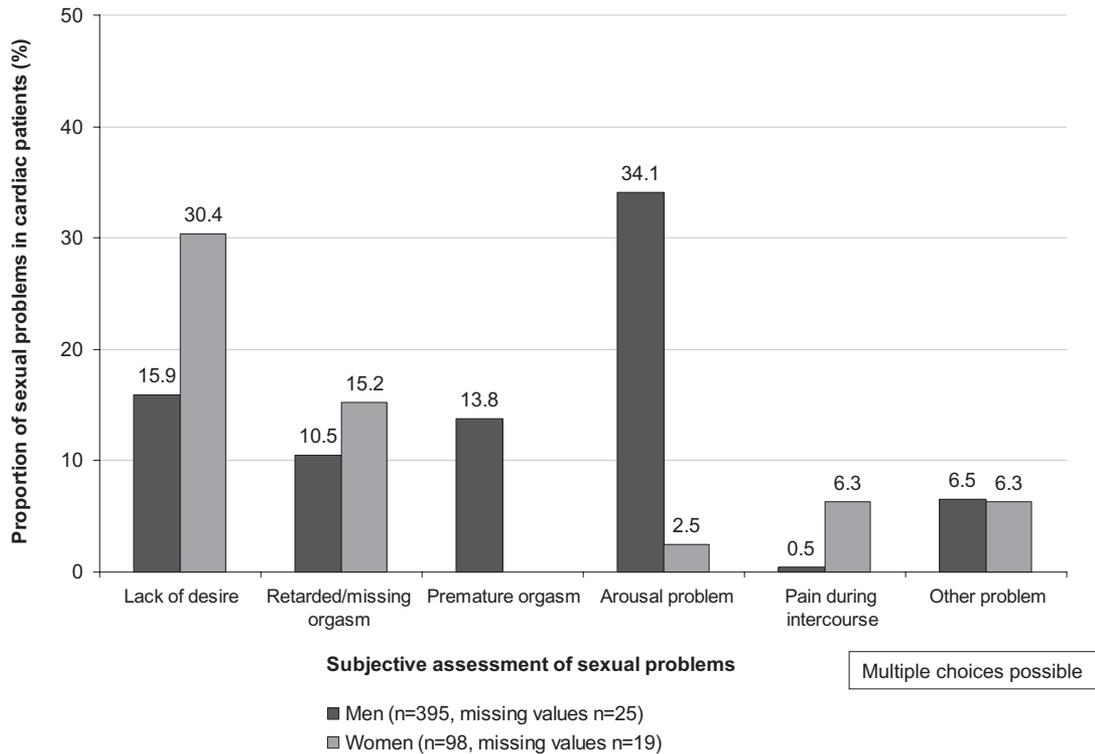


Figure 2 Subjective assessment of sexual problems.

ing to IIEF (erectile function domain score), 20.2% of participating men had at least a moderate ED.

Sexual Problems According to Subjective Assessment and Partnership Quality

Figure 3 shows that persons with sexual problems differed in all subscales of the PBF and in the main scale quality of partnership from persons that did not report any kind of sexual problem. Men and women with sexual problems showed significantly more quarrelling ($P = 0.001$), significantly less tenderness ($P < 0.001$), communication ($P < 0.001$), as well as significantly lower quality of partnership overall ($P < 0.001$), compared with men and women without sexual problems. Scores of cardiac female and male responders without sexual problems were similar to those of the healthy control group listed in the PFB manual. Furthermore, suffering from a sexual problem impaired partnership quality of women to a significantly greater extent than of men (see interaction effects in Table 2).

Sexual Dysfunction According to IIEF and FSFI-d and Partnership Quality

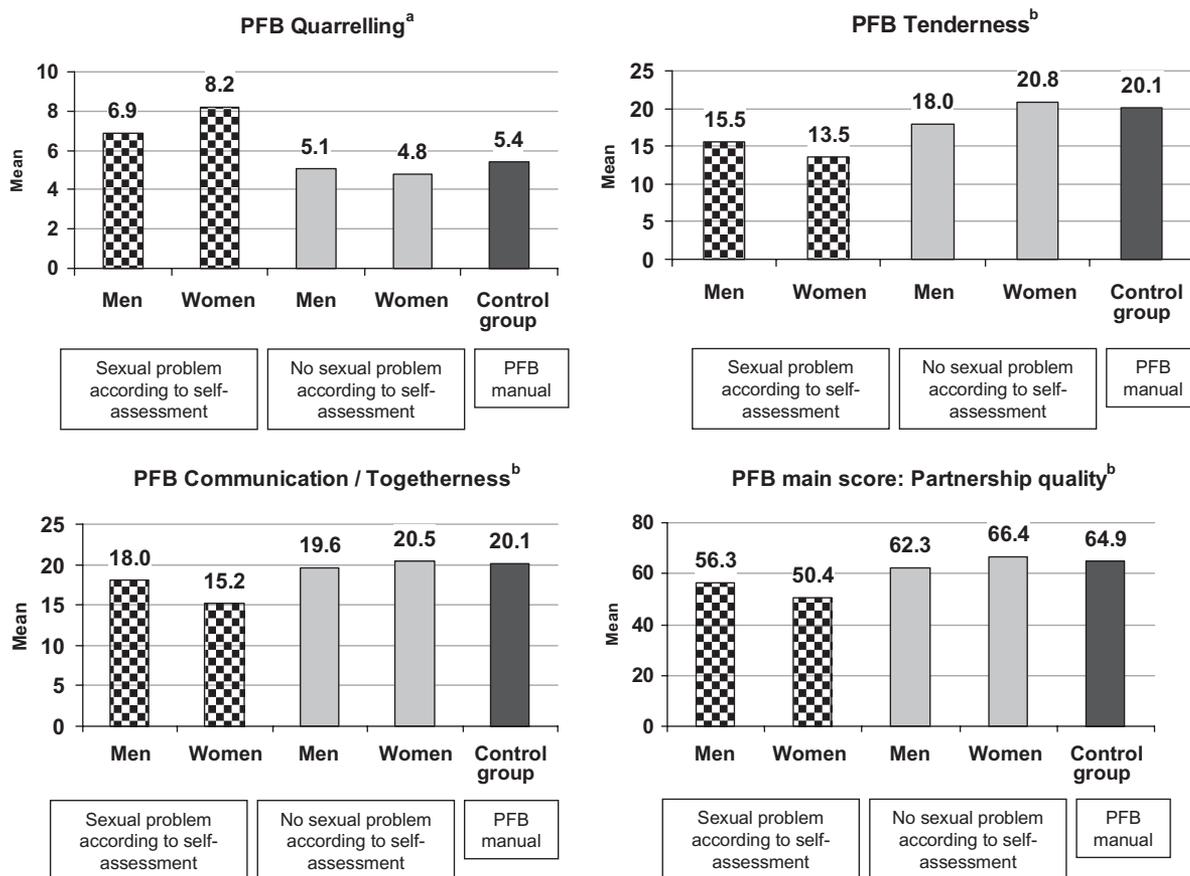
The correlation matrix (see Table 3) illustrates the association between the dimension of sexual func-

tion in men (IIEF) and women (FSFI-d), and the aspects of partnership satisfaction (PFB scales). All partial correlations, except between female desire and quarrelling ($P = -0.175$), proved to be significant. The associations in men were with $r = 0.2$ to $r = 0.4$ moderate, in women with $r = 0.3$ to $r = 0.6$ even higher. These results support the results of the covariance analyses, which show that the quality of partnership of cardiac women is impaired by an existent sexual dysfunction to a greater extent than of men.

Discussion

The SPARK study investigated the prevalence of sexual dysfunction in men and women with cardiovascular problems and its association with the quality of partnership.

There are some limitations to this study. A central problem is a possible selection bias of patients. It cannot be proven that all men and women who stayed at the rehabilitation center received the survey from their physicians. Despite the clear instruction to include all newly admitted patients, it is possible that the medical staff excluded subjects, who were subjectively judged to be inappropriate for the study. As a consequence,



^a Higher values indicate lower quality

^b Higher values indicate higher quality

Sample size: SPARK group: men N=351; women N=82

Control group: men N=103; women N=132

Figure 3 Association of sexual problems and quality of partnership.

older and more diseased persons might be less likely to be included in the study. Main reason for not participating as indicated by the patients was that the survey was assessed as too private. This could also be an explanation for the high number of blank returned questionnaires and may indicate a possible self-selection bias.

A second problem is the altogether low response rate in all patients. Of 331 patients who refused participation, 68 specified reasons. Fifty-three percent stated that questions were too private, 10.3% were not able to participate because of bad mental or physical status, and a further 8.8% did not find the study useful enough. Because of its private nature, no further actions to increase response were taken and the anticipated low response rate had to be accepted. Therefore, it might be possible that our sample contains a self-selection bias towards a population that is more

interested in the topic of sexuality as compared with the nonresponding population. In a systematic review investigating methods to increase response rates to postal questionnaires 372 eligible trials and 98 different strategies were analyzed [21]. Main results were that response was more likely when the surveyed persons received monetary incentives (odds ratio [OR] 1.99, $P < 0.001$), a prenotification (OR 1.50, $P < 0.001$), or a follow-up contact (OR 1.44, $P < 0.001$). Thus, educational information prior to the survey and providing the patients chance for discussion with the medical staff afterwards might improve the willingness of participation in future studies. Furthermore, shorter questionnaires might increase response rates (OR 1.73, $P < 0.001$). Our survey was rather long and it might be more appropriate to apply a short questionnaire with a closing question whether patients were willing to fill out a

Table 2 Covariance analysis of gender and sexual functioning effects on partnership quality

	<i>F</i> (df = 1)	<i>P</i> value	Explained variance (%)	
			Term*	Model†
Scale 1: quarrelling				
Main effect 1: gender	0.481	0.488	0.1	3.6
Main effect 2: existence of sexual problem	11.702	0.001	3.1	
Interaction effect	1.231	0.268	0.3	
Covariate: age	3.588	0.059	1.0	
Covariate: severity of physical disease	1.512	0.220	0.4	
Scale 2: tenderness				
Main effect 1: gender	0.165	0.685	0.0	9.8
Main effect 2: existence of sexual problem	29.604	<0.001	7.5	
Interaction effect	7.599	0.006	2.0	
Covariate: age	5.140	0.024	1.4	
Covariate: severity of physical disease	0.481	0.489	0.1	
Scale 3: communication/togetherness				
Main effect 1: gender	1.398	0.238	0.4	6.2
Main effect 2: existence of sexual problem	19.212	<0.001	5.0	
Interaction effect	5.671	0.018	1.5	
Covariate: age	4.083	0.044	1.1	
Covariate: severity of physical disease	0.124	0.725	0.0	
Total: partnership quality				
Main effect 1: gender	0.196	0.659	0.1	7.7
Main effect 2: existence of sexual problem	26.146	<0.001	6.9	
Interaction effect	5.553	0.019	1.6	
Covariate: age	1.639	0.201	0.5	
Covariate: severity of physical disease	0.043	0.835	0.0	

*Partial eta-squared.

†Adjusted *F*².

more detailed questionnaire. In the review, odds of response were also increased with nonmonetary incentives (OR 1.13, $P < 0.001$). The allocation of information material about the association between heart disease and sexual problems might be a useful and helpful incentive in future studies.

The response rate was twice as high in men as in women. It is possible (though none of the centers provided evidence) that the mostly male physicians might have avoided handing out the questionnaire to female patients because of shame. Because of the survey, patients were likely to prompt talking about sexual problems with their physician. Gott et al. found a barrier in discussing such problems with the opposite gender [22]. To avoid a consultation, physicians may have dispensed female questionnaires more rarely. Second, it is possible that questions about sexuality and partnership are more intimate for women, and the willingness of participation is higher in men. Third, the higher response rate in male patients might be explained by the fact that male treatment for sexual dysfunction, especially erectile dysfunction, is better known because of the more intensive research in male treatment options. Men may believe that participation in this study leads to more support on the physician's side.

A further important shortcoming concerns the anonymity of the questionnaire. Because the local

ethic committee required a named informed consent for this survey, patients had to sign this sheet and turn it together with the questionnaire. This might have felt inconsistent with the claim of an anonymous survey. To ensure the highest possible anonymity, the informed consent form was separated from the questionnaire immediately after receipt.

Despite these limitations some important conclusions can be made. Three results have to be highlighted.

First, there is a strong association between sexual dysfunction and cardiovascular problems.

According to self-assessment, as well as according to the total score of FSFI-d, nearly half of all women in cardiovascular rehabilitation have a sexual dysfunction. In other studies, the prevalence was even higher. In a small Turkish study by Kaya et al., 60% of 20 women with coronary artery disease, compared with 33.3% of 15 healthy subjects, suffered from sexual dysfunction [23]. An American large-scale study of 1,091 sexually active women with coronary artery disease (mean age 67 years) came to a similarly high prevalence rate [24]. Lower sexual problem scores were associated with having better self-reported health. After a first myocardial infarction, women reported less sexual activity and satisfaction compared with the time before the cardiac event [25]. An explanation

Table 3 Association between dimensions of sexual function and aspects of partnership quality

	Women FSFI-d [†] (N = 71)					Men IIEF [‡] (N = 92)						
	Desire	Arousal	Lubrication	Orgasm	Satisfaction	Pain	Total scale	Orgasmic function	Sexual desire	Intercourse satisfaction	Overall satisfaction	Erectile function
Quarrelling [†]	-0.175	-0.322*	-0.373*	-0.361*	-0.632**	-0.336*	-0.433**	-0.195**	-0.178*	-0.225**	-0.340**	-0.233**
Tenderness [‡]	0.478**	0.489**	0.598**	0.604**	0.661**	0.521**	0.592**	0.261**	0.233**	0.368**	0.448**	-0.311**
Communication [†]	0.439**	0.459**	0.484**	0.486**	0.599**	0.408**	0.522**	0.215**	0.180*	0.239**	0.321**	0.224**
Partnership quality [‡]	0.426**	0.465**	0.552**	0.542**	0.689**	0.482**	0.558**	0.271**	0.228**	0.333**	0.436**	0.305**

Partial correlations with control variable "severity of physical disease."

* $P < 0.05$; ** $P < 0.001$.

[†]Higher values indicate lower quality.

[‡]Higher values indicate higher quality.

FSFI-d = Female Sexual Function Index; IIEF = International Index of Erectile Function.

for the lower prevalence rate of sexual dysfunction in the female SPARK sample could be the selection bias described earlier that might have led to an exclusion of more severely diseased women. The use of nonvalidated instruments in other studies to collect data about the sexual function as well as cultural differences could also have led to this discrepancy. Finally, the population in our study might have altogether been in a better state of health with regard to their cardiac disease than the subjects in other studies. Nevertheless, the prevalence rate of sexual dysfunction in female cardiovascular diseased patients is high. It is possible that the development of sexual problems in women with cardiovascular problems depends on the duration of heart disease. Women with a preexisting heart disease may have lower levels of sexual desire and arousal than women with an acute cardiac event, which is usually not expected to cause a decrease in sexual functioning. An analysis of the subgroups (acute vs. long-term heart disease) with regard to the presence of sexual problems might be interesting for further studies.

In men, more than 50% stated to have some kind of sexual problem. One in three men reported arousal problems. According to IIEF, every fifth man had at least a moderate ED. The higher prevalence of subjectively perceived as compared with questionnaire-assessed arousal problems could be caused by the fact that men with a mild ED are not classified as problematic through the IIEF, but might well experience a sexual problem subjectively. The subjective severity of the sexual problem was not recorded in the self-assessment scale. However, it has to be mentioned that the prevalence of ED in the male SPARK sample is lower than in some other studies where prevalence rates of 60% to 75% in cardiac patients were found [1,26]. This can be ascribed to different criteria to define ED. This means that while Hood and Robertson used a liberal criterion for ED (IIEF score ≤ 21), in the SPARK study a more conservative criterion (IIEF score ≤ 17 , resembling at least moderate ED) was used. It is questionable whether mild erectile problems should already be included in the category erectile dysfunction. This does not mean that mild ED should not be seen as a sexual disorder, but rather that the criteria used in publications should be reflected [27]. It might be worthwhile thinking about the suggestions of Schäfer and Ahlers, which pointed out the importance of differentiating between erectile dysfunction and erectile disorder [28]. Men who are not too concerned about the dysfunction belong to the first category,

and men who experience distress because of their problem belong to the second group. The unconsidered mixture of both groups may lead to incredibly high prevalence rates. Despite of methodologically influenced likely over- or underestimation of prevalence rates, it becomes apparent that sexual dysfunctions are very common in patients with cardiovascular diseases. This is in concordance with Laumann et al. who already reported that sexual dysfunction is more likely among men and women with poor physical and emotional health [29]. Former studies indicated that the presence of an ED might be seen as a herald in the development of cardiovascular diseases [30,31]. At the same time, patient's knowledge about risk factors for ED is often poor [32]. A better education and information of patients is necessary to prevent erectile problems as well as associated heart diseases.

The second important result of this study is the strong association between sexual dysfunction and partnership quality, which was investigated for the first time for cardiac patients. It could be demonstrated that men and women with sexual problems show a significantly higher quarrelling behavior, significantly less tenderness and communication as well as less satisfaction with partnership overall. Because of missing longitudinal data the question about the direction of found associations must remain open. The fitting of structural equation modeling is yet intended. Metz and Epstein showed that couples with sexual problems often have stronger conflict patterns in their relationship than satisfied couples [33]. The authors claim that such dysfunctional partnership conflicts may be a cause or result of sexual problems, whereas constructive interaction could add to emotional and sexual intimacy. For the practice it is often helpful to treat the sexual dysfunction, which frequently leads to a higher sexual and partnership satisfaction [6]. Sexual dysfunction and associated marital problems are relevant for physical health in cardiovascular diseased patients. A Swedish study demonstrated the higher risk of recurrent cardiac events in the presence of marital distress [34]. A one-sided approach that only includes one of the three important domains—physical health status, partnership quality, and sexual functioning—may be oversimplified and may not consider sufficiently the interrelation of these constructs. Holistic approaches seem to be more appropriate.

The third important result is the interaction between gender and existence of sexual problems for the relationship quality. Women are signifi-

cantly more impaired in their partnership than men because of a sexual dysfunction. A possible explanation is that sexual function and partnership quality might depend on each other in women to a greater extent than in men. Men might be much more able to separate both life conditions from each other. Therapists of any profession should be able to address the issues of sexual functioning in a positive way and not be afraid that it should require too much time. It was also recently demonstrated that even low threshold approaches, like distributing written information material, might have significant beneficial effects[35].

Conclusion

In summary, the SPARK study is the first to demonstrate strong associations between heart disease, the existence of sexual problems, and satisfaction with interpersonal relationship. Our study adds to the growing literature that these important interrelations need to be addressed by both medical staff in their daily rehabilitative and preventive practice, as well as by researchers in the future. The latter is especially important with regard to longitudinal study models.

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Conflict of Interest: Cindy Gunzler currently receives travel expenses reimbursement from Boehringer Ingelheim. Levente Kriston previously received travel expenses reimbursement from Pfizer Inc. Anja Harms currently receives travel expenses reimbursement from Boehringer Ingelheim. Michael M. Berner currently holds research grants from Boehringer Ingelheim, the German Ministry for Education and Research, Pfizer Inc. He received tuition fees from Astra Zeneca, Boehringer.

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