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Health-Related Quality of Life is Associated with Positive Affect in Patients with Coronary Heart Disease Entering Cardiac Rehabilitation

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Abstract Health-related quality of life (QoL) is an important and widely used outcome measure in cardiac populations. We examined the relationship between positive affect and health-related quality of life, controlling for traditional cardiovascular risk factors, clinical variables and negative affect. We further investigated the role of gender in this relationship given the well-known gender differences in cardiovascular health. We enrolled 746 patients with coronary heart disease (CHD) before they entered outpatient cardiac rehabilitation. All patients completed the Global Mood Scale and the SF-36 Health Survey. Positive affect was independently associated with mental ($p < .001$) and physical QoL ($p < .001$) after controlling for control variables. Gender moderated the relationship between positive affect and physical QoL ($p = .009$) but not mental QoL ($p = .60$). Positive affect was positively associated with physical QoL in men ($p < .001$) but not in women ($p = .44$). The health-related QoL of patients with CHD is associated with a person's level of positive affect.

Keywords Affect · Cardiovascular disease · Quality of life · Rehabilitation

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Introduction

Several psychosocial risk factors have been identified which may contribute to the development and recurrence of cardiovascular disease (CVD), including myocardial infarction (MI). Depression (Barth, Schumacher, & Hermann-Lingen, 2004), anxiety (Roest, Martens, Denollet, & de Jonge, 2010), hostility (Chida & Steptoe, 2009), vital exhaustion (Melamed, Shirom, Toker, Berliner, & Shapira, 2006) and type D personality (Denollet, Schiffer, & Spek, 2010) all may increase the risk for cardiac events. Comparably little attention has been paid to psychosocial factors which may protect from CVD (Chida & Steptoe, 2008). Especially positive affect has been demonstrated to have a favorable effect on survival after MI, even when controlling for traditional cardiovascular risk factors and negative affect in recent meta-analysis and reviews (Brummett et al., 2005; Chida & Steptoe, 2008; Denollet et al., 2010). Positive affect is commonly defined as a pleasurable engagement with the environment eliciting feelings such as happiness, joy, excitement, enthusiasm and contentment (Watson & Pennebaker, 1989). It reflects not the mere opposite of negative affect, as a person can experience positive and negative affect simultaneously (Versteeg et al., 2009). In the present study, we will use positive affect as a state as opposed to a trait being aware that this distinction is not consistently applied in the literature (Chida & Steptoe 2008).

In cardiac populations, health-related quality of life (QoL) is an important outcome measure comprising the subjective appraisal of a person's mental, physical and social functioning (Fortin, Dubois, Hudon, Soubhi, & Almirall, 2007). A major goal of cardiac rehabilitation programs is to improve patient's QoL (Hevey, Mc Gee, & Horgan, 2004). Also in terms of long-term prognosis, self-reported QoL is an important predictor of mortality and hospitalizations due to recurrent cardiac events (Mommersteeg, Denollet, Spertus, & Pedersen, 2009; Rumsfeld et al., 1999; Spertus, Jones, McDonell, Fan, & Fihn, 2002).

A variety of factors are known to negatively impact QoL (Beck, Joseph, Bélisle, & Pilote, 2001; Höfer et al., 2005), but there is a lack of knowledge concerning the influence of protective factors, such as positive affect. Two studies (Versteeg et al., 2009; Spindler, Denollet, Kruse, & Pedersen, 2009) found a positive relationship between positive affect and both mental and physical QoL in patients with CVD and chronic heart failure, independent of covariates. These relationships were observed cross-sectionally (Spindler et al., 2009) as well as 12 months after a coronary intervention (Versteeg et al., 2009). However, these studies did not control for ventricular function (Versteeg et al., 2009) and coronary artery bypass graft (CABG) surgery (Spindler et al., 2009). Several studies report on the association between QoL and sociodemographic variables (Denvir et al., 2006; Höfer et al., 2005), cardiovascular risk factors (Fortin et al., 2007) and severity of disease (Beck et al., 2001; Pettersen, Kvan, Rollag, Stavem, & Reikvam, 2008). Therefore, it is important to control for these potential biomedical and psychosocial confounds when postulating an independent association between positive affect and QoL in cardiac rehabilitation.

Different pathways have been proposed which may link positive affect to health in general, including shared genetic factors and favorable health behaviors due to higher positive affect (Steptoe, Dockray, & Wardle, 2009). Psychobiological mechanisms, including neuroendocrine and inflammatory processes might also account for some of the associations. Finally, positive affect might be a marker of other psychosocial factors. Some authors (Garavalia et al., 2007) posit a perspective of "affect as information", which describes the process of using affective states as an informational basis to evaluate subjective QoL. According to this notion, a greater amount of positive affect would also prompt a person to report on better QoL.

Studies in cardiac rehabilitation find differences between men and women in terms of cardiovascular prognosis and also gender differences in psychosocial benefit drawn from rehabilitation (Barth et al., 2009; Bjarnason-Wehrens, Grande, Loewel, Völler, & Mittag, 2007). Although the incidence of CVD is higher among men than women, women show a higher mortality rate, more mental comorbidities and worse recovery from MI (Garavalia et al., 2007). One study showed that men and women differ in recovery goals after MI (Grande & Romppel, 2011) which may help to explain gender differences in the satisfaction with rehabilitation programs. Gender differences in cardiac event rates need to consider that women tend to be several years older than men at the time of clinical onset of CVD (Bjarnason-Wehrens et al., 2007).

The aim of this study was to further elucidate the association between positive affect and QoL in patients with coronary heart disease (CHD). We hypothesized, that positive affect would be an independent positive predictor of QoL, after controlling for demographic variables, traditional cardiovascular risk factors, clinical variables and negative affect. Such an association might inform future intervention studies aimed at improving QoL through targeting positive affect. Given the importance of gender differences in cardiovascular health, we additionally investigated the role of gender in the relationship between positive affect and QoL.

Method

Participants and Study Design

Study participants were all part of an outpatient cardiovascular rehabilitation program at the University Hospital Bern, Switzerland. A total of 746 patients with a diagnosis of CHD completed the questionnaires in the first week of an 8- to 12-week comprehensive cardiac rehabilitation program tailored for patients with CHD, which was the primary diagnosis for referral to the program. The study protocol was approved by the institutional review board. Patients were included in the study if they had an angiographically confirmed coronary 1-, 2- or 3-vessel disease (minimal stenotic diameter 50 %) and participated in the program between January 2004 and December 2010. All included patients had stable CHD, twenty-six patients were excluded due to concomitant cancer or chronic obstructive pulmonary disease because both these diseases may substantially influence health-related QoL (Di Bonaventura et al. 2012; Ernst, Götze, Brähler, Körner, & Hinz, 2012). Demographic and medical data were obtained through a history and physical exam at the beginning of the rehabilitation program and from hospital charts.

Main Outcome Measures

Patients completed a German version of the Global Mood Scale (GMS) (Denollet, 1993). Subjects have to rate 20 mood items on a 5 point Likert scale according to their

appearance in the last week ranging from zero to 4 (0 = not at all to 4 = extremely). Typical items are "cheerful", "lively", and "dynamic" for positive mood and "fatigued", "wearied", and "worn out" for negative mood. The positive mood subscale comprises 10 items and the negative mood subscale also comprises 10 items. Each subscale yields a sum score between 0 and 20 points. The internal consistency of the GMS is considered to be good (Cronbach's $\alpha = .92$) (Spindler et al., 2009). In our sample, we found comparable values for Cronbach's α (positive affect $\alpha = .92$, negative affect $\alpha = .93$). The GMS has been validated in cardiac populations, showing a good responsiveness for changes in mood during cardiac rehabilitation programs (Hevey et al., 2004). The two factorial structure of the GMS has also been confirmed (Denollet, 1993).

Health-related QoL was assessed with the German version of the SF-36 Health Survey (Bullinger et al., 1998; Ware & Sherbourne, 1992). The 36 items reflect the 8 scales: physical functioning, role-physical, bodily pain, general health, vitality, social functioning, role-emotional and mental health (Ware & Gandek, 1998). As previously described (Ellert & Kurth, 2004), sum scores for mental and physical QoL were computed by first transforming the raw scores into a range with a minimum of 0 and a maximum of 100. The scores were then z transformed and multiplied by the American coefficients for the mental and physical factor and summed up. At last, the scores were t-transformed (stanine). Ware and Gandek (1998) report good reliabilities of the physical and the mental sum score with Cronbach's α around .90.

Statistical Analysis

Data were analyzed using PASW 17.0 statistical software package (SPSS Inc., Chicago, IL). Between 0 and 9 % of variables used for the present study were missing. We applied the expectation maximum algorithm in order to achieve a complete data set (Do & Batzoglou 2008; Enders, 2006). Normal distribution was verified with the Kolmogorov Smirnoff test. Patient characteristics were analyzed applying a median split on positive affect scores. The two groups below and above the median were compared using independent sample t test, Mann–Whitney test and Chi-square test for continuous and categorical variables, respectively. Significance level was set at $p < .05$ (2-tailed).

We applied multiple regression analysis, using forced entry, in order to detect the contribution of positive affect to health-related QoL independent of sociodemographic variables, traditional cardiovascular risk factors, clinical variables, and negative affect. Assumptions of linearity, homoscedasticity and independence of errors were assured using scatter plots and curve estimations. We computed two regression equations, each with mental QoL and physical QoL as the outcome variable. As a first step we entered the a priori defined control variables age, gender and education into the model. In a second step we entered traditional risk factors (body mass index, hypertension, dyslipidemia, diabetes, smoking, family history) and in the third step clinical variables (left ventricular ejection fraction (LVEF), number of diseased vessels, CABG, previous MI). Last, negative and positive affect were entered into the equation. Unstandardized b coefficients, standard errors of the mean (SEM) and changes in R^2 (explained variance) of each step are displayed with p-values. Effect sizes are expressed as b coefficients.

In order to test a moderator hypothesis for gender in the relationship between positive affect and QoL, we additionally entered the interaction term of gender and positive affect in the fifth step. The variables were centered to the mean before multiplication to reduce problems with multicollinearity. A significant interaction would indicate that the relationship between positive affect and QoL depends on gender (i.e. different in female and male patients) (Baron & Kenny, 1986).

Results

Patient Characteristics

Table 1 shows the sample characteristics of all patients with CHD and for patients stratified by the median split on scores for positive affect. The majority of eligible patients ($N = 746$) were men (81.6 %) and significantly more men than women scored above the median on the positive affect scale ($x^2(1) = 11.52$, $p < .001$). Age and the frequency of traditional cardiovascular risk factors did not significantly differ between patients with high versus those with low levels of positive affect, whereas educational level significantly differentiated between groups. Whereas a greater proportion of patients with primary school or college/university degree scored below the median, more patients with a vocational training scored above the median. About two-thirds of patients had a previous MI, which, however, did not distinguish patients in terms of positive affect. A significant difference was found with respect to CABG surgery in that patients with higher positive affect had undergone significantly less frequently bypass surgery than patients with lower positive affect. In terms of CHD severity, patients with high positive affect were similar to patients with low positive affect with respect to STEMI versus non-STEMI infarction ($x^2(1) = 0.000$, $p = .99$) and the number of diseased coronary vessels. Cardiac medications did not significantly differentiate patients in terms

Table 1 Patient characteristics ($N = 746$) stratified by positive affect

Variable (cut-off = 23)	Total ($N = 746$)	Low positive affect ($n = 349$)	High positive affect ($n = 397$)	p Value
Age	60.5 ± 11.0	61.2 ± 11.5	59.9 ± 10.6	.115
Male gender (%)	81.6	76.5	86.1	.001
Highest level of education				
Primary school (%)	9.4	12.3	6.8	
Vocational training (%)	62.9	58.2	67.0	
College or University (%)	27.7	29.5	26.2	.011
Body Mass Index (kg/m^2)	27.1 ± 4.1	27.0 ± 4.2	27.2 ± 4.1	.241
Hypercholesterolemia (%)	71.8	74.8	69.3	.095
Hypertension (%)	66.1	69.3	63.2	.078
Diabetes (%)	13.0	14.3	11.8	.313
Smoking (%)	48	49.3	46.9	.507
Family disposition (%)	33.1	34.1	32.2	.591
LVEF	52.9 ± 13.4	52.8 ± 13.0	52.9 ± 13.7	.871
Number of diseased vessels (%)				
1 vessel	39.4	35.2	43.1	
2 vessel	24.7	25.5	23.9	
3 vessel	35.9	39.3	33.0	.078
CABG (%)	20.2	26.1	15.1	.000
Myocardial infarction (%)	67.8	65.6	69.8	.225
With ST elevation	64.2	64.2	64.3	
Without ST elevation	35.8	35.8	35.7	.987
Aspirin cardio (%)	94.2	93.9	95.7	.277
Beta blocker (%)	83.4	85.5	82.7	.298
Statin (%)	93.2	93.9	93.7	.884
ACE (%)	64.6	65.0	65.1	.992
Plavix (%)	67.3	61.0	73.7	.000
Negative affect	14.4 ± 8.5	19.5 ± 7.4	9.9 ± 6.7	.000
Positive affect	22.6 ± 7.5	16.4 ± 5.4	28.0 ± 4.3	.000

CABG coronary artery bypass graft, *LVEF* left ventricular ejection fraction

of positive affect. Patients with high positive affect showed a significantly lower level of negative affect than those with low positive affect.

Regression Analysis for Mental and Physical Health-Related Quality of Life

As shown in Table 2, with the mental QoL sum score as outcome, age and gender each made a significant contribution in step 1, accounting for 4.0 % of the variance. When the cardiovascular risk factors were entered in step 2, only the risk factor smoking was significant such that smokers had 2 points less on the mental QoL sum score compared to no smokers ($p < .01$). BMI, hypertension, hypercholesterolemia, diabetes and family history were all not significantly associated with mental QoL. In step 3, clinical variables were added as predictors to the model. None of the clinical variables was significantly associated with mental QoL. Negative and positive affect were additionally entered in step 4. In this step, LVEF and CABG surgery became significant correlates of mental QoL. Those patients who had undergone CABG surgery, had almost 3 points greater mental QoL than those who did not have CABG surgery ($p < .001$). Negative affect was a significant and negative predictor of mental QoL ($b = -0.432$, $p < .001$). After controlling for negative affect, the contribution of positive affect to mental QoL remained significant ($b = 0.516$, $p < .001$). By adding negative and positive affect together to the model in step 4, the model explained an additional 43.2 % of the mental QoL sum-score. Positive affect alone explained 7.7 % ($p < .001$) of the variance, after controlling for all other covariates.

Table 3 shows the hierarchical regression analysis for the physical QoL sum score. Control variables accounted for 4.6 % of the variance in step 1, with older age ($b = -0.127$, $p < .001$) being associated with lower physical QoL and with men reporting better physical QoL than women. A higher degree of education was significantly

Table 2 Hierarchical multiple regression analysis with the mental QoL sumscore as outcome

Variables entered	Step 1	Step 2	Step 3	Step 4
Model statistics	$\Delta R^2 = .040$	$\Delta R^2 = .017$	$\Delta R^2 = .005$	$\Delta R^2 = .438$
	$p < .001$	$p = .042$	$p = .374$	$p < .001$
Age	.126 ± .033***	.123 ± .036**	.128 ± .037***	.063 ± .027*
Gender	3.473 ± .961**	3.527 ± .966***	3.482 ± .972***	.611 ± .721
Education	1.197 ± .636	1.024 ± .638	1.037 ± .639	.612 ± .468
BMI		.138 ± .091	.153 ± .092	.071 ± .068
Hypertension		−.620 ± .833	−.473 ± .838	−.160 ± .613
Dyslipidemia		−1.226 ± .820	−1.123 ± .826	−.223 ± .605
Diabetes		−.489 ± 1.110	−.422 ± 1.119	1.377 ± .822
Smoking		−2.156 ± .744**	−2.260 ± .748**	−1.300 ± .549**
Family history		−.283 ± .780	−.295 ± .785	−.165 ± .574
LVEF			−.043 ± .028	−.057 ± .021**
Number of diseased vessels			−.617 ± 477	−.401 ± .349
CABG			.879 ± 1.030	2.862 ± .757***
Previous MI			.300 ± .848	−.347 ± .621
NA				−.432 ± .043***
PA				.516 ± .048***

Note. The Table shows the unstandardized *b* coefficients with *SEM* and significance level for *p* values: * $p < .05$, ** $p < .01$, *** $p < .001$

BMI body mass index, *CABG* coronary artery bypass graft, *LVEF* left ventricular ejection fraction, *MI* myocardial infarction, *NA* negative affect, *PA* positive affect

associated with greater physical QoL ($b = 1.748$, $p < .01$). Step 2 revealed that patients suffering from diabetes reported a more than two-fold lower physical quality of life than those without diabetes ($p < .05$). Step 3 accounted for an additional 7.1 % of the variance. LVEF was directly associated with better physical health ($b = .089$, $p < .05$), whereas CABG surgery contributed significantly negative to the outcome ($b = -4.776$, $p < .001$), which is contrary to the mental QoL sum score. Patients with previous MI reported lower physical QoL than patients with no such history ($b = -3.013$, $p < .001$). As with self-reported mental QoL, negative affect was predictive for poorer physical QoL ($b = -0.489$, $p < .001$). Independent of all risk factors, clinical variables and negative affect, greater positive affect ($b = 0.251$, $p < .001$) contributed significantly to better physical QoL, explaining 1.9 % ($p < .001$) of the variance (to compare: CABG surgery alone accounted for 0.8 % of the total variance in physical QoL). There was no significant interaction between positive and negative affect for both health-related mental QoL ($p = .091$) and physical QoL ($p = .301$).

Moderation Hypothesis

We explored, whether the relationship between positive affect and QoL would depend on gender. With physical QoL as dependent variable, the interaction term between positive affect and gender turned out to be significant ($p = .009$). In the men, positive affect contributed significantly to physical QoL ($b = 0.311$, $p < .001$) explaining 2.3 % of the variance. However, positive affect was not significantly associated with physical QoL in women ($b = 0.08$, $p = .44$). Figure 1 displays the scatter plot for the uncontrolled interaction between positive affect and gender with regard to physical QoL. There was no significant interaction between positive affect and gender for mental QoL ($p = .60$).

Discussion

The current study aimed to identify the association of positive affect with physical and mental QoL and to what extent this relationship would be independent of traditional cardiovascular risk factors, clinical variables and negative affect in a sizeable sample of patients with CHD entering cardiac rehabilitation. Positive affect emerged as an independent predictor of both mental QoL and physical QoL. Independent of all entered control variables, positive affect explained 1.9 % respectively 7.7 % in physical and mental QoL, indicating that the appraisal of a CHD patient's health-related QoL is related to positive affect (Kuppens et al., 2008; Sullivan, LaCroix, Russo, & Walker, 2001). These results are in line with previous findings of positive

Table 3 Hierarchical multiple regression analysis with the physical QoL sumscore as outcome

Variables entered	Step 1	Step 2	Step 3	Step 4
Model statistics	$\Delta R^2 = .046$	$\Delta R^2 = .014$	$\Delta R^2 = .071$	$\Delta R^2 = .280$
	$p < .001$	$p = .093$	$p < .001$	$p < .001$
Age	−.127 ± .034***	−.118 ± .036**	−.053 ± .036	−.110 ± .030***
Gender	2.718 ± .973**	3.040 ± .979**	3.645 ± .951***	1.499 ± .795
Education	1.748 ± .644**	1.593 ± .647*	1.548 ± .625**	1.173 ± .516*
BMI		−.071 ± .093	−.070 ± .090	−.115 ± .075
Hypertension		−.727 ± .844	−.521 ± .819	−.409 ± .676
Dyslipidemia		−.299 ± .831	.151 ± .808	.815 ± .667
Diabetes		−2.648 ± 1.125*	−1.995 ± 1.094	−.387 ± .907
Smoking		−1.066 ± .755	−.959 ± .731	−.097 ± .605
Family history		−.127 ± .791	−.083 ± .767	.127 ± .633
LVEF			.089 ± .028**	.082 ± .023***
Number of diseased vessels			−.480 ± .466	−.262 ± .384
CABG			−4.776 ± 1.007***	−3.300 ± .835***
Previous MI			−3.013 ± .829***	−2.409 ± .684***
NA				−.489 ± .047***
PA				.251 ± .053***

Note. The table shows the unstandardized *b* coefficients with *SEM* and significance level for *p* values: * $p < .05$, ** $p < .01$, *** $p < .001$

BMI body mass index, *CABG* coronary artery bypass graft, *LVEF* left ventricular ejection fraction, *MI* myocardial infarction, *NA* negative affect, *PA* positive affect

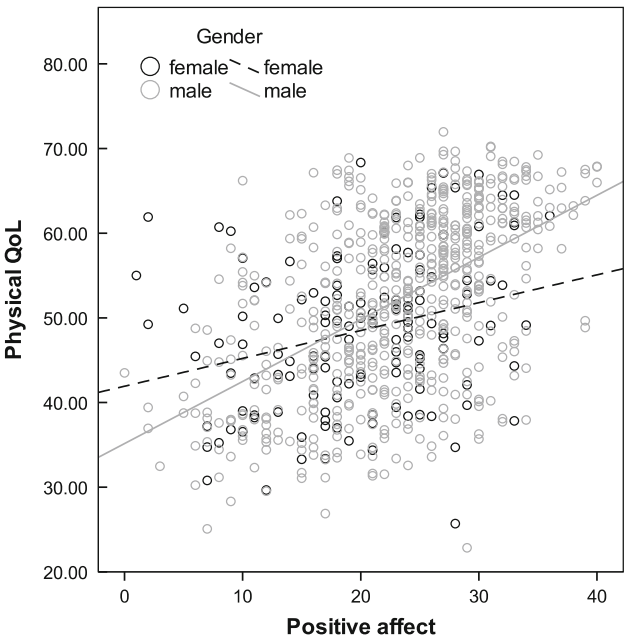

Fig. 1 Interaction between positive affect and gender, showing the direct association between positive affect and health-related physical quality of life (QoL)

affect being positively related to self-reported health in patients with CHD (Versteeg et al., 2009; Spindler et al., 2009). In our study, we specifically controlled for sociodemographic variables, traditional cardiovascular risk factors and CHD disease severity. We also found that negative affect was an independent predictor of mental QoL as well as physical QoL when taking positive affect into account. This result is in line with other studies, reporting on the individual contribution of positive and negative affect to health related QoL (Denollet, 1993; Versteeg et al., 2009). While negative affect is a dimension of distress, positive affect is rather understood as a dimension of energy, excitement and enthusiasm (Watson & Pennebaker, 1989). We measured positive affect as a state and patients were asked only about their affect in the last 7 days which might not reflect the usual or more trait-like positive mood level of patients. However, Watson & Pennebaker (1989) pointed out that persons with high trait positive affect are also more likely to experience states of positive affect. Interestingly, we could not replicate the moderator effect (Versteeg et al., 2009; Sullivan et al., 2001) of positive affect for the relationship between negative affect and QoL. This could be interpreted as further evidence of the independence of the two affective systems from each other.

Among the sociodemographic variables, age emerged as a significant predictor, with older patients reporting better mental QoL but worse physical QoL. This interesting finding might warrant further research to better understand the mental resilience in the face of physical decline in older patients attending outpatient cardiac rehabilitation. Patients with a higher educational degree reported better physical QoL, but no relationship occurred with regard to mental

QoL. This result could be explained by the findings that education improves health and QoL indirectly through economic conditions, social resources, working conditions and a healthy lifestyle (Ross & Wu, 1995). Among the risk factors, only smoking appeared to be related to QoL with smokers reporting lower mental QoL, but similar physical QoL as non-smokers. Because of the cross-sectional design of the study, no causal conclusions can be drawn, but several studies show a positive association between impaired mental health and smoking (Alvarado & Breslau, 2005; Marinho, Blay, Andreoli, & Gastal, 2008). Our result also concurs with the extensive literature on the relationship between smoking and depression in patients with a CHD (Freedland, Carney, & Skala, 2005). Surprisingly, LVEF was inversely related to mental QoL, a finding which is contrary to previous research showing none (Crilley & Farrer, 2001) or positive associations between LVEF and mental QoL (Coyne et al., 2000; Pettersen et al., 2008). Possibly, unmeasured third variables account for this association. As the relationship between LVEF and mental QoL only became significant after positive and negative affect were controlled for in the last step of the model, it could be that it is not mental QoL as a whole construct but rather its sub-factors short of affect relating to better LVEF. However, more sophisticated approaches like factor analysis would be needed to disentangle these likely complex intercorrelations. LVEF might also be a suppressor variable, accounting for artifact variance from the other entered predictor variables. As expected, patients with a higher LVEF reported better physical QoL.

Considering CABG surgery as an indicator of severity of disease, the result that patients who had undergone surgery reported a better mental QoL may seem puzzling. However, explanations for this finding might be that patients are delighted to have survived the surgery or that they feel the surgery will protect them against future cardiac events. We also found that physical QoL was inversely associated with CABG surgery a finding that might reflect sequelae of the surgery like pain, fatigue, and wound healing disturbances. Their impact on mental health might depend on the stage of recovery from surgery. However, there were no significant correlations between time elapsed since CABG surgery and positive affect, negative affect as well as mental and physical QoL (data not shown) suggesting that time elapsed since surgery did not evidently influence the results from our study. Patients with a previous MI reported lower physical QoL. This might be associated with the experience of pain and physical deconditioning and impaired physical health in general.

In exploratory analysis we could show that the relationship of positive affect and physical QoL was moderated by gender. While positive affect showed a direct correlation with physical QoL in men, no such association could be observed in women. These results point out that a substantial amount of either good or poor physical QoL in male patients with CHD can be explained by the presence or absence, respectively, of positive affect. Interestingly, the amount of the variance in physical QoL that remained unexplained was higher in women than in men. A possible explanation for this finding might be that women suffer from more severe aftermath in the wake of the cardiac event, which could predict physical QoL stronger in women than in men (Emery et al., 2004). One study (Mortensen et al., 2007) found that women suffered from more angina and dyspnea one month after MI and that they also reported more physical symptoms than men. Barth et al. (2009) emphasized that after a cardiac event, women tend to continue with their usual chores at home, while men do not usually resume their gainful occupation; therefore, the women's behavior might lead to a comparably higher workload. With regard to mental QoL, we found no moderation effect. The mental QoL in men and women was equally explained by the amount of positive affect.

Our study has several limitations. The cross-sectional and observational design of the study prohibits any conclusion about causal relationships between the control variables, positive affect and health-related QoL. Only a prospective design might reveal whether health-related QoL is causally determined by positive affect or vice versa. Further, we enrolled patients who agreed and were able to participate in an outpatient cardiac rehabilitation program, which may have led to a self selected population. For instance, the level of symptoms, well-being and motivation might differentiate participants from non-participants. We did not control for additional physical and psychiatric comorbidities and psychosocial risk factors of CVD in our analysis, for instance low social support and chronic stress of informal caregiving to a family member. Although these psychosocial risk factors will inevitably elicit affective states that overlap with constructs of negative and positive affect used in our study (Smith, 2011), this also leaves open the possibility that such factors had considerably accounted for some of the relationship between positive affect and QoL. In addition, the use of antidepressants was not systematically recorded in hospital charts.

In conclusion, our study confirms the positive relationship of positive affect with health-related QoL in cardiac patients. Objective medical factors such as the severity of CHD contributed comparably little to health-related QoL, but more so to physical QoL than to mental QoL. Comprehensive cardiac rehabilitation programs might be particularly effective in terms of improving mental QoL if they consider the building up of low positive affect levels, through for instance encouraging patients to participate in pleasurable activities, social contacts and cognitive behavioral psychotherapy (Fava & Tomba, 2009). To

support such an assumption the development and randomized control testing of appropriate interventions targeting positive affect would be required. For instance, previous studies outside cardiac rehabilitation showed that positive affect can be increased through means like mindfulness meditation or relaxation training (Jain et al., 2007). Also a new avenue of psychotherapy research specifically focuses on cultivating positive emotions, behaviors or cognitions (Sin & Lyubomirsky, 2009). Results are promising, showing favorable effects on general well-being and depression, but further research on this in the field of cardiac rehabilitation is clearly needed.

References

Alvarado, G. F., & Breslau, N. (2005). Smoking and young people's mental health. *Current Opinion in Psychiatry, 18*, 397–400.

Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology, 51*, 1173–1182.

Barth, J., Schumacher, M., & Herrmann-Lingen, C. (2004). Depression as a risk factor for mortality in patients with coronary heart disease: A meta-analysis. *Psychosomatic Medicine, 66*, 802–813. doi:10.1097/01.psy.0000146332.53619.b2.

Barth, J., Volz, A., Schmid, J., Kohls, S., von Känel, R., Znoj, H., & Saner, H. (2009). Gender differences in cardiac rehabilitation outcomes: Do women benefit equally in psychological health? *Journal of Women's Health*, *18*, 2033–2039. doi:10.1089=jwh.2008.1058.

Beck, C. A., Joseph, L., Bélisle, P., & Pilote, L. (2001). Predictors of quality of life 6 month and 1 year after myocardial infarction. *American Heart Journal, 142*, 271–279. doi:10.1067/mhj.2001.116758.

Bjarnason-Wehrens, B., Grande, G., Loewel, H., Völler, H., & Mittag, O. (2007). Gender specific issues in cardiac rehabilitation: Do women with ischaemic heart disease need specially tailored programmes? *European Journal of Cardiovascular Prevention and Rehabilitation, 14*, 163–171. doi:10.1097/HJR.0b013e3280128bce.

Brummett, B. H., Boyle, S. H., Siegler, I. C., Williams, R. B., Mark, D. B., & Barefoot, J. C. (2005). Ratings of positive and depressive emotion as predictors of mortality in coronary Patients. *International Journal of Cardiology, 100*, 213–216. doi:10.1016/j.ijcard.2004.06.016.

Bullinger, M., Alonso, J., Aplone, G., Leplège, A., Sullivan, M., Wood-Dauphinee, S., et al. (1998). Translating health status questionnaires and evaluating their quality: The IQOLA project approach. *Journal of Clinical Epidemiology, 51*, 913–923.

Chida, Y., & Steptoe, A. (2008). Positive psychological well-being and mortality: A quantitative review of prospective observational studies. *Psychosomatic Medicine, 70*, 741–756. doi:10.1097/PSY.0b013e31818105ba.

Chida, Y., & Steptoe, A. (2009). The association of anger and hostility with future coronary heart disease: A meta-analytic review of prospective evidence. *Journal of the American College of Cardiology, 53*, 936–946. doi:10.1016/j.jacc.2008.11.044.

Coyne, K. S., Lundergan, C. F., Boyle, D., Greenhouse, S. W., Draoui, Y. C., Walker, P., & Ross, A. M. (2000). Relationship of infarct artery patency and left ventricular ejection fraction to health-related quality of life after myocardial infarction: The Gusto-I angiographic study experience. *Circulation, 102*, 1245–1251.

Crilley, J. G., & Farrer, M. (2001). Impact of first myocardial infarction on self-perceived health status. *Quarterly Journal of Medicine, 94*, 13–18.

Denollet, J. (1993). Emotional distress and fatigue in coronary disease: The global mood scale (GMS). *Psychological Medicine, 23*, 111–121.

Denollet, J., Schiffer, A. A., & Spek, V. (2010). A general propensity to psychological distress affects cardiovascular outcomes: Evidence from research on the type D (distressed) personality profile. *Circulation: Cardiovascular Quality and Outcomes*, *3*, 546–557. doi:10.1161/CIRCOUTCOMES.109.934406.

Denvir, M. A., Lee, A. J., Rysdale, J., Walker, A., Eteiba, H., Starkey, I. R., & Pell, J. P. (2006). Influence of socioeconomic status on clinical outcomes and quality of life after percutaneous coronary intervention. *Journal of Epidemiology and Community Health, 60*, 1085–1088. doi:10.1136/jech.2005.044255.

Di Bonaventura M., Poulose-Ram R., Su, J., McDonald, M., Zou, K., Wagner, J., & Shah, H. (2012). The impact of COPD on quality of life, productivity loss, and resource use among the elderly united states workface. *COPD, 9*, 46–57. doi:10.3109/15412555.2011.634863.

Do, C. B., & Batzoglou, S. (2008). What is the expectation maximization algorithm? *Nature Biotechnology, 8*, 897–899.

Ellert, U., & Kurth, B. M. (2004). Methodische Betrachtungen zu den Summenscores des SF-36 anhand der erwachsenen bundesdeutschen Bevölkerung. *Bundesgesundheitsblatt – Gesundheitsforschung – Gesundheitsschutz*, *47*, 1027–1032. doi:10.1007/s00103-004-0933-1.

Emery, C. F., Frid, D. J., Engebretson, T. O., Alonzo, A. A., Fish, A., Ferketich, A. K., et al. (2004). Gender differences in quality of life among cardiac patients. *Psychosomatic medicine, 66*, 190–197. doi:10.1097/01.psy.0000116775.98593.f4.

Enders, C. A. (2006). A primer on the use of modern missing-data methods in psychosomatic medicine research. *Psychosomatic Medicine, 68*, 427–436. doi:10.1097/01.psy.0000221275.75056.d8.

Ernst, J., Götze, H., Brähler, E., Körner, A., & Hinz, A. (2012). Quality of life of parents diagnosed with cancer: Change over time and influencing factors. *European Journal of Cancer Care*. doi:10.1111/j.1365-2354.2012.01330.

Fava, G. A., & Tomba, E. (2009). Increasing psychological well-being and resilience by psychotherapeutic methods. *Journal of Personality, 77*, 1903–1934. doi:10.1111/j.1467-6494.2009.00604.x.

Fortin, M., Dubois, M., Hudon, C., Soubhi, H., & Almirall, J. (2007). Multimorbidity and quality of life: A closer look. *Health and Quality of Life Outcomes, 5*(52). Retrieved from http://www.hqlo.com/content/5/1/52.

Freedland, K. E., Carney, R. M., & Skala, J. A. (2005). Depression and smoking in coronary heart disease. *Psychosomatic Medicine, 67*, 42–46. doi:10.1097/01.psy.0000162255.55629.9c.

Garavalia, L. S., Decker, C., Reid, K. J., Lichtman, J. H., Parashar, S., Vaccarino, V., et al. (2007). Does health status differ between men and women in early recovery after myocardial infarction? *Journal of Women's Health, 16*, 93–101. doi:10.1089/jwh.2006.M073.

Grande, G., & Romppel, M. (2011). Gender differences in recovery goals in patients after acute myocardial infarction. *Journal of Cardiopulmonary Rehabilitation and Prevention, 31*, 164–172. doi:10.1097/HCR.0b013e31820333c8.

Hevey, D., Mc Gee, H. M., & Horgan, J. (2004). Responsiveness of health-related quality of life outcome measures in cardiac rehabilitation: Comparison of cardiac rehabilitation outcome

measures. *Journal of Consulting and Clinical Psychology, 6*, 1175–1180. doi:10.1037/0022-006X.72.6.1175.

Höfer, S., Benzer, W., Alber, H., Ruttmann, E., Kopp, M., Schüssler, G., & Doering, S. (2005). Determinants of health-related quality of life in coronary artery disease patients: A prospective study generating a structural equation model. *Psychosomatics, 46*, 212–223.

Jain, S., Shapiro S. L., Swanick, S., Roesch, S. C., Mills, P. J., Bell, I., & Schwartz, G. E. R. (2007). A randomized controlled trial of mindfulness versus relaxation training: Effect on distress, positive state of mind, rumination, and distraction. *Annals of Behavioral Medicine, 33*, 11–21.

Kuppens, P., Realo, A., & Diener, E. (2008). The role of positive and negative emotions in life satisfaction judgement across nations. *Journal of Personality and Social Psychology, 95*, 66–75. doi:10.1037/0022-3514.95.1.66.

Marinho, V., Blay, S. L., Andreoli, S. B., & Gastal, F. (2008). A prevalence study on current tobacco smoking in later life community and it's association with sociodemographic factors, physical health and mental health status. *Social Psychiatry and Psychiatric Epidemiology, 43*, 490–497. doi:10.1007/s00127-008-0338-9.

Melamed, S., Shirom, A., Toker, S., Berliner, S., & Shapira, I. (2006). Burnout and risk of cardiovascular disease: Evidence, possible causal paths, and promising research directions. *Psychological Bulletin, 132*, 327–353. doi:10.1037/0033-2909.132.3.327.

Mommersteeg, P. M. C., Denollet, J., Spertus, J. A., & Pedersen, S. S. (2009). Health status as a risk factor in cardiovascular disease: A systematic review of current evidence. *American Heart Journal, 157*, 208–218. doi:10.1016/j.ahj.2008.09.020.

Mortensen, O. S., Bjorner, J. B., Newman, B., Oldenburg, B., Groenvold, M., Madsen, J. K., & Andersen, H. (2007). Gender differences in health-related quality of life following ST-elevation myocardial infarction: Women and men do not benefit from primary percutaneous coronary intervention to the same degree. *European Journal of Cardiovascular Prevention and Rehabilitation, 14*, 37–43. doi:10.1097/HJR.0b013e3280114f00.

Pettersen, K. I., Kvan, E., Rollag, A., Stavem, K., & Reikvam, A. (2008). Health-related quality of life after myocardial infarction with level of left ventricular ejection fraction. *BMC Cardiovascular disorders, 8*, 28. doi:10.1186/1471-2261-8-28.

Roest, A. M., Martens, E. J., Denollet, J., & de Jonge, P. (2010). Prognostic association of anxiety postmyocardial infarction with mortality and new cardiac events: A meta-analysis. *Psychosomatic Medicine, 72*, 563–569. doi:10.1097/PSY.0b013e3181dbff97.

Ross, C. E., & Wu, C. (1995). The links between education and health. *American Sociological Review, 60*, 719–745.

Rumsfeld, J. S., MaWhinney, S., McCarthy, M., Shroyer, A. L. W., VillaNueva, C. B., O'Brien, M., et al. (1999). Health-related quality of life as a predictor of mortality following coronary artery bypass graft surgery. *JAMA, 281*, 1298–1303.

Sin, N. L., & Lyubomirsky, S. (2009). Enhancing well-being and alleviating depressive symptoms with positive psychology interventions: A practice friendly meta-analysis. *Journal of Clinical Psychology, 65*, 467–487. doi:10.1002/jclp.20593.

Smith, T. W. (2011). Toward a more systematic, cumulative, and applicable science of personality and health: Lessons from type D personality. *Psychosomatic Medicine, 73*, 528–532. doi:10.1097/PSY.0b013e31822e095e.

Spertus, J. A., Jones, P., McDonell, M., Fan, V., & Fihn, S. D. (2002). Health status predicts long-term outcome in outpatients with coronary disease. *Circulation, 106*, 43–49. doi:10.1161/01.CIR.0000020688.24874.90.

Spindler, H., Denollet, J., Kruse, C., & Pedersen, S. (2009). Positive affect and negative affect correlate differently with distress and health-related quality of life in patients with cardiac conditions: Validation of the Danish Global Mood Scale. *Journal of Psychosomatic Research, 67*, 57–65. doi:10.1016/j.jpsychores.2008.11.003.

Steptoe, A., Dockray, S., & Wardle, J. (2009). Positive affect and psychobiological processes relevant to health. *Journal of Personality, 77*, 1747–1776. doi:10.1111/j.1467-6494.2009.00599.x.

Sullivan, M. D., LaCroix, A., Russo, J. E., & Walker, E. A. (2001). Depression and self-reported physical health in patients with coronary disease: Mediating and moderating effects. *Psychosomatic Medicine, 63*, 248–256.

Versteeg, H., Pedersen, S. S., Erdman, R. A. M., van Nierop, J. W. I., de Jaegere, P., & van Domburg, R. T. (2009). Negative and positive affect are independently associated with patient reported health status following percutaneous coronary intervention. *Quality of Life Research, 18*, 953–960. doi:10.1007/s11136-009-9511-1.

Ware, J. E., & Gandek, B. (1998). Overview of the SF-36 health survey and the International Quality of Life Assessment (IQOLA) project. *Journal of Clinical Epidemiology, 51*, 903–912.

Ware, J. E., & Sherbourne, C. D. (1992). The MOS 36-item Short Form Health Survey (SF-36). I. Conceptual framework and item selection. *Medical Care, 30*, 473–483.

Watson, D., & Pennebaker, J. W. (1989). Health complaints, stress, and distress: Exploring the central role of negative affectivity. *Psychological Review, 96*, 234–254.