

# Health-related quality of life after coronary artery bypass grafting: A gender analysis using the Duke Activity Status Index

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Further appendixes are available online.

**Objective:** Our objectives were to document the preoperative and postoperative functional status of patients undergoing coronary artery bypass grafting, to examine factors that influence functional recovery, and to determine whether gender differences exist in the preoperative and postoperative functional status with the Duke Activity Status Index.

**Methods:** One thousand eight hundred twenty-five patients undergoing isolated coronary artery bypass grafting had baseline and follow-up quality-of-life surveys. Mean follow-up from baseline to postoperative Duke Activity Status Index was 8.0 months for women and men. The influence of 47 variables, in addition to baseline scores on postoperative functional status, was examined with logistic ordinal modeling. An ordinal model for the follow-up score was determined by means of backward selection, with variables retained if they satisfied the criterion of a *P* value of less than .05.

**Results:** Median baseline Duke Activity Status Index scores (women, 21.5; men, 32.2; *P* < .001) and first follow-up scores (women, 42.7; men, 58.2; *P* < .001) were lower in women than in men. Patients who were older and those who had chronic obstructive pulmonary disease, myocardial infarction, stroke, diabetes, vascular disease, postoperative serious infection, and return to the operating room had lower postoperative scores. After adjusting for these factors, women still had lower follow-up scores (odds ratio for men, 2.1 [95% confidence interval, 1.7-2.6]; *P* < .001).

**Conclusions:** A number of preoperative factors, operative variables, and postoperative events are associated with functional recovery after coronary revascularization. In addition, female gender is associated with more postoperative functional impairment after adjusting for these perioperative variables.

**B**eyond the survival benefit of coronary artery bypass grafting (CABG), functional recovery is the expectation of patients who select CABG for relief of symptoms. Although there is general appreciation that CABG reduces or relieves angina, there is less appreciation that patient quality of life is improved after surgical intervention.<sup>1</sup> Our objectives were to measure preoperative and postoperative functional status in patients undergoing isolated CABG, identify factors influencing functional recovery, and determine whether there were gender differences in preoperative and postoperative functional status. To meet these

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**BOX 1. The Duke Activity Status Index<sup>2</sup>**

Activity: Can You...	Weight
1. take care of yourself, that is, eating dressing, bathing or using the toilet?	2.75
2. walk indoor, such as around your house?	1.75
3. walk a block or 2 on level ground?	2.75
4. climb a flight of stairs or walk up a hill?	5.50
5. run a short distance?	8.00
6. do light work around the house like dusting or washing dishes?	2.70
7. do moderate work around the house like vacuuming, sweeping floors, or carrying in groceries?	3.50
8. do heavy work around the house like scrubbing floors or lifting or moving heavy furniture?	8.00
9. do yard work like raking leaves, weeding, or pushing a power mower?	4.50
10. have sexual relations?	5.25
11. participate in moderate recreational activities like golf, bowling, dancing, doubles tennis, or throwing a baseball or football?	6.00
12. participate in strenuous sports like swimming, singles tennis, football, basketball, or skiing?	7.50

The Duke Activity Status Index score is the sum of positive responses.

objectives, physical aspects of quality of life were assessed with the Duke Activity Status Index (DASI; Box 1).<sup>2</sup>

**Methods****Patients**

Of the 3352 consecutive patients who underwent isolated CABG at the Cleveland Clinic Foundation from January 1, 1997, through December 31, 1998, 1825 completed both a baseline DASI survey and at least one postoperative DASI survey. The baseline DASI survey was given as a self-administered questionnaire to patients preoperatively. If a patient was unable to complete the questionnaire, a research assistant administered the survey by reading the exact wording of the survey questions. Patients completed the postoperative DASI survey by means of telephone interview at 6 and 12 months postoperatively. Among those patients who did not have a follow-up DASI survey, 39 died in hospital, and 18 died within 6 months after surgical intervention. There were small differences between responders and nonresponders that are detailed in Electronic Appendix 1. Baseline characteristics of the study population are listed in Appendixes 1 and 2, and postoperative morbidities are listed in Appendix 3.

**Duke Activity Status Index**

The DASI is a disease-specific quality-of-life questionnaire validated for cardiovascular disease.<sup>2,3</sup> It is a self-administered 12-item instrument that measures major activities of daily living, such as personal care, ambulation, household tasks, sexual function, and recreational activities (Box 1).<sup>2</sup> Each item is weighted on the known metabolic cost of each activity, and weights of positive

terms are summed to form the DASI score for the patient.<sup>2</sup> The DASI is measured on a semicontinuous scale that allows for possible scores between 0 and 58.2. High scores represent better physical functioning, and a score of zero reflects inability to perform any basic activities of daily living.<sup>2</sup>

**Data**

Values for perioperative variables were prospectively collected concurrently with patient care by dedicated individuals trained in database management and entered into the Cleveland Clinic Foundation Department of Cardiothoracic Anesthesia Database. Institutional review board approval was obtained to perform research analyses on the database.

**Statistical Analyses**

Forty-seven variables were considered in the analysis, including baseline demographics, clinical history, laboratory values, operative variables, and postoperative morbid events.

**Preliminary analysis.** Before modeling, summary statistics for each variable were calculated. Approximately 6% of the patients had missing values for albumin and bilirubin. Noninformative imputation was used to supplement the data. Univariable statistics were initially computed to compare men and women by using the Student *t* test for continuous variables and the  $\chi^2$  or Fisher exact statistics for categorical variables. Also, because logistic ordinal regression would be used, the cumulative logit of grouped follow-up scores was plotted against continuous and ordinal variables to identify possible transformations necessary to linearize the relationship and to check for obvious violations of the proportional odds assumption.

Postoperative DASI surveys were collected at approximately 6 and 12 months (actual follow-up times ranged from 6-15 months). Of the 1825 patients, only 1138 completed surveys at both follow-up times. Although a longitudinal analysis was considered to study the change in scores over time, preliminary inspection of the change scores exhibited a notable similarity of scores at both follow-up times, with 64% of patients indicating no change. In addition, it has been reported that postoperative functional recovery status stabilizes by 6 months.<sup>4</sup> To maximize the sample size, we therefore used the first observed postoperative DASI score as our primary end point and considered time to first follow-up as a fixed effect in the analysis. Mean intervals from baseline to first observed follow-up DASI were similar for women and men ( $8.0 \pm 1.0$  months for women vs  $8.0 \pm 1.1$  months for men,  $P = .89$ ).

**Modeling.** To perform an ordinal analysis, the scores were rounded to their lowest integer value and modeled against a list of explanatory variables, including baseline values, discretized into 10-point intervals (personal communication, Dr Eugene H. Blackstone).<sup>5</sup> Ordinal regression produces an intercept estimate for each successive level of the response. Similar intercept estimates were grouped to establish an ordinal scale for the score, resulting in grouped scores of 0 to 18, 19 to 26, 27 to 32, 33 to 42, 43 to 50, and 51 to 58. Finally, a model for the follow-up score was determined by means of backward selection, with a criterion of a *P* value of less than .05 required for retention. The  $\chi^2$  score test for the proportional odds assumption was met for the final model ( $P = .18$ ). None of the interaction terms investigated was statistically significant.

Men and women were propensity matched on the basis of all preoperative and operative variables, postoperative morbidities, and baseline DASIS scores to more simply compare the influence of gender on follow-up DASIS scores with fewer assumptions (Electronic Appendix 2).<sup>6-9</sup>

All results were computed by using SAS 8.2 software (SAS Institute, Cary, NC).

## Results

### Unadjusted Functional Recovery

Median baseline DASIS scores for the 483 women and 1342 men were 21.5 (25th percentile, 15.2; 75th percentile, 32.2) and 32.2 (25th percentile, 19.0; 75th percentile, 50.2;  $P < .001$ ), respectively. Figure 1, A displays the distribution of baseline scores by gender. Women dominated the lower DASIS scores, whereas men more frequently had scores of greater than 51. Postoperative median scores for the first follow-up DASIS survey for women and men were 42.7 (25th percentile, 30.2; 75th percentile, 58.2) and 58.2 (25th percentile, 42.7; 75th percentile, 58.2;  $P < .001$ ), respectively (Figure 1, B). Compared with the large spread of values preoperatively, where more than 10% of men and 3.5% of women had scores ranging between 51 and 58, the majority of patients had excellent functional recovery, with 56.7% of men and 31.7% of women having follow-up DASIS scores of 51 to 58.

### Factors Associated with Functional Recovery

Results from the ordinal regression model demonstrated that male gender was associated with higher follow-up DASIS scores compared with female gender. Men were twice as likely than women to score in the highest functional follow-up DASIS category compared with the other ordered categories (Table 1). Baseline DASIS scores strongly influenced the postoperative DASIS scores after adjusting for a number of comorbid conditions. For example, patients with baseline DASIS scores of 50 or greater were more than twice as likely to have follow-up DASIS scores in the high categories than those patients in the reference baseline DASIS group (odds ratio, 2.4 [95% confidence interval, 1.6-3.4],  $P < .001$ ). Use of a left internal thoracic artery graft was associated with a 30% greater chance of having follow-up DASIS scores in the higher versus lower score groups compared with results in patients with vein grafts.

Variables associated with lower (less favorable) follow-up DASIS scores included advanced age, longer interval from the operation to the first follow-up DASIS, chronic obstructive pulmonary disease, and other comorbidities. In particular, patients with diabetes were 35% less likely to have a follow-up score in the 51- to 58-point range versus the other ordered categories.

Figure 2 illustrates the effect of gender and increasing age on functional recovery after CABG in patients with a low-risk profile. The low-risk patient profile includes no history of prior myocardial infarction, stroke, chronic ob-

structive pulmonary disease, diabetes, vascular disease, or mitral valve dysfunction; average bilirubin level of 0.7 mg/dL; blood urea nitrogen level of 20 mg/dL; aortic clamp time of 75 minutes; use of a left internal thoracic artery graft; no serious postoperative infection; or return to the operating room postoperatively. Average follow-up time for the low-risk patient profile is 8.0 months. As shown in Figure 2, the older patient will be less likely to be in the highest functional category and more likely to be in the lower functional categories. However, at all ages, women demonstrate lower probability of achieving follow-up scores in the 51- to 58-point range compared with men. Figure 3 displays the overall predicted probability of follow-up DASIS score groups by age for low-risk women and men. Figure 4 shows the relationship of baseline DASIS score, gender, and age to achieving a follow-up score of between 51 and 58 for patients with a low-risk profile. Women again demonstrate lower predicted probability of achieving scores in the 51- to 58-point category compared with men.

### Propensity-matched Comparison of Functional Recovery

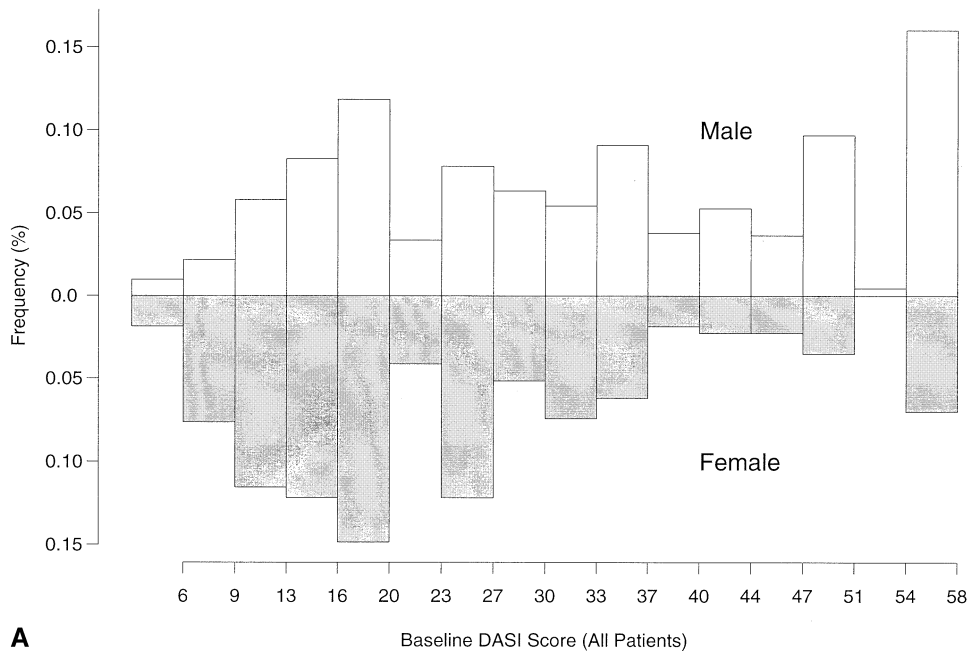
Among propensity-matched pairs, women had consistently lower median follow-up DASIS scores compared with men (see Electronic Appendix 2).

## Discussion

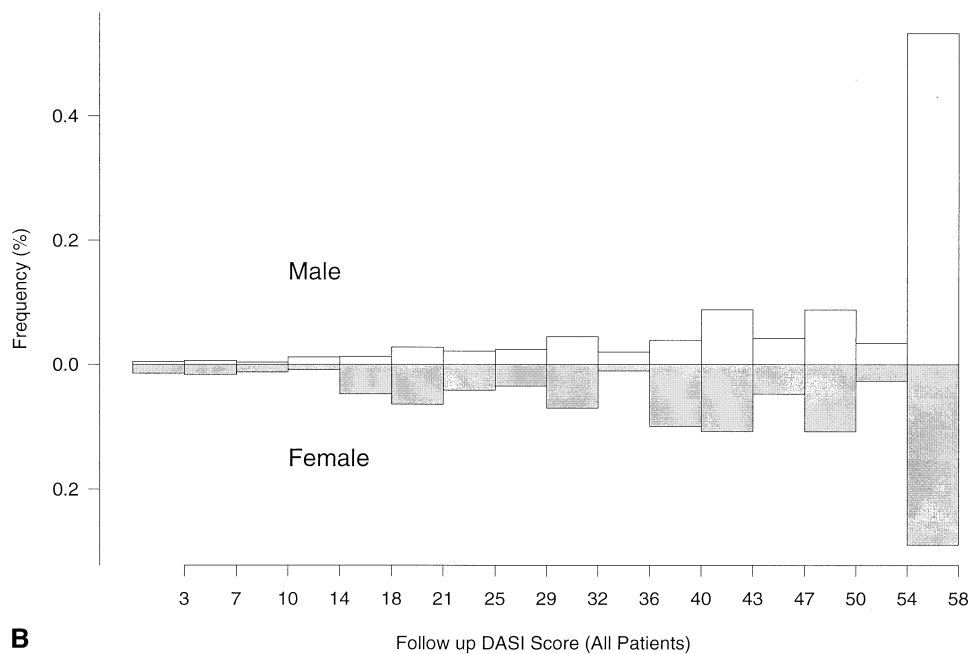
Quality-of-life measures reflect the patient's perception of his or her burden of disease.<sup>10,11</sup> Because patients are interested in not only survival and relief of angina but also resumption of their daily activities,<sup>12</sup> a comprehensive assessment of these aspects of quality of life are important. A number of studies have reported improvements in both physical and mental functional health status after coronary revascularization procedures.<sup>10,13-16</sup> Interestingly, quality-of-life measures reflect hard outcome measures, such as postoperative mortality<sup>10,17-19</sup> and hospital length of stay.<sup>18</sup>

### Gender, CABG, and Quality of Life

**Principal findings.** Studies of gender differences in health-related quality of life after CABG report variable results with regard to the influence of gender (Table 2). Our investigation demonstrated that baseline and follow-up DASIS scores for women were significantly lower than those of men. After taking into consideration differences in baseline scores, preoperative demographics, comorbid conditions, operative factors, and postoperative morbidities, women continued to have significantly lower functional status after coronary revascularization than men. Among the strengths of this investigation are the inclusion of operative factors and postoperative morbid outcome events in the analysis for postoperative functional recovery and the use of propensity matching to demonstrate gender differences in



A



B

**Figure 1. A, The gender distributions of baseline DASI scores are represented in this mirrored histogram. Men have a greater frequency of scoring in the highest functional score group compared with women. B, Follow-up DASI scores are displayed in this mirrored histogram. Women continue to have a lower frequency of representation in the highest functional group compared with men.**

postoperative functional recovery. A number of other perioperative factors significantly affected postoperative functional recovery for both women and men in the months after CABG (Table 1).

Others have reported results consistent with our findings (see Table 2). Sjoland and colleagues<sup>14</sup> prospectively ex-

amined the effects of CABG on quality of life and exercise capacity. They reported improvement in patients' quality of life 2 years after CABG with all 3 quality-of-life instruments used in their investigation. In addition, those patients with the most impaired exercise capacity, those with the most severe angina, and women appeared to have the great-

**TABLE 1. Factors associated with follow-up DASI scores (multivariable ordinal logistic regression)**

Factor	Estimate ± SE	Estimated odds ratio (95% confidence interval)	P value
Baseline DASI score*			<.001
10-20	0.60 ± 0.17	1.8 (1.3-2.5)	
20-30	0.61 ± 0.18	1.8 (1.3-2.6)	
30-40	0.84 ± 0.18	2.3 (1.6-3.3)	
40-50	0.98 ± 0.22	2.7 (1.7-4.1)	
50-60	0.87 ± 0.19	2.4 (1.6-3.4)	
Higher (better score)			
Demography			
Male	0.75 ± 0.11	2.1 (1.7-2.6)	<.001
Laboratory			
Bilirubin	0.30 ± 0.14	1.4 (1.0-1.78)	.04
Operative			
Total aortic clamp time	0.0043 ± 0.0015	1.0 (1.0-1.0)	.004
Left internal thoracic artery used	0.24 ± 0.11	1.3 (1.0-1.6)	.03
Lower (worse score)			
Demography			
Age	-0.028 ± 0.0052	0.97 (0.96-0.98)	<.001
Laboratory			
BUN	-0.010 ± 0.0050	0.99 (0.98-1.0)	.04
Cardiac comorbidity			
History of myocardial infarction	-0.23 ± 0.093	0.80 (0.66-0.95)	.01
Mitral valve regurgitation	-0.32 ± 0.13	0.73 (0.6-0.95)	.02
Noncardiac comorbidity			
History of chronic obstructive pulmonary disease	-0.58 ± 0.18	0.56 (0.40-0.79)	.008
History of stroke	-0.73 ± 0.18	0.48 (0.34-0.68)	<.001
History of diabetes	-0.42 ± 0.10	0.65 (0.54-0.79)	<.001
History of vascular disease	-0.33 ± 0.14	0.72 (0.6-0.94)	.014
Postoperative morbidity			
Serious infection morbidity	-1.2 ± 0.39	0.31 (0.15-0.66)	.002
Return to operating room	-0.41 ± 0.20	0.66 (0.4-0.98)	.04
Follow-up time	-0.16 ± 0.04	0.85 (0.8-0.93)	<.001
Intercepts			
Follow-up score 51-58†	1.8 ± 0.55		.001
Follow-up score 43-50†	2.4 ± 0.55		<.001
Follow-up score 33-42†	3.4 ± 0.56		<.001
Follow-up score 27-32†	3.9 ± 0.56		<.001
Follow-up score 19-26†	4.6 ± 0.56		<.001

DASI, Duke Activity Status Index; BUN, blood urea nitrogen.

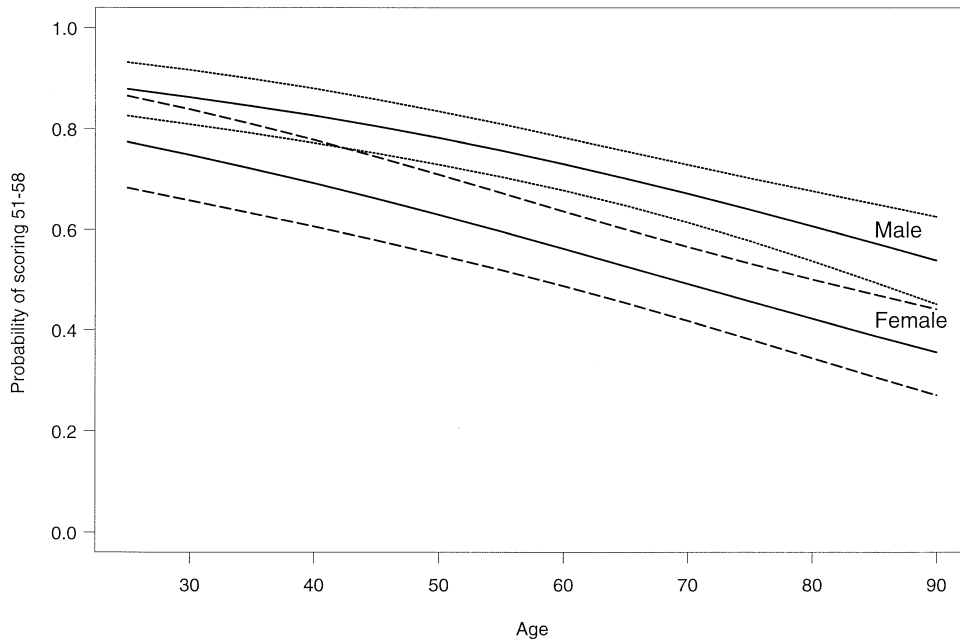
\*The reference group for the baseline DASI scores is 0 to 10.

†Intercept term representing the cumulative increase in follow-up scores.

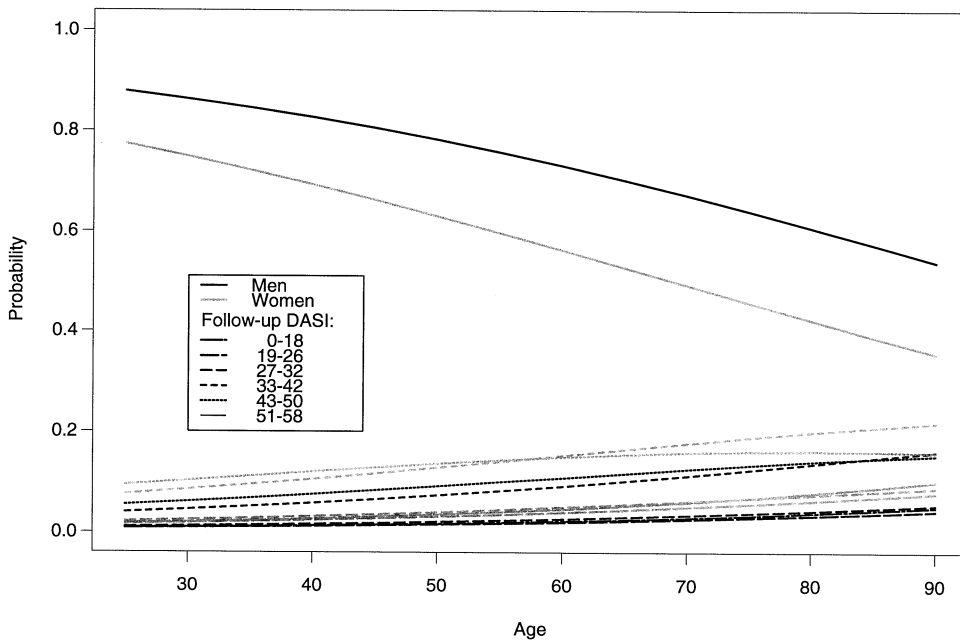
est improvements in quality of life after CABG. However, patients, such as women, who start at low baseline scores have more opportunity for improvement. Furthermore, despite greater absolute improvement for women in their investigation, the Nottingham Health Profile scores and exercise capacity were significantly less favorable for women preoperatively and postoperatively compared with those for men.

In a recent investigation, Vaccarino and associates<sup>20</sup> examined the influence of gender on recovery in the 4- to 6-week recovery period after CABG. Women had lower baseline Short Form-36 physical functioning scores, as well as more preoperative unstable angina and heart failure.

Adjusted results demonstrated higher hospital readmission rates for women, a decrease in physical functioning from baseline, and worsening depressive symptoms. Male patients' physical functioning remained unchanged, and their depressive symptoms improved. After stratifying patients according to baseline scores, they reported that women had significantly lower physical functioning scores than men at follow-up for each quintile of baseline physical functioning scores. Stratification also demonstrated that women in all groups except the lowest category of preoperative physical functioning demonstrated a decrease in functional status in the 6- to 8-week follow-up period compared with men, who reported slight improvements. Although we also reported



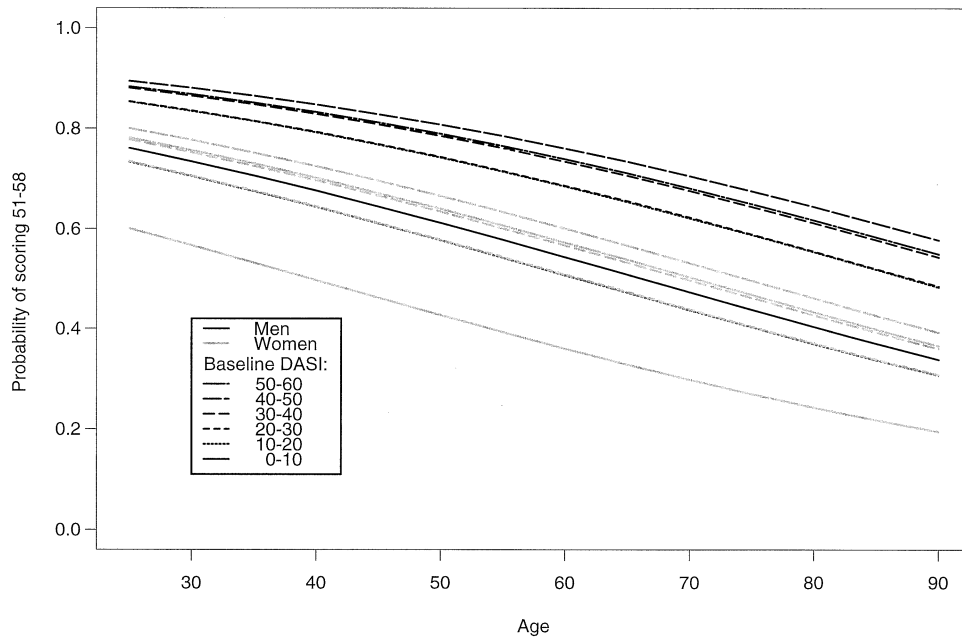
**Figure 2.** The predicted probability of follow-up DASI scores by age and sex for patients with a low-risk profile are displayed in this graph. Male patients have an overall higher probability of scoring in the highest follow-up DASI group (51-58) compared with women for each of the age groupings. The *dotted* and *dashed lines* represent 95% confidence intervals for men and women, respectively.



**Figure 3.** The overall predicted probability of male and female patients scoring in each of the follow-up DASI score groups by age is displayed in this graph. Note that within each age grouping, women consistently have a lower probability of scoring in the 51- to 58-point follow-up group compared with men.

lower baseline and follow-up scores for women compared with men, women had a relative improvement in functional recovery after CABG in contrast to a decrease, as demonstrated by Vaccarino and associates. Differences in study results might be

more reflective of the timing for follow-up quality-of-life measures. Vaccarino and associates performed their follow-up between 6 and 8 weeks postoperatively, whereas our follow-up was 6 to 12 months postoperatively.



**Figure 4.** The predicted probability of low-risk patients scoring between 51 and 58 on follow-up DASI by age and baseline scores is represented in this graph. For each of the baseline DASI groups, female patients have an overall lower probability of scoring in the 51- to 58-point follow-up DASI group compared with men.

Herlitz and coworkers<sup>12</sup> identified female sex as an independent predictor for inferior quality of life after CABG. A history of diabetes and chronic obstructive pulmonary disease were also associated with poor quality of life. Multivariable analysis showed that a poor preoperative quality of life was a strong predictor for an impaired quality of life 5 years after CABG. This investigation dichotomized the 3 quality-of-life scores by defining an inferior quality of life as worse than the median value for the 3 individual instruments.

Artinian and Duggan<sup>21</sup> examined sex differences in physical, psychologic, and social recovery after CABG. They reported a slower physical recovery for women than men during the 6-week period after discharge. Although both women and men experienced continuous improvement over time with physical aspects of recovery, men experienced significantly quicker improvement. No adjustments were made to control for the differences in preoperative risk profiles between the women and men or the effect of the different risk profiles on functional recovery.

A number of investigations similarly report less satisfactory health status for women compared with men after coronary revascularization.<sup>16,22,23</sup>

Other studies have reported *similar* quality-of-life outcomes after coronary revascularization in women and men. Ayanian and colleagues<sup>24</sup> assessed the physical and psychosocial functional status in patients undergoing CABG. Although women presented as more “severely ill” than men

preoperatively, they reported similar physical and psychosocial functioning after surgical intervention. Unadjusted postoperative scores for instrumental activities of daily living and vitality were significantly lower for women compared with for men; however, after adjustment for age, marital status, education, severity of angina, recent myocardial infarction, congestive heart failure, and preoperative coexisting illnesses, the differences became insignificant. Women reported adjusted gains that were similar to or greater than those of men in instrumental activities of daily living and vitality.

Stewart and associates<sup>25</sup> also found similar functional outcomes for women and men after CABG. Women had lower preoperative and follow-up DASI scores; however, in the multivariable regression analyses female gender was not an independent predictor of mean change in DASI score or a predictor of postoperative functional recovery.

Our findings that baseline DASI scores have a significant effect on postoperative DASI scores are consistent with the findings of other publications.<sup>12,15,23</sup> Rumsfeld and coworkers<sup>15</sup> examined the relationship between preoperative health status and changes in quality of life after CABG. On average, patients’ Mental Component Summary and Physical Component Summary scores improved in the 6-month follow-up period. Preoperative health status was the major determinant of change in quality of life after adjusting for anginal burden and other clinical characteristics. They found that patients with good preoperative health status were more likely to have a decrease in their postoperative health-

TABLE 2. Quality-of-life studies

Data source	Sample size	Quality-of-life instrument	Validated?	Baseline	Follow-up	Analysis	Findings
Ayanian et al <sup>24</sup>	W = 66 M = 240	FSQ, SF-36 vitality scale	Yes	6 mo postop	6 mo	ANCOVA, logistic regression	Similar physical and psychosocial functioning for women and men
Stewart et al <sup>25</sup>	W = 54 M = 104	DASI	Yes	50% preop 50% postop before discharge	6 mo	Linear and logistic regression	Similar functional improvement for women and men
Sjoland et al <sup>27</sup>	W = 196 M = 964	PGWB, NHP, PAS	Yes	Preop	3, 12, 24 mo	Mann-Whitney <i>U</i> test, chi-square test, Cochran-Mantel-Haenszel, Wilcoxon signed rank and sign test	Quality-of-life scores less favorable for women
Sjoland et al <sup>14</sup>	NHP: W = 184 M = 911 Exercise test: W = 48 M = 313	PGWB, NHP, PAS	Yes	Preop	24 mo	Wilcoxon signed rank test, Spearman rank order correlation	Quality-of-life scores and exercise capacity less favorable for women
Vaccarino et al <sup>20</sup>	W = 309 M = 804	SF-36 (PF), GDS, ESSi	Yes	Postop before discharge	6-8 wk	ANCOVA, logistic regression	Women have less favorable PF, worse depressive symptoms
Carey et al <sup>26</sup>	W = 287 M = 1048	Questionnaire	No	6 mo postop	12 mo, annually for 2-18 y (mean 4.3)	ANOVA, Wilcoxon rank-sum, chi-square	Mean health status less favorable for women
Yun et al <sup>22</sup>	W = 162 M = 381	HSQ	Yes	Preop	3, 12, and 24 mo	Repeated-measures ANOVA, multivariable regression	Lower scores for women in a majority of quality-of-life measures
Artinian et al <sup>21</sup>	W = 47 M = 132	SIP, SI, BDI, RSS, CLS	Yes	Postop before discharge	1, 3, and 6 wk	Repeated-measures ANOVA	Women have slower recovery, less physical functioning
Herlitz et al <sup>12</sup>	W = 142 M = 771	PAS, PGWI, NHP	Yes	Preop	5 y	Logistic regression	Poorer quality of life for women
Mayer et al <sup>23</sup>	W = 39 M = 84	SF-36	Yes	1-1.5 y postop	1-1.5 y	Student <i>t</i> , chi-square test	Poorer functional status for women

FSQ, Functional Status Questionnaire; SF-36, Medical Outcomes Trust Short Form 36-item Health Survey; ANCOVA, analysis of covariance; ANOVA, analysis of variance; DASI, Duke Activity Status Index; PGWB, Psychological General Well-being Index; NHP, Nottingham Health Profile; PAS, Physical Activity Score; PF, physical function subscale; GDS, Geriatric Depression Scale; ESSi, Social Support Inventory of Enhancing Recovery In Coronary Heart Disease (ENRICH); HSQ, Health Status Questionnaire; SIP, Sickness Impact Profile; SI, Symptom Inventory; BDI, Beck Depression Inventory; RSS, Rosenberg Self-Esteem Scale; CLS, Cantril Ladder Scale.

related quality of life, leading them to recommend CABG only if it is predicted to improve survival. In contrast to Rumsfeld and colleagues' investigation, we demonstrated, with ordinal regression analysis, that patients with higher

baseline DASI scores do not necessarily have a decrease in their functional capacity after CABG. In each of the baseline DASI groups in our study (compared with in the reference DASI group), patients were more likely to be repre-



sented in the higher follow-up DASI score groups than the lower follow-up DASI score groups (odds ratio, 1.8-2.7).

**Critique of the state of the art.** A number of investigations have been limited by small sample size,<sup>21,22,24,25</sup> retrospective collection of preoperative quality-of-life measures in the postoperative follow-up period,<sup>23,24</sup> and use of quality-of-life measures that have not been validated.<sup>26</sup> Furthermore, some did not consider the influence of operative factors or postoperative morbid outcome events on subsequent functional recovery.<sup>12,14,20-24,27</sup> The variability in quality-of-life instruments used and the different follow-up intervals and statistical approaches to data analysis limits generalizability of the individual study results (see Table 2).

### Study Limitations

Our investigation was done in a tertiary care center and therefore is limited in its ability to generalize results to practice in the community setting. The DASI assesses the physical component of health-related quality of life in patients with coronary disease. Quality of life after CABG encompasses multiple dimensions comprising both physical functioning and psychosocial factors. A number of investigations have reported a strong association between mental health status, such as depressive symptoms, and poor overall health status outcomes in patients with coronary artery disease.<sup>28-30</sup>

Although we included preoperative and operative variables, as well as postoperative morbid events, the lower preoperative and follow-up DASI scores for women in our study might reflect variables not collected. Consider that women might experience more ambulation difficulties unrelated to symptoms of coronary artery disease in which revascularization procedures would not improve women to the full functional capacity of men. As quality-of-life instruments become part of risk stratification for patients undergoing CABG, parameters that assess ambulation impairment might need to be collected.

### Clinical Inferences

Unfavorable patient characteristics, such as diabetes, obesity, hypertension, and increased triglycerides, typify the female patient undergoing CABG.<sup>31</sup> Patients with an unfavorable risk profile who go on to have reduced postoperative functional capacity have the most to gain from cardiac rehabilitation programs. Studies have demonstrated that benefits of cardiac rehabilitation programs include improvement in long-term prognosis, reduced readmissions to the hospital,<sup>32</sup> decrease in submaximal heart rate,<sup>33</sup> and improvement in exertional capacity and cardiac function.<sup>34,35</sup> Dylewicz and colleagues<sup>36</sup> reported that short-term endurance training in patients after CABG resulted in a favorable modifying factor for glucose metabolism and an advanta-

geous alteration of lipid metabolism parameters. They suggested that endurance training might be useful for the secondary prevention of coronary heart disease in patients who have undergone CABG, especially in patients with abnormal carbohydrate and lipid metabolism results. Despite these potential gains from cardiac rehabilitation programs, such programs are underused by women.<sup>37,38</sup>

### Conclusions

In our study of 1825 patients, women report more functional limitations after CABG than men. Women with reduced postoperative functional capability and a greater prevalence of modifiable risk factors could benefit from more aggressive referral to cardiac rehabilitation programs after CABG.

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See appendixes on pages 294 and 295.

## Appendix 1. Baseline continuous variables according to gender

Characteristic	All patients				Student <i>t</i> test, <i>P</i> value
	Male sex		Female sex		
	n	Mean (±SD)	n	Mean (±SD)	
Demographics					
Age at the time of the operation (y)	1342	65 ± 10	485	68 ± 10	<.01
Weight (kg)	1342	88 ± 16	484	73 ± 15	<.01
Body surface area (m <sup>2</sup> )	1342	2.0 ± 0.2	484	1.8 ± 0.2	<.01
Months to follow-up	1342	8.0 ± 1.1	483	8.0 ± 1.0	.89
Preoperative laboratory values					
Hematocrit (%)	1342	41 ± 4.3	485	37 ± 4.3	<.01
Bilirubin (mg/dL)	1253	0.8 ± 0.3	459	0.6 ± 0.3	<.01
Albumin (g/dL)	1253	4.1 ± 0.5	461	3.9 ± 0.5	<.01
BUN (mg/dL)	1342	19 ± 8.0	485	20 ± 12	.13
Serum creatinine (mg/dL)	1342	1.1 ± 0.6	485	1.1 ± 1.0	.52
Aortic crossclamp time (min)	1342	77.6 ± 31.4	485	68.4 ± 30.8	<.01

*BUN*, Blood urea nitrogen.

## Appendix 2. Baseline categoric variables according to gender

Characteristic	All patients				$\chi^2$ , P value
	Male		Female		
	n	%	n	%	
Coronary-valvular pathology					
Aortic valve regurgitation	50	3.7	26	5.4	.12
Mitral valve regurgitation	156	12	73	15	.049
Aortic valve stenosis	13	0.07	8	1.7	.23
Any circumflex disease	1194	89	397	82	<.01
Any left main disease	617	46	204	42	.15
Any LAD disease	1283	96	461	95	.60
Any RCA disease	1222	91	425	88	.028
Cardiac comorbidity					
Pulmonary hypertension	8	0.6	8	1.7	.05*
Hypertension	900	67	371	77	<.01
Heart failure	193	14	109	23	<.01
Coronary reoperation	333	25	64	13	<.01
Noncardiac morbidity					
Chronic obstructive pulmonary disease	85	6.3	34	7.0	.60
Smoking	958	72	208	43	<.01
Diabetes	425	32	198	41	<.01
Dialysis	7	0.5	11	2.3	<.01*
Stroke	81	6.0	37	7.6	.22
Vascular disease	163	12	61	13	.8
Vascular surgery	51	3.8	13	2.7	.25
Carotid surgery	75	5.6	20	4.1	.21
Carotid disease	207	15	97	20	.02
Symptoms					
Emergency surgery	46	3.4	13	2.7	.43
Preoperative IABP	40	3.0	13	2.7	.74
Ventricular function					
Myocardial infarction	708	53	259	53	.81
Abnormal left ventricular function					.65
Normal	638	48	237	49	
Mild	283	21	99	20	
Mild-moderate	43	3.2	21	4.3	
Moderate	143	11	56	12	
Moderate-severe	77	5.7	25	5.2	
Severe	158	12	47	9.7	
Operative factors					
Left internal thoracic graft	1045	77.9	384	79.2	.55
Right internal thoracic graft	272	20.3	60	12.4	<.01
Intra-aortic balloon pump	79	5.9	23	4.7	.35
Return to operating room	77	5.7	27	5.6	.89

LAD, Left anterior descending coronary artery; RCA, right coronary artery; IABP, intra-aortic balloon pump.

\*Fisher exact test.

## Appendix 3. Postoperative events according to gender

Characteristic	All patients				$\chi^2$ , P value
	Male		Female		
	n	%	n	%	
Intubation morbidity	40	3.0	22	4.5	.10
Cardiac morbidity	9	0.7	7	1.4	.15*
Neurologic morbidity	10	0.8	7	1.4	.17*
Serious infection morbidity	23	1.7	3	0.6	.08
GI-hepatic morbidity	14	1.0	1	0.2	.14*

GI, Gastrointestinal.

\*Fisher exact test.