Cardiovascular Topics

Predictors of the successful outcome of one-year survivors of coronary artery bypass surgery

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Summary

This study was conducted on a South African cohort to establish the factors that may predict the successful outcome of coronary artery bypass surgery when assessed in terms of improved quality of life one year after the surgery. Information was sought on the socio-economic status of patients, their risk-factor profiles and clinical history. From the patient files, information was recorded on left ventricular ejection fraction, number of vessels bypassed, bypass time, and aortic cross-clamp time. The characteristics that were predictive of a successful outcome one year after surgery were identified. Patients in this study represented a high-risk population with multiple risk factors (obese, heavy smokers, hypertensive, hypercholesterolaemic, inactive, family history of heart disease, diabetes, and regular intake of alcohol).

Measured medical parameters could not distinguish between the group with an improved quality of life and the group who did not have improved quality of life. One year after CABG all patients with an improved quality of life were men. The additional identified predictor variables for a successful outcome were: being married, patients' height, the knowledge that smoking affects the cardiovascular system, number of years that sporting activities were stopped prior to CABG surgery, a better-quality sex life after the operation, acceptance of self-responsibility for rehabilitation, and the spouse knowing the diet the patient should follow. The predictors of a successful outcome at the time of the operation were: being married (OR = 22.6; $p = 0.02$); taller than 170 cm (OR = 15.5; $p = 0.01$); stopped all sporting activities for a period less than 20 years prior to their surgery (OR 11.4; $p = 0.01$).

We concluded that the outcome of coronary artery bypass surgery could not be predicted on the basis of a medical model that considers exclusively the extent of the patient's disease and associated co-morbidities. Patients should be carefully selected and an intensive post-operative educational intervention should be provided to patients and their spouses/caregivers.

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Coronary artery bypass graft (CABG) surgery remains the optimal therapy for severe symptomatic coronary artery disease when other medical therapies are unsuccessful or contra-indicated. The major objectives of the intervention include reducing mortality, relieving symptoms of angina and improving patients' quality of life. It is an expensive intervention; the cost in South Africa (1995–1998) is in the range of R30 000 to R100 000. The objectives of the surgical intervention are only achieved if patients understand that they have a chronic disease and need to modify their lifestyle in order to stay well.[1] Considering the cost of CABG and the fact that the outcome is unlikely to be successful unless the patient adheres to a prescribed programme of risk-factor modification and lifestyle changes, it is important that the factors determining a successful outcome should be known.

Health-related quality of life (HQOL) is increasingly being used as one of the primary outcome measures in studies to assess the effectiveness of treatment.[2] An improvement in health-related quality of life is a major objective in the treatment of patients with chronic disease. It is no longer adequate to demonstrate that medical interventions result in physiological changes unless an accompanying change in functional activities of daily living can also be demonstrated.[3] Quality-of-life measures that have relied on clinical judgement alone may have inadequately represented patient values. Frequently the focus has been on objective measures and not on subjective indicators of quality of life.[4]

There is widespread scepticism whether quality of life can be measured in any meaningful manner because of inadequate measures used to assess the impact of cardiac disease and its treatment on the lives of patients. However, methods are constantly improving and there are a number

of standard measures of quality of life currently available, making quality-of-life assessments possible and worthwhile.[5]

Improvement in quality of life is a major objective in the treatment of chronic diseases and it has also been used as a measure of the successful outcome of bypass surgery. However, little is known about the socio-demographic and clinical characteristics that predict the successful outcome of CABG surgery, measured in terms of improvement in quality of life.

The objectives of this study were to establish the factors that could predict the successful outcome of patients who had undergone bypass surgery when assessed in terms of improved quality of life one year after surgery. Information was sought on the socio-economic status of patients as well as their risk-factor profiles and clinical history. From the patient files, information was recorded on left ventricular ejection fraction, number of vessels bypassed, bypass time, and aortic cross-clamp time. The characteristics that were predictive of a successful outcome one year after surgery were identified. Successful outcome was measured in terms of an improved quality of life one year after the intervention.

Methods

This study was passed by the Ethics Committee for Research on Human Subjects of the University of the Witwatersrand (Ethics clearance number: 36/9/92). Informed consent was obtained from all participants in this study.

Sample selection

Patients and their spouses were selected from two private hospitals and one public hospital in Johannesburg, Gauteng. Cardiothoracic surgeons operating at these hospitals gave permission to include their patients in this study. Because it was not always possible to interview patients pre-operatively due to emergency admissions and also because it was felt that patients were depressed and very anxious prior to the surgery, a decision was made to interview the patients on days four to six post-operatively. The days selected for conducting interviews depended largely on the surgeons' theatre allocations, the ward routine and the staff. The spouse was contacted either telephonically or during the patient's hospital stay and asked to participate. Patients and spouses were assured that they would remain anonymous and that they could withdraw from the study at any stage. Patients and spouses who were willing to participate signed a consent form. The selection of patients was regarded as random as it was assumed that patients were admitted and operated on in a random manner. Only patients who had undergone coronary artery bypass surgery and did not have any other form of cardiac surgery were included. All patients who could understand English or Afrikaans and were willing to participate were interviewed. Patients who had not returned to the ward either because they were too ill or were still intubated by day six, were excluded.

Sample size

The primary objective of the original study was to assess the incidence of successful rehabilitation of survivors of coronary artery bypass surgery after one year. From a potential sampling population of 450 patients, 54 needed to be included in the study in order to estimate the expected success rate of 80% to an accuracy of 10% at the 95% confidence level. Since a drop-out rate of around 30% was expected during the one-year follow-up, 75 patients needed to be included in the study to ensure the minimum sample size.

Seventy-three patients who had undergone CABG surgery and their spouses or caregivers agreed to participate in the study. The first interview with patients was conducted in the hospital ward, four to six days post-operatively. At the time of this interview the ward files, as well as the operation notes of patients, were studied to provide information on their medical condition as well as the operative procedures. Patients were subsequently contacted by telephone 12 months after the operation. The spouses (or caregiver in the case where there was no spouse) were also interviewed telephonically 12 months after the operation.

The questionnaire

The questionnaire was designed by a series of five pilot studies. It provided information on socio-demographic characteristics such as age, gender, marital status, work status, total annual income, home language, occupation and education at the time of entry to the study. Information on clinical characteristics such as previous myocardial infarct, previous CABG, angina, breathlessness, fatigue and the presence of stress (anxiety) were also recorded.[6]

Establishing improved quality of life

The final factors considered for improved quality of life were the same as those suggested by the CASS principal investigators.[7]

- Return to work (regardless of the capacity) or to recreational activity (the same as, or more than before the operation).
- Amelioration of cardiac-related symptoms (patients who had had angina before as well as after the operation). Patients tend to confuse the pain and discomfort of a sternotomy with angina and for this reason, only patients who had had angina before the operation and no angina after the operation were considered to have amelioration of cardiac-related symptoms. The criteria for improved quality of life were therefore more stringent in this study than those applied by the CASS researchers. This could mean that the number of patients in this study identified with improved quality of life could be fewer than in other studies that determined improved quality of life.
- Improved functional activity (more active than before). When the question 'Are you as active as before the operation?' was answered as 'More' was considered an indicator of improved functional capacity. This gave a subjective evaluation of functional capacity. The subjective evaluation of the spouse was also considered and if both spouse and patient reported improved activity levels, it was documented as 'improved functional capacity'. A stress test tends to give a more positive result of the patient's functional ability than the patient's self-estimated ability.[8] It was felt that patients themselves are probably the best judge of their activity levels.

It is recognised that the domains used by the CASS principal investigators are incomplete as there is no recognition of the patient's evaluation of personal life satisfaction. Our designed questionnaire would, however, produce the required additional information. Patients reported on their perceived presence of risk factors. The medical files provided limited and inconsistently documented information. The surgical procedures, however, were carefully documented and provided the most consistent and reliable source of information. The following medical information was available: information on exercise stress test (limited), serum cholesterol levels (limited), medication, affected coronary arteries and the percentage stenosis, left ejection fraction, number of vessels bypassed, donor sites, bypass time, aortic cross-clamp time, days in ICU, and days in the ward. The questionnaire also covered other aspects of quality of life as suggested by Ory *et al*.[9] These included stress, sexual functioning, and satisfaction with the outcome of the operation. These aspects were not used to determine (diagnose) quality of life but would yield valuable information.

Patients with improved quality of life were assigned to Group 1 and patients whose quality of life was not improved were assigned to Group 2.

Statistical analyses

Having identified the above two groups, statistical analyses were done to determine factors which were significantly different between the two groups at days four to six post-operatively and after 12 months. When two groups are compared with regard to categorical variables (improved quality of life; no improved quality of life), the Chi-square or Fischer's exact tests are commonly used.[10] Analysis of variance (ANOVA) was used to assess the levels of one or more factors with respect to a continuous outcome variable. This was followed by a stepwise logistic regression to determine the factors that could predict successful outcome. A number of parameters were recorded four to six days after surgery. These parameters consisted of socio-economic factors, medical, and attitudinal factors. Logistic regression enters independent (predictor) variables in a stepwise manner and it will also fit specified models. For this analysis, logistic regression was used to determine the probability that an individual would have an improved quality of life if a number of variables were considered. Since the response variable, which could be influenced by the observed parameters was binary (successful, unsuccessful), a stepwise logistic regression analysis, aided by clinical judgement, was used to estimate the probability that an individual would have an improved quality of life.

Results

Socio-demographic data

The baseline socio-demographic and clinical characteristics of 73 patients in the immediate post-operative period are presented in Table I. Sixty-two patients were operated on in private hospitals and 11 in a public hospital.

Table I shows that over a period of 12 months, 15 patients, all males, were lost to follow-up. The five patients who died during the study all had severe cardiac disease with a history of previous myocardial infarcts (three patients), diabetes (two), stroke (one) and smoking (four). The remaining 10 could either not be traced or refused to be interviewed. All 10 females could be traced one year later. The majority of the 73 subjects participating in this study were white South Africans with a few Asians. Only 19% of the sample was in an income bracket higher than R120 000 per annum.

TABLE I. SOCIO-DEMOGRAPHIC INFORMATION.

No of patients	Admission (M/F): 73 (63:10) 12 months (M/F): 58 (48:10) Deaths (M/F): 5 (5:0)
Marital status	Married: 75%; single: 4%; divorced: 11%; widowed: 10%
Children per family	Mean: 2.6 (range 0 9)
Population distribution	White: 83%; Black: 5%; Asian: 11%; Coloured: 1%
Home language	Afrikaans: 47%; English: 40%; African: 5%; other: 8%
Family income (annual)	62% < R50 000; 19% between R50 000 and R120 00.00 and 19% > R120 000
Educational level	56%: Grade 12 or higher
Employment status	(FT and PT): pre op: 70%; 12 months: 37%
Occupational status	62%: middle class white collar workers, skilled arti sans, manual foremen, farmers 2%: professionals or managers
Religion as important aspect of life	69%: regarded religion important

M/F: male/female
FT/PT: full time/part time.

TABLE II. RISK-FACTOR PROFILE.

Hypercholesterolaemia	47%: reported elevated serum cholesterol concentration 27%: knew level Reported total serum cholesterol concentration: mean 6.3 mmol/l (5–11.2 mmol/l)
Hypertension	41%: reported hypertension 26%: knew values Reported mean systolic 143 mmHg (110–190 mmHg) Reported mean diastolic 91 mmHg (60–130 mmHg)
Smoking	75% smokers (96% smoked cigarettes) Mean pack years 40.4 (2–150) 12 months post op: 15% still smoking
Physical activity	92%: at some stage of life 85%: at school (rugby, soccer, cricket): mean: 8 hr/week 68%: after school (rugby, soccer, tennis): mean: 6 hr/week Years sporting activity stopped prior to operation: mean 25 years 5%: at time of operation (golf, walking, cycling)
Family history of CHD	58%: reported a death in the family due to CHD
Stress	71%: work related issues 45%: constant stress
Diabetes mellitus	15%: 1% IDDM; 14% NIDDM
Body mass index	Reported mean: 27.8 kg/m^2 (20–37 kg/m^2) Weight gain since school leaving: mean 14.4 kg
Alcohol intake	48% regular intake Mean: 23 drinks per week (2–70)

No of patients: 73
IDDM: insulin dependent diabetes mellitus
NIDDM: non insulin dependent diabetes mellitus
Values in brackets represent ranges.

Thirty per cent of the sample was not employed, or was on pension or disability pension. None of the patients who were out of work at the time of the operation returned to employment. Twelve months after the operation, another 24 patients were out of work.

Risk-factor profile

The information on risk factors was self-reported by the patients as only limited medical information was available from the ward files and physicians' files (Table II).

Slightly more than a quarter of patients (27%) knew their total serum cholesterol concentrations. Of the entire sample, 26% knew their systolic and diastolic blood pressures, in spite of hypertension having been present for a mean period of 12 years (SD ± 9). Patients had smoked for an average of 27 years (SD ± 12) and had smoked a mean of 27 cigarettes (SD ± 14) per day. The patients in this sample were heavy smokers.

Only six patients in this group had never participated in any sport. The active patients (sport at school and/or after leaving school) had stopped sporting activities an average of 25 years before the operation. As the mean age was 57 years (SD ± 12), it meant that they had continued with sporting activities to a mean age of 32 years (Table III).

Identifying patients with improved quality of life

One year after CABG, 58 patients could be contacted and the data to allow for the statistical analysis of improved quality of life were complete in 56 cases. Seventeen males were judged to have an improved quality of life (Group1) using the criteria suggested in the CASS study.[7] Thirty-nine patients were judged not to have an improved quality of life (Group 2). All 10 females were in Group 2.

In Table IV, variables measured on admission into the trial that were significantly different between the two groups, are presented. The table is split into two sections with the categorical data in the first section and the continuous data in the second section. A p value of 0.05 or less was regarded as significant.

Patients who had an improved quality of life 12 months after CABG surgery were statistically different from the group whose quality of life had not improved, in that, on admission, they were married males with an income greater than R50 000 a year. They had also reported a normal sex life prior to hospital admission.

Patients with an improved quality of life were also taller, had participated more extensively in sporting activities at school and had continued participating in sport for a longer period prior to surgery, than had patients who did not have an improved quality of life. There were no significant differences between the two groups with regard to body mass index.

The identified predictor variables for successful outcome one year after CABG were:

- height of patient
- knowledge that smoking affects the cardiovascular system
- number of years that sporting activities were stopped prior to CABG surgery
- better-quality sex life after the operation
- acceptance of self-responsibility
- married
- male
- spouse knew the diet the patient should follow.

(Goodness of fit $\chi^2 = 9.72$, $p = 1.00$.)

All the patients in the sample with an improved quality of life were men. A clinical model best suited to the South African bypass patient population was fitted and included the following predictor variables:

- married (OR = 22.6; $p = 0.02$)
- height of patient > 170 cm (OR = 15.5; $p = 0.01$)
- number of years that sporting activities were stopped prior to CABG surgery < 20 years (OR = 11.4; $p = 0.01$).

TABLE III. MEDICAL AND SURGICAL INFORMATION.

Medical information	
Prior to admission	51%: angina 56%: previous myocardial infarct 33%: PTCA 7%: CABG
On admission	Angina: 84% (62% severe, very uncomfortable or most severe pain ever experienced) Tiredness: 48% (very tired often or worst tiredness one could expect to have) Breathlessness: 63% Additional problems: 38% (Ca prostate; old CVA etc)
Surgical information	LVEF: mean 51% Vessels bypassed: mean 2.8 (1–5) Bypass time: mean 111 min (32–230) Aortic cross clamp time: 57 min (14–117)

No of patients: 73
PTCA: percutaneous transluminal coronary angioplasty
CABG: coronary artery bypass graft surgery
CVA: cerebral vascular accident
LVEF: left ventricular ejection fraction
Two patients operated on had cancer of the prostate and another two had had cerebrovascular accidents (stroke) some time before the operation.

TABLE IV. ON ADMISSION INTO THE TRIAL.

		Chi square	
Categorical data			
Group 1 (Improved quality of life)	*df*	χ^2 *value*	p *value*
Male	1	5.31	0.01
Married	1	5.44	0.02
Income > R50 000 a year	1	4.74	0.03
Normal sex life	1	5.10	0.04
		ANOVA	
Continuous data	*Mean*	F *value*	p *value*
Taller (cm)			
Group 1	176.53 (± 6.7)	6.68	0.01
Group 2	168.36 (± 12.2)		
Years that sporting activities stopped prior to CABG			
Group 1	15.67 (± 8.5)	10.14	< 0.01
Group 2	27.70 (± 13.5)		

Group 1: improved quality of life (n 17)
Group 2: no improved quality of life (n 39)
NS: not statistically significant.

Discussion

In this study of 73 patients who underwent coronary artery bypass surgery, 15 were lost to follow-up. Five patients (7%) had died (all of whom had severe cardiac disease and four were smokers) and 10 could not be traced or refused to be interviewed. One-year post-operative mortality rates of 4% were reported for patients (average age 61.1 years) undergoing CABG surgery by the BARI investigators.[11] The patients in this study were younger (average age 57 years) and had a higher mortality rate than reported by the BARI investigators.[11] There is a possibility that the higher mortality rate was due to a greater percentage of smokers in the current study (75% compared to 25% of smokers in the BARI trial). Patients who smoke are known to have poorer results after revascularisation procedures.[12] In most cases, patients who refused to be interviewed had a particularly poor outcome, and serious financial and/or emotional problems.

Of the survivors one year after surgery, 17 patients (30%) were identified with improved quality of life and 39 (70%) were judged not to have improved quality of life. The sentiment expressed by Kos-Munson *et al*. that a successfully repaired heart does not necessarily guarantee a successfully repaired life seems particularly apt for this group of patients.[13]

Patients with an improved quality of life one year after operation revealed the following significant characteristics at baseline entry into the study (Table IV). They were married males with an income over R50 000 and a normal sex life before the operation. They had a history of physical activity, had spent a mean of 11 hours per week at sport during their school years, had stopped sporting activities on average 16 years before the operation, and were reasonably tall (mean height 177 cm).

When compared to other reported studies, patients in this study were similar with regard to medical and surgical factors, marital status, educational levels, and return to work.[11,12,14] This indicates that the results of this study are therefore transferable to other populations. Differences in this study were that patients probably were younger and fewer females underwent CABG.

All the patients with improved quality of life were males ($p = 0.01$). This result correlates well with the results reported by Steine *et al*. indicating male sex to be a significant predictor of enhanced well-being after coronary artery bypass surgery.[15]

Not one female was identified with improved quality of life. This may be due to the fact that there were so few females in the sample (14%). However, it has frequently been reported in the literature that men do significantly better after CABG surgery than do females.[16] Penckofer and Holm found that females experienced less relief from angina and dyspnoea, more psychosocial impairment, and in addition had a poorer long-term bypass graft patency rate.[17] The in-hospital mortality experienced by females has been reported to be 1.6 times greater than in males.[18] Not one of the female patients in the current sample died post-operatively, although there was an overall mortality rate of 6.8% for the entire sample.

Hawthorne stated that women felt surgical intervention was quite successful in relieving symptoms and that they were satisfied with the results of surgery.[19] According to Clancy *et al.*, irrespective of how successful CABG surgery may be from a medical point of view, patients' futures are based on how they feel about themselves and what they feel they are able to do.[20] If patients do not perceive that their condition has improved, the surgery cannot be called successful. It can therefore be argued that if the patient is satisfied with the outcome and feels the condition has improved, then surgery can be considered successful. All the females in this study either remained symptomatic or reported decreased levels of activity post-operatively.

There was a close correlation between levels of education and income levels. Patients earning less than R50 000 were likely to have a level of education of grade 12 or less. These patients at the time of CABG surgery should be identified as an extremely high-risk group on social grounds and every effort was made to support them and their spouses post-operatively. A significant number of males in the group with improved quality of life ($p = 0.02$) were married. Psychosocial support is a major component of successful outcome.[21] In several studies, patients with reduced social support have been found to have increased morbidity and mortality rates following cardiac events.[22]

Individuals with heart disease experience fear and anxiety regarding sexual performance, and many report sexual dysfunction or abstinence from sexual activity.[23] In this study, patients with an improved quality of life, as assessed one year post-operatively, had a significantly 'normal' sex life on admission, compared to those who did not have an improved quality of life ($p = 0.036$). The question asked on admission was whether the patient regarded his sex life as 'normal'. At 12 months, patients were asked if their sex life had improved, was the same, or worse. Patients with an improved quality of life reported their sexual performance to be better than before the operation. This was significantly different from the group who did not have an improved quality of life ($p = 0.011$). The reason may simply be that the patients with an improved quality of life were all married. Miller *et al*. indicated a positive effect of the marital relationship on sexual functioning.[24] They found that the return to sexual activity was positively influenced by a strong emotional relationship between husband and wife.

The criteria for improved quality of life in this study included improved physical activity, and this may also be a reason for the difference in sexual performance between the groups. Jenkins *et al.* found a close association between improved physical activity and improved sexual performance, and Kavanaugh and Shepard found that with exercise programmes, sexual activity was the same or improved.[25,26]

This study reported a drop in time spent on sporting activities after leaving school. This drop is to be expected because it is known that as adults age they become physically more inactive.[27] Twenty-one patients (29%) regarded themselves as physically active at the time of the operation. At that time, only four patients were doing physical activity for training. The questionnaire was not adequately designed to examine the extent of the leisure activities engaged in by this sample of patients. It is known that regular exercise of moderate intensity may be of benefit.[28] It is disconcerting that only 29% of patients reported any form of physical

activity at the time of the operation. More emphasis should be placed on physical activity as a preventative measure for coronary artery disease. It is also highly unlikely that if these patients were not engaged in physical activities prior to their surgery, they would do so after surgery.

It cannot be over-emphasised that this clinical incident (CABG surgery) should be used as a 'window' of opportunity to encourage and educate patients about the value of exercise in optimising the outcome of surgery. A supervised outpatient exercise training programme results in significant improvement in functional capacity for CABG patients. The improvement in functional capacity can be as high as 20% one year after training.[29]

The current study established a significant difference in height between the group with improved quality of life and those who did not have improved quality of life ($p = 0.01$). The patients with improved quality of life were taller (mean height: 177 cm) than the patients whose quality of life had not improved (mean height: 168 cm). Several studies have observed an increased risk for coronary disease in shorter men.[30,31] The reasons for this may be the diameter of the coronary artery lumen.[31] Men have larger diameters of the mid-left anterior descending artery than women and small mid-LAD (left anterior descending) arteries are associated with a substantially increased risk of in-hospital mortality ($p < 0.001$) with CABG surgery.[32] These observations may also explain the higher peri-operative mortality in women and smaller people.[33]

Socio-economic factors in childhood will also affect growth. Poor growth in childhood is associated with higher mortality rates from cardiovascular disease in adulthood.[34] Height may in fact be a significant predictor of coronary artery disease. In 1992, Allebeck and Bergh concluded that there was an inverse relationship between body height and mortality and that the association could be explained almost entirely by social and behavioural characteristics.[34]

The controversy surrounding the inverse relationship between height and mortality from cardiovascular disease has not been resolved. However, from the results of this study it can be concluded that should taller people have CABG surgery, they are more likely than shorter people, to have an improved quality of life one year post-operatively.

Another important finding of this research was that certain parameters such as left ventricular ejection fraction, the number of vessels bypassed, bypass time and aortic cross-clamp time, did not predict improved quality of life of patients 12 months after CABG surgery.

Conclusion

The patients in this study had many risk factors for CHD and are representative of the South African population. The socio-demographic profiles of patients in this study were similar to those of other international studies, with the exceptions that the mean age of this population was younger and that fewer females underwent CABG surgery. The results of this study are therefore transferable to other populations.

The most important finding of this study was that the successful outcome of survivors of coronary artery bypass surgery, if measured in terms of an improved quality of life one year post-operatively, is not dependent on medical parameters but on psychosocial factors. Although the surgery is in many instances a life-saving intervention, it is also an expensive intervention and for many patients in this study the cost implication was considerable. If patients do undergo CABG surgery, a determined attempt should be made to achieve a successful outcome in terms of an improved quality of life. The value of the spouse in the successful outcome was demonstrated in our study and this makes it essential that more time and effort be given to the support of the spouse, as well other measures to educate patients on the role each must personally play in their successful rehabilitation.

References

1. Marshall J, Penckofer S, Llewellyn J. Structured postoperative teach ing and knowledge and compliance of patients who had coronary artery bypass surgery. *Heart Lung* 1986; **15**: 76 82.
2. Oldridge N, Gottlieb M, Guyatt G, Jones N, Streiner D, Feeny D. Predictors of health related quality of life with cardiac rehabilitation after acute myocardial infarction. *J Cardiopul Rehab* 1998; **18**: 95 103.
3. Lomas J, Pickard L, Mohide A. Patient versus clinical item generation for quality of life measures**.** *Med Care* 1987; **25**: 764 769.
4. O'Young J, McPeek BC. Quality of life in surgical trials. *J Chron Dis* 1987; **40**: 513 522.
5. Mayou R, Bryant B. Quality of life in cardiovascular disease: Position paper. *Br Heart J* 1993; **69**: 460 466.
6. Eales C, Stewart A. Factors which may predict successful rehabilita tion of patients who have undergone coronary artery bypass surgery: A pilot study. *S Afr J Physiother* 1994; **49**: 45 49.
7. Principal Investigators and their Associates Coronary Artery surgery Study (CASS): a randomized trial of coronary artery bypass surgery. Quality of life in patients randomly assigned to treatment groups. *Circulation* 1983; **68**: 951 96.
8. Ågren B, Ryden O, Johnsson P, Nilsson Ehle. Rehabilitation after coronary bypass surgery: Coping strategies predict metabolic improve ment and return to work. *Scan J Rehab Med* 1993; **24**: 83 95.
9. Ory MG, Cox DM, Gift HC, Abeles RP. Aging and quality of life: celebrating new research discoveries. In: Abeles RP, Gift HC, Ory MG, eds. *Ageing and Quality of Life*. New York: Springer, 1994: 4.
10. Bland M. *An Introduction to Medical Statistics*. New York: Oxford University Press, 1996.
11. The Writing Group for the Bypass Angioplasty Revascularization Investigation (BARI) Investigators. Five year clinical and functional outcome comparing bypass surgery and angioplasty in patients with multivessel coronary disease. *J Am Med Assoc* 1997; **277**: 715 721.
12. Payne N, Saul C. Variations in use of cardiology services in a health authority: comparison of coronary artery revacularization rates with prevalence of angina and coronary mortality. *Br Med J* 1997; **314**: 257 261.
13. Kos Munson BA, Alexander LD, Hinthorn PAC, Gallagher EL, Goetze CM. Psychosocial predictors of optimal rehabilitation post coronary artery bypass surgery. *Schol Inq Nurs Prac: Int J* 1988; **2**: 171 193.
14. Bandrup Wognsen G, Haglid M, Karlsson T, Herlitz J. Preoperative risk indicators of death at an early and late stage after coronary artery bypass grafting. *J Thorac Cardiovasc Surg* 1995; **43**: 77 82.
15. Steine S, Laerum E, Eritsland J, Arnesen H. Predictors of enhanced well being after coronary artery bypass surgery. *J Int Med* 1996; **239***:* 69 73.
16. Allen JK. Coronary risk factor modification in women after coronary artery bypass surgery. *Nurs Res* 1996; **45**: 260 265.
17. Penckofer SM, Holm K. Women undergoing coronary artery bypass surgery: Physiological and psychological perspectives. *Cardiovasc Nurs* 1990; **26**: 13 18.

18. Jaglal SB, Tu JV, Naylor CD. Higher in hospital mortality in female patients following coronary artery bypass surgery: a population based study. Provincial Adult Cardiac Network of Ontario. *Clin Invest Med* 1995; **18**: 99 107.
19. Hawthorne MH. Women recovering from coronary artery bypass surgery. *Schol Inq Nurs Prac: Int J* 1993; **7**: 223 243.
20. Clancy C, Wey J, Guinn G. The effect of patients' perceptions on return to work after coronary artery bypass surgery. *Heart Lung* 1984; **13**: 173 174.
21. Williams RB, Littman AB. Psychosocial factors. Role in cardiac risk and treatment strategies. *Cardiol Clin* 1996; **14**: 97 104.
22. Case RB, Moss AJ, Case N, McDermott M, Eberly S. Living alone after myocardial infarction: Impact on prognosis. *J Am Med Assoc* 1992; **267**(4): 515 519.
23. Seidl A, Bullough B, Haughey B, Scherer Y, Rhodes M, Brown G. Understanding the effects of a myocardial infarction on sexual functioning: A basis for sexual counseling. *Rehab Nurs* 1991; **16**: 255 264.
24. Miller P, Wikoff R, McMahon M, Garrett M J, Ringel K. Marital functioning after cardiac surgery. *Heart Lung* 1990; **19**: 55 61.
25. Jenkins DC, Stanton B A, Savageau JA, Denlinger P, Klein MD. Coronary artery bypass surgery: Physical, psychological, social and eco nomic outcomes six months later. *J Am Med Assoc* 1983; **250**: 782 788.
26. Kavanaugh T, Shepard RJ. Sexual activity after myocardial infarction. *Can Med Assoc J* 1977; **116**: 1250 1530.
27. National Institutes of Health (NIH) Consensus Conference. Physical activity and cardiovascular health. *J Am Med Assoc* 1996; **276**: 241 246.
28. Gordon N, Kohl HW, Blair SN. Life style exercise: A new strategy to promote physical activity for adults. *J Cardiopul Rehab* 1993; **13**: 161 163.
29. Hamm LF, Leon AS. Exercise training for the coronary patient. In: Wenger NK, Hellerstein HK, eds. *Rehabilitation of the Coronary Patient*, 3rd edn. New York: Churchill Livingstone, 1992: 370 371.
30. The Steering Committee of the Physicians' Health Study Research Group. Final report on findings from the aspirin component of the ongoing Physicians' Health Study. *N Engl J Med* 1989; **321**: 129 135.
31. Herbert PR, Rich Edwards JW, Manson JE, Ridker PM, Cook NR, O'Connor GT, Buring JE, Hennekens CH. Height and incidence of cardiovascular disease in male physicians. *Circulation* 1993; **88**: 1437 1443.
32. O'Connor NJ, Morton JR, Birkmeyer JD, Olmstead EM, O'Connor GT for the Northern New England Cardiovascular Disease Study Group. Effect of coronary diameter in patients undergoing coronary artery bypass surgery. *Circulation* 1996; **93**(4): 652 655.
33. Rich Edwards JW, Manson JE, Stampfer MJ, Colditz GA, Willet WC, Rosner B, Speizer FE, Hennekens CH. Height and the risk of cardiovascular disease in women. *Am J Epidem* 1995; **142**: 909 917.
34. Allebeck P, Bergh C. Height, body mass and mortality: Do social factors explain the association? *Pub Hlth* 1992; **106**: 375 382.