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IMPACT OF AGE ON IMPROVEMENT IN HEALTH-RELATED QUALITY OF LIFE 5 YEARS AFTER CORONARY ARTERY BYPASS GRAFTING

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The aim of this study was to describe the relief of symptoms and improvement in other aspects of health-related quality of life 5 years after coronary artery by-pass grafting in relation to age. Patients in western Sweden were approached with an inquiry prior to surgery and 5 years after the operation. Health-related quality of life was estimated with 3 different instruments: Physical Activity Score (PAS), Nottingham Health Profile (NHP), Psychological General Well-Being Index (PGWB). Prior to surgery patients were approached either in the ward or by post and 5 years after surgery they were approached by post. A total of 1719 patients were available for the survey, of whom 876 (51%) responded to the survey both prior to and after 5 years. Among the 876 respondents 287 were <60 years, 331 were 60–67 years and 258 were >67 years. In terms of physical activity, chest pain and dyspnoea, a similar improvement was observed regardless of age. In terms of health-related quality of life questionnaires, there was an inverse association between age and improvement when using PAS and a similar trend was observed with NHP and PGWB. In conclusion, 5 years after coronary artery bypass grafting relief of symptoms and improvement in physical activity was not associated with age, whereas improvement in other aspects of health-related quality of life tended to be less marked in elderly people. Overall age seemed to have a small impact on the improved well-being 5 years after coronary surgery. However, due to the limited response rate the results may not be applicable to a non-selected coronary artery bypass grafting population.

Key words: age, coronary surgery, quality of life.

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INTRODUCTION

Severe coronary artery disease can be treated successfully with coronary artery bypass grafting (CABG) with a considerable improvement in terms of the relief of angina pectoris.

Approximately 3 out of 4 patients are free from ischaemic events for 5 years (1). However, increased survival is demonstrated only in selected subgroups with advanced coronary artery disease (2) and this effect has not been established in elderly patients. The outcome in terms of increased physical activity, symptom relief and other aspects of quality of life (QoL) is of major importance in severely symptomatic patients and particularly if a prognostic gain cannot be expected. Health-related QoL constitutes the individual's perception of symptoms, well-being, and physical and mental functional capacity. However, reports on the influence of age on long-term outcome after CABG in terms of health-related QoL are scarce.

This study evaluates the effect of CABG on health-related QoL for 5 years after the procedure in relation to age. In a shorter perspective age has not been shown to substantially influence health-related QoL after CABG (3, 4).

MATERIAL AND METHODS

Patients

All patients from all 15 hospitals in the western region of Sweden (1.6 million inhabitants), who underwent CABG at the 2 referral centres for CABG in western Sweden, Sahlgrenska University Hospital and the Scandinavian Heart Center, both in Göteborg, between June 1988 and June 1991, received a questionnaire regarding health-related QoL symptoms at the time of coronary angiography prior to the operation and at 5 years after the operation. The pre-operative questionnaires were administered prior to coronary angiography to all patients on the waiting-list who were scheduled for an elective angiography. Patients undergoing emergency coronary evaluation received the questionnaires in the ward prior to angiography.

The demographic data were collected through review of medical charts, interviews, and physical examination of the patients by a physician of the research team, when the patient was hospitalized for CABG. The functional classification was made according to the New York Heart Association.

In total, 2365 patients underwent CABG during the inclusion period. Out of these 244 were excluded due to concomitant valve surgery and 121 patients were excluded due to previous CABG. Of the remaining 2000 patients 281 (14%) died during the subsequent 5 years. Five-year mortality in the 3 age groups (youngest first) were: 8%, 12% and 22%, respectively ($p < 0.0001$ for correlation with actual age). Thus, there were 1719 patients available for this survey, of whom 876 (51%) answered the inquiry both prior to the procedure and 5 years later. Among the 876 respondents 287 were <60 years, 331 were 60–67 years and 258 were >67 years.

In Table I responders are compared with non-responders. Responders included fewer females, they had a less severe angina pectoris, a lower prevalence of previous AMI, congestive heart failure, renal dysfunction and percutanous transluminal coronary angioplasty (PTCA).

In Table II responders are compared with non-responders in the 3 age-groups with regard to previous history and observations at cardioangiography. An interaction with age was found for gender and a history of hypertension.

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Table I. *Clinical characteristics at operation in all patients alive at 5 years after operation in relation to whether patients answered the questionnaire both prior to and at 5 years after operation (%)*

	Responders $n = 876$	Non-responders $n = 843$	p*
Female sex/male	16/84	21/79	0.005
Age (years) (mean)	62.4	62.0	
NYHA class (7)#			0.01
1	2	3	
2	12	14	
3	65	52	
4	21	32	
Previous MI	55	63	0.0006
Angina pectoris	98	97	
Congestive heart failure	11	14	0.05
Hypertension (2)#	36	36	
Diabetes mellitus	10	11	
Renal dysfunction (3)#	22	27	0.01
Cerebrovascular disease	8	7	
Claudication (1)#	10	11	
Obesity	12	12	
Current smoker (2)#	11	14	
Previous PTCA	4	8	0.0003
3-vessel disease (6)#	66	63	
EF <0.40 (77)#	7	9	

NYHA, New York Heart Association; MI, myocardial infarction; PTCA, percutaneous transluminal coronary angioplasty; EF, ejection fraction.
*Given if below 0.05.
Number of patients with missing information.

Symptom scores; single item questions

All of the questionnaires were administered to the patients and collected by 1 person. The study was approved by the local ethics committee in Göteborg. The patients were approached with the first questionnaire at the time of coronary angiography (mean of 3.6 months prior to the operation) and then approached with the same inquiry, by post, 5 years after the operation. The questionnaire included questions about physical activity, the reasons for limitation of physical activity, the occurrence of various types of chest pain, the frequency of chest pain and the occurrence of various types of dyspnoea. Examples are: Have you had symptoms of dyspnoea during the last month? Have you had discomfort or pain in the chest during the last month?

The questionnaires were modified from (5) and validated regarding dyspnoea (6, 7) as well as chest pain (8). Modifications involved translation and addition of some questions.

Validations have been made in previous population studies evaluating clinical signs (7) and left ventricular wall motion abnormalities (9) in cardiac dyspnoea, as well as prognosis in patients with chest pain (uncomplicated angina pectoris; complicated angina pectoris; myocardial infarction) (8).

Health-related Quality of Life questionnaires

The patients completed 3 self-administered questionnaires for the assessment of health-related QoL: the Physical Activity Score (PAS), the Nottingham Health Profile (NHP) and the Psychological General Well-Being (PGWB) index. These questionnaires have been carefully validated and tested for its reliability (10–13).

The PAS represents 1 dimension of an angina-specific questionnaire (14), the Angina Pectoris Quality of Life questionnaire, which contains 6 questions for the self-estimation of physical abilities and limitations. Each response is graded from 1 to 6 and the mean value for all 6 questions is calculated. The higher the value, the greater the degree of disability.

The NHP is divided into 2 parts. Part I, which is used in this study, consists of 38 statements which convey limitations of activity or aspects of distress in 6 dimensions: physical mobility, pain, sleep, energy, social isolation and emotional reactions. Patients are required to indicate by a yes/no answer which of the problems they are experiencing at the time they complete the questionnaire. A score ranging from 0 to 100 can be calculated for each dimension (15). The higher the score, the worse the health-related QoL. Reference values from a healthy population are available (16).

The PGWB index contains 22 questions, dealing with 6 dimensions of well-being: anxiety, depressed mood, vitality, general health, self-control and well-being (11). The response format is graded from 1 to 6

Table II. *Clinical characteristics at operation in responders* and non-responders among different age groups (%)*

	Age 32–59 years Responders Yes/No $n = 287/309$	Age 60–67 years Responders Yes/No $n = 331/267$	Age 68–86 years Responders Yes/No $n = 258/267$	p for interaction with age†
Female sex	14/13	16/22	17/29	0.05
NYHA class				
1	3/3	1/3	<1/3	
2	15/18	11/13	9/9	
3	65/54	62/51	68/50	
4	17/24	25/33	22/39	
Previous MI	59/64	52/63	55/64	
Angina pectoris	97/97	99/97	>99/97	
Congestive HF	8/9	10/10	14/23	
Hypertension	36/29	38/41	32/39	0.02
Diabetes mellitus	9/12	12/13	9/9	
Renal dysfunction	4/5	18/24	47/57	
Cerebrovascular disease	3/4	8/7	12/12	
Claudication	7/8	13/12	10/14	
Obesity	18/13	10/14	8/8	
Current smoker	20/24	8/12	4/4	
Previous PTCA	6/11	3/6	2/4	
3-vessel disease	57/52	68/64	75/74	
EF <0.40	8/9	6/6	7/10	

NYHA, New York Heart Association; MI, myocardial infarction; HF, heart failure; PTCA, percutaneous transluminal coronary angioplasty; EF, ejection fraction.
*Responders are defined as patients answering the questionnaire both prior to and at 5 years after operation
†Given if below 0.05.

Table III. *Physical activity prior to and at 5 years after operation*

	Pre-op				5 years post-op			
Age (years)	<60 %	60–67 %	>67 %		<60 %	60–67 %	>67 %	
Physical activity not limited	5	3	4		36	43	35	
Physical activity slightly limited	23	24	19		39	32	33	
Physical activity severely limited	45	41	36		19	20	22	
Unable to perform physical activity	28	33	42		7	6	10	
	0.0006*				—**			
					<0.0001†	<0.0001‡	<0.0001§	
Physical activity limited due to:				*p*				*p*
Tiredness	11	10	13	—*	16	14	21**	
					—†	—‡	0.004§	
Palpitations	2	2	1	—	3	3	4	—
					—	—	—	
Dyspnoea	25	27	22	—	34	35	41	
					0.009	0.008	<0.0001	
Chest pain	77	78	77	—	25	20	18	—
					<0.0001	<0.0001	<0.0001	

* *p* for correlation with actual age.
** *p* for correlation with actual age, adjusted for preoperative value.
† *p* for change from preop - patients aged 28–59 years.
‡ *p* for change from preop - patients aged 60–67 years.
§ *p* for change from preop - patients aged 68–86 years.
— indicates *p*-value above 0.05.

(total score range 22–132), with the highest value corresponding to superior well-being. Reference values derived in an unselected population are available (14).

Selection of questionnaires

The symptomatic response to myocardial ischaemia in angina pectoris is chest discomfort, induced by physical or mental stress, thereby limiting physical performance. However, angina pectoris has also other detrimental impacts, such as increased anxiety and limitations of leisure activity, working capacity and social and sexual function (17).

The PAS represents 1 dimension of a disease-specific questionnaire for the estimation of physical capacity in angina pectoris (13). The NHP and the PGWB index are categorized as generic questionnaires. The NHP is most useful in patients with chronic diseases and/or with pronounced symptoms (18). The NHP has previously been used to evaluate the effect of CABG (19, 20). The PGWB index is suitable for addressing the impact of symptoms on well-being and is applicable in healthy as well as patient populations. The purpose of this choice of questionnaires was to capture the whole range of outcomes, from symptomatic limitations of physical abilities due to angina pectoris to overall well-being and health-related QoL. These questionnaires were chosen rather than other estimates, observed to have a lesser ability to reflect subjective results after CABG, such as NYHA classification, and return to work.

Statistics

In Table I the Mann-Whitney U test was used for age and functional class and Fisher's exact test for dichotomous variables. Logistic regression was used to test interaction in Table II. Otherwise, Spearman's rank statistic were used to test correlation with age. Actual age was used in all *p*-value calculations. Patients were divided into the 3 age groups for illustrative purposes. Adjustments for preoperative values in Tables III–VI were made by using Spearman's partial rank statistic. For changes over time within groups Wilcoxon's signed rank test and the sign test were used, for ordered/continuous variables and dichotomous variables, respectively.

Except for Tables I and II, only patients answering the questionnaire both prior to and at 5 years after CABG were included in the analysis.

All *p*-values are 2-sided and considered significant if below 0.05 in Tables I and II and if below 0.01 otherwise. In Tables I and II *p*-values are noted if below 0.05, and in the remaining tables if below 0.01.

RESULTS

Symptoms and physical activity

Physical activity (Table III). There was an association between limitation of physical activity and age prior to, but not 5 years after, CABG. In all three age groups the degree of limitation of physical activity decreased 5 years after CABG compared with prior to the operation.

Among patients in the oldest age group more of them had their physical activity limited due to tiredness 5 years after CABG than prior to surgery, but this difference was not significant in the two youngest groups. The proportion of patients who had their physical activity limited due to dyspnoea increased after the operation in all three age groups, whereas the proportion who had their physical activity limited due to chest pain decreased markedly in all three age groups.

Symptoms of dyspnoea (Table IV)

Prior to surgery there was an association between age and dyspnoea in 5 of 7 specific situations (more dyspnoea in the elderly), whereas such an association was found only in 1 of 7 situations 5 years after surgery. The proportion of patients who were free from dyspnoea 5 years after the operation increased markedly compared with prior to surgery in all 3 age groups.

Correspondingly the proportion of patients with symptoms of

Table IV. *Symptoms of dyspnoea prior to and at 5 years after operation*

	Pre-op				5 years post-op			
Age (years)	<60 %	60–67 %	>67 %	*p*	<60 %	60–67 %	>67 %	*p*
No dyspnoea	14	15	10	—*	42 <0.0001†	40 <0.0001‡	37 <0.0001§	—**
When walking uphill or quickly on the level	83	82	87	—	55 <0.0001	55 <0.0001	58 <0.0001	—
When walking with people of own age on the level in their speed	65	65	72	—	33 <0.0001	35 <0.0001	38 <0.0001	—
Have to stop to catch breath when walking on the level in own speed	26	35	45	<0.0001	10 <0.0001	12 <0.0001	20 <0.0001	
When dressing or washing	14	23	27	0.0001	9 0.009	9 <0.0001	10 <0.0001	—
At rest, when sitting down, or at night	8	12	15	0.003	3 0.007	3 <0.0001	4 <0.0001	—
Have to sit down and rest when returning from a walk	58	61	69	0.001	27 <0.0001	33 <0.0001	42 <0.0001	0.002
Wake up at night due to dyspnoea	10	17	22	<0.0001	6 —	6 <0.0001	8 <0.0001	—

* *p* for correlation with actual age.
** *p* for correlation with actual age, adjusted for preoperative value.
† *p* for change from preop - patients aged 28–59 years.
‡ *p* for change from preop - patients aged 60–67 years.
§ *p* for change from preop - patients aged 68–86 years.
— indicates *p*-value above 0.05.

dyspnoea at specific occasions decreased in all age groups 5 years after surgery, with the exception of patients aged <60 years with regard to waking up at night due to dyspnoea.

Number of attacks of chest pain (Table V)

The frequency of attacks of chest pain was not related to age neither prior to surgery nor 5 years later. The number of attacks of chest pain decreased significantly in all 3 age groups.

Chest pain on various occasions (Table VI)

Prior to CABG the occurrence of chest pain was related to age (more common in elderly subjects) on the following occasions: when walking in own speed, when dressing or washing, at night and when out in windy or cold weather.

Five years after surgery chest pain was not positively associated with age in any situation. On the other hand, chest pain was observed to be negatively associated with age 5 years after surgery when under stress and after dinner.

In all situations chest pain was markedly and significantly reduced 5 years after CABG compared with prior to surgery in all 3 age groups.

Physical activity score (Fig. 1). Both prior to and 5 years after CABG there was a significant correlation between age and PAS indicating less physical activity in elderly subjects. There

Table V. *Number of attacks with chest pain per week prior to and at 5 years after operation*

	Pre-op			5 years post-op		
Age (years)	<60 %	60–67 %	>67 %	<60 %	60–67 %	>67 %
Number of attacks						
None	6	2	3	50	56	57
Less than once a week	10	8	6	20	20	17
1–2 per week	14	15	11	12	9	11
3–6 per week	15	21	20	9	5	2
Once or twice daily	32	29	32	6	6	8
Several daily	24	25	28	4	4	4
	0.03*			—**		
				<0.0001†	<0.0001‡	<0.0001§

* *p* for correlation with actual age.
** *p* for correlation with actual age, adjusted for preoperative value.
† *p* for change from preop - patients aged 28–59 years.
‡ *p* for change from preop - patients aged 60–67 years.
§ *p* for change from preop - patients aged 68–86 years.
— *p*-value above 0.05.

Table VI. *Chest pain at various occasions prior to and at 5 years after operation*

	Pre-op				5 years post-op			
Age (years)	<60 %	60–67 %	>67 %	*p*	<60 %	60–67 %	>67 %	*p*
When walking uphill or quickly on the level	91	93	97	*	43 <0.0001†	38 <0.0001‡	42 <0.0001§	—**
When walking with people of own age on the level in their speed	75	75	85	0.004	25 <0.0001	25 <0.0001	25 <0.0001	—
When walking on the level in own speed	27	35	44	<0.0001	5 <0.0001	7 <0.0001	9 <0.0001	—
When dressing or washing	18	25	34	<0.0001	4 <0.0001	7 <0.0001	4 <0.0001	—
At rest, when sitting down	13	18	17	—	4 0.0008	3 <0.0001	5 0.0001	—
At night	23	31	39	<0.0001	7 <0.0001	8 <0.0001	9 <0.0001	—
When under stress	89	82	85	—	48 <0.0001	37 <0.0001	35 <0.0001	0.002
After dinner	32	37	37	—	16 <0.0001	9 <0.0001	6 <0.0001	0.002
When out in windy or cold weather	78	86	89	0.0007	43 <0.0001	41 <0.0001	42 <0.0001	—

*p for correlation with actual age.
** p for correlation with actual age, adjusted for preoperative value.
† p for change from preop - patients aged 28–59 years.
‡ p for change from preop - patients aged 60–67 years.
§ p for change from preop - patients aged 68–86 years.
— indicates p-value above 0.05.

was also an association between improvement and age, the improvement being more marked in younger patients than in elderly patients, although a significant improvement was observed in all 3 age groups.

Nottingham Health Profile

Subcomponents (Fig. 2). Prior to surgery there was a positive association between age and the pain and mobility subcomponents, indicating more symptoms in the elderly. On the other hand, there was a negative association between age and emotions prior to surgery (more problems in younger patients).

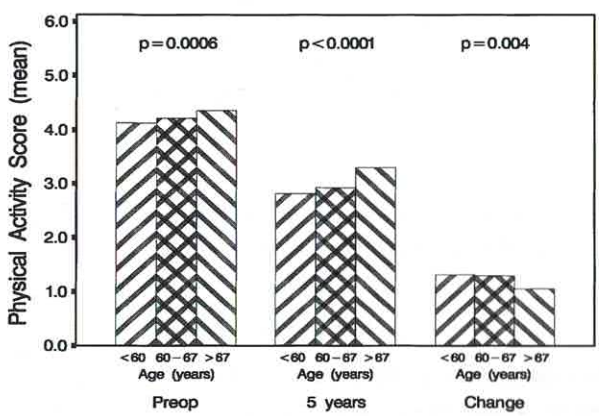

Fig. 1. Mean of physical activity score prior to and at 5 years after operation in relation to age.

Five years after the operation there was a positive association between age and the following subcomponents: energy, pain and mobility. Improvement was significantly more marked in younger patients in the emotions and energy subcomponents.

In terms of sleep there was no improvement in the oldest age group and in terms of social isolation there was no improvement in any of the age groups. Significant improvements were found in all other subcomponents in all 3 age groups.

Psychological General Well-Being Index

Total score (Fig. 3). Prior to CABG there was a significant correlation between age and PGWB with less well being seen in younger patients. Such a correlation was not found 5 years after CABG. The improvement was significant in all 3 age groups, but there was only a trend towards an association between low age and improvement.

Subcomponents. Prior to surgery there was a positive association between anxiety and age and between well-being and age. Five years after surgery there was still a positive association between age and anxiety. In all subcomponents there was an improvement in all 3 age groups 5 years after CABG compared with prior to surgery. Improvement was similar regardless of age with exception for well-being, where improvement was more marked in younger patients.

Relation to other study groups

Compared with a normal population, patients showed a lower health-related QoL prior to CABG, but a similar QoL 5 years

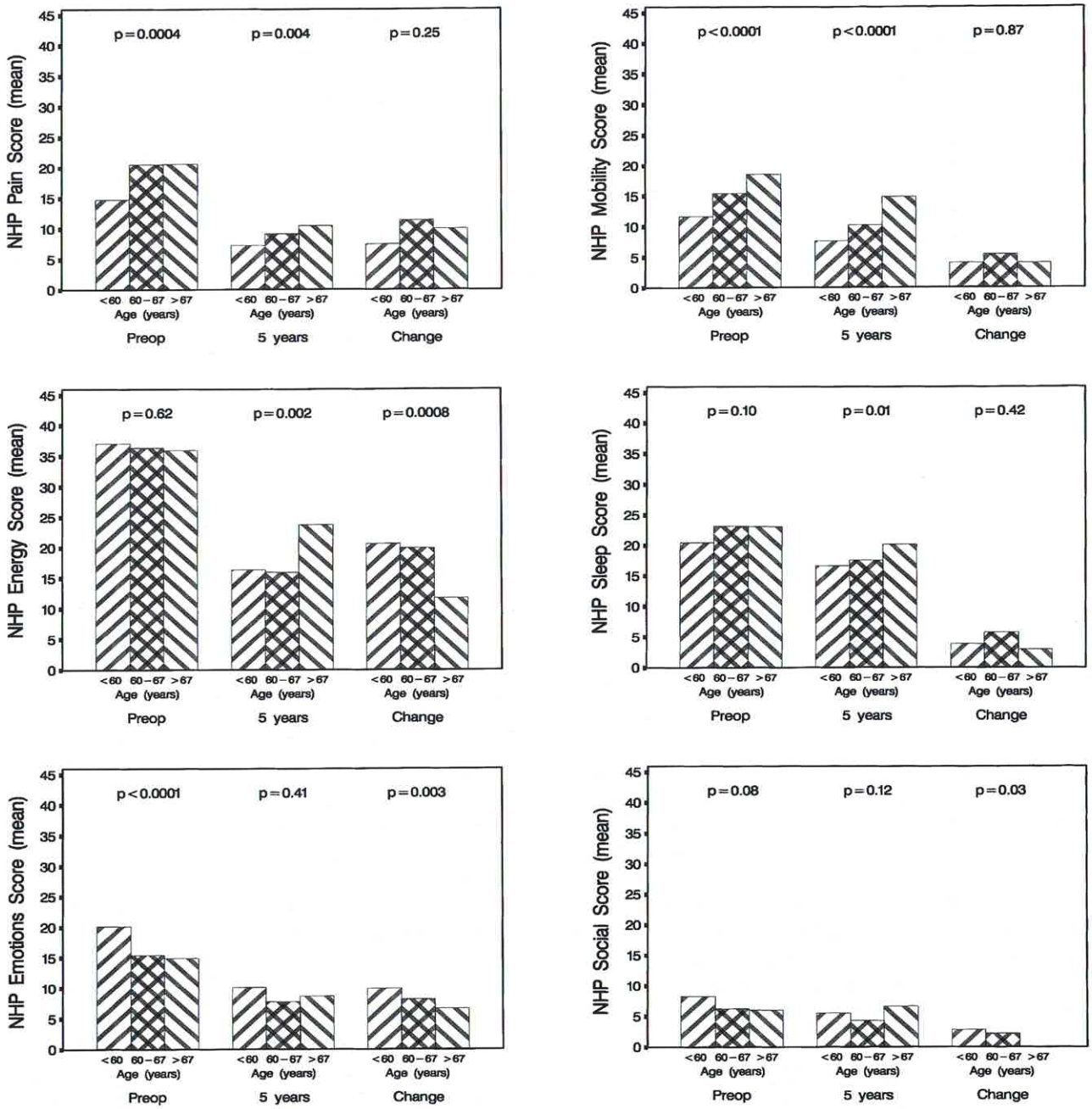

Fig. 2. Mean of NHP subcomponent score prior to and at 5 years after operation in relation to age. Upper right = mobility; upper left = pain; medium right = sleep; medium left = energy; lower right = social; lower left = emotions. NHP = Nottingham Health Profile.

after CABG when measured with PGWB total score (14). When compared with another patient population, it was found that patients with heartburn had a better health-related QoL than patients waiting for CABG (14).

When evaluating various subcomponents of NHP, patients appeared to have a worse health-related QoL prior to CABG than a normal population, whereas 5 years after CABG health-related QoL was similar to a normal population (12). However health-related QoL according to NHP subcomponents was better among patients both prior to and after CABG as compared with patients suffering from arthrosis and arthritis (12, 21).

DISCUSSION

This study evaluates the impact of CABG on improvement in various aspects of QoL during 5 years after the operation in relation to age. Although we found somewhat less improvement in QoL among elderly patients when evaluating health-related

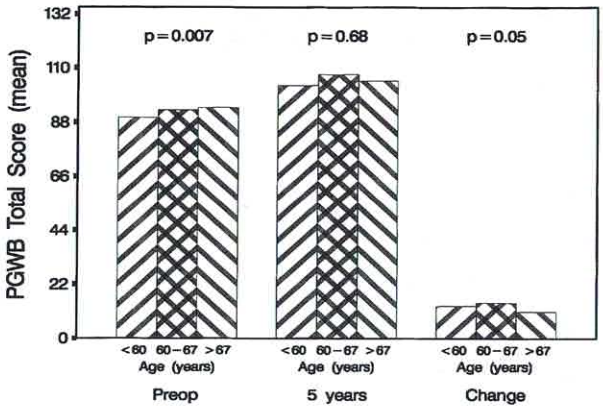

Fig. 3. Mean of Psychological General Well-Being (PGWB) total score prior to and at 5 years after operation in relation to age.

QoL questionnaires, their relief of symptoms and improvement in physical activity was similar to that among younger patients.

Previous studies have found favourable and in some cases equal results in an ageing population as in a younger population in terms of health-related QoL after CABG (22–26).

It has previously been shown that CABG in older patients is more expensive than in younger patients due to more complications and longer hospitalizations (27). It is therefore important to consider age aspects on outcome, not only in terms of survival, but also in terms of symptoms and various aspects of health-related QoL.

Unlike younger patients, among elderly patients the main goal of surgery is not necessarily to prolong life, but to eliminate angina and improve health-related QoL.

We did not study return to work in this investigation. Other studies have found that chest pain is the main variable negatively influencing return to work, but also that increasing age is a negative factor (28). It is therefore important that we see a marked and similar improvement in physical activity, relief of chest pain and relief of dyspnoea regardless of age. This observation indicates that we can expect a similar relief of symptoms related to myocardial ischaemia also in the elderly.

Despite the fact that younger patients had more pain at dinner and under stress even 5 years after surgery, we observed that younger patients improved more in terms of physical activity than older patients. This indicates that chest pain at rest might not prevent patients from improving their physical capacity after CABG.

In accordance with other studies (29), we have previously shown that the alteration of health-related QoL after CABG is an early phenomenon after surgery (30). When evaluating well-being in terms of various measurements of health-related QoL, our long-term results presented in this report appear slightly different from the improvement in symptoms which was unrelated to age. Thus, at least with regard to PAS, improvement tended to be less marked in the elderly. A similar tendency was observed with regard to both NHP and PGWB. Although we found a tendency towards less improvement in health-related QoL among elderly patients, there was still an impressive effect. This is in accordance with previous findings in octogenarians (31).

There was a discrepancy with regard to the association between age and physical respective psychological symptoms; a positive association with the former and a negative association with the latter. This finding is in agreement with what has been found among patients with other manifestations of ischaemic heart disease (32).

Prior to surgery we found a negative correlation between age and emotions and a positive correlation between age and anxiety. We have no explanation to this finding other than that emotion and anxiety measure different aspects of health-related QoL.

A possible explanation for the slight discrepancy in age correlation with symptoms and other aspects of health-related QoL is that various measurements of health-related QoL take into account not only symptoms of ischaemic heart disease, but other symptoms as well. It is possible that rehabilitation programs can improve long-term health-related QoL and this might favourably affect the older age groups. Thus, it has been shown that 5-year restriction in physical mobility on the NHP was lower among patients undergoing a rehabilitation program after CABG (33).

Limitations

1. We were unable to administer reminders and this might have reduced the response rate to our questionnaire. The low response rate prior to CABG was primarily due to administrative reasons or the fact that emergency surgery was performed, precluding the possibility to make an assessment at short notice. The symptomatic results of CABG in the patients who did not respond to the questionnaires is unknown. Those patients appeared to suffer from more severe coronary artery disease than the responders. Therefore, our results may not be applicable in a totally non-selected population undergoing CABG.
2. The patients were approached with the first questionnaire at the time of coronary angiography, where not only angina pectoris, but also the personal distress of mental preparation for cardiac surgery may have affected health-related QoL scores. However, favourable expectations of the surgical procedure might also have influenced the results.
3. No objective data on long term myocardial function and myocardial ischaemia was available. However, it is important to stress that the major objective of CABG is to relieve symptoms.
4. There was a lack of information regarding lipid management during follow-up.
5. There was no information on the number of patients who underwent rehabilitation programmes.
6. Since there are a total of over 200 tests performed in this study, the increased probability of false significances should be considered. A Bonferroni correction (which is

too conservative to be quite appropriate in this case) would require an uncorrected *p*-value of below 0.0003 for significance at the 0.05 level.

Implications

Our results suggest that the relief of symptoms and improvement in physical activity during long-term follow-up after CABG is similar in elderly patients and younger patients. Improvement in other aspects of health-related QoL, which take into account not only symptoms related to myocardial ischaemia, tended to be less marked in elderly patients. Overall age seemed to have a small impact on the improved well being 5 years after coronary surgery. Due to a limited response rate our results may not be applicable to a non-selected population of CABG patients.

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