# Comparison of the SF-36 health survey questionnaire with the Nottingham Health Profile in long-term survivors of a myocardial infarction

Nigel Brown, Martin Melville, David Gray, Tracey Young, Allan M. Skene and John R. Hampton

## Abstract

**Background** Health-related quality of life, an important outcome measure in health interventions, can readily be assessed by questionnaire. Two widely evaluated examples are the Short Form 36 (SF-36) and Nottingham Health Profile (NHP) questionnaires, but as yet the discriminatory power of these tools has not been compared in a large population of patients with coronary heart disease.

**Methods** All 4-year survivors of a myocardial infarction, identified from the Nottingham heart attack register, were sent the SF-36, NHP and additionally the Rose angina and dyspnoea questionnaires. Mean scores on the SF-36 and NHP were compared with age- and sex-adjusted norms in patients under and over 65 years. Sensitivity of the respective tools was assessed in distinguishing patients with differing degrees of cardiovascular symptomatology.

**Results** In patients under 65 years the SF-36 and NHP differed to the same extent from normative data – scores were lower in the comparable domains physical functioning/mobility, bodily pain/pain and energy/vitality, but not in mental health/emotional reaction scores. In social functioning/social isolation results were disparate – SF-36 scores were lower and the NHP similar to normative data. In patients over 65 years mean scores in all five domains were not significantly different from normative data for either tool. The SF-36 was more sensitive than the NHP at detecting the impact of breathlessness, particularly in patients with mild symptoms. Similarly, the SF-36, but not the NHP, could distinguish the effect of differing degrees of angina severity and frequency on social functioning.

**Conclusion** At least in myocardial infarction survivors, the SF-36 appears a more sensitive tool and may have benefits for assessing health-related quality of life in this patient group.

**Keywords:** myocardial infarction, health-related quality of life, Nottingham Health Profile, SF-36

## Introduction

Traditionally doctors have evaluated the result of medical interventions in terms of effects on major morbidity or mortality, although today, few physicians would doubt the importance of the patients point of view or health-related quality of life as an outcome measure in health interventions.[1] Furthermore, the public health impact of coronary heart disease is generally recognized only in terms of deaths and use of National Health Service resources but not in terms of health-related quality of life. Routine assessment of health-related quality of life could be a useful addition to simple clinical information and routinely collected data, allowing better measurement of the public health impact of disease in survivors. The large numbers of tools available testify to the difficulties in measuring 'perceived health'; some assess the impact of a specific disease and others are intended for general use.

The Quality of Life after Myocardial Instrument (QLMI), developed in Canada and Australia,[2,3] is the only tool designed specifically for use after a myocardial infarction. It was initially developed for a subgroup of patients with psychological upset such as depression and anxiety, and there were concerns about its content validity in women. At the inception of this study the QLMI was still undergoing further evaluation, but this may nevertheless prove to be a useful disease specific tool for future use.

'Generic' questionnaires apply equally to a range of diseases and allow comparison between diseases. The Short Form-36 (SF-36),[4] the Nottingham Health Profile (NHP)[5] and the

[1]Division of Cardiovascular Medicine, University Hospital, Nottingham NG7 2UH.

[2]British Heart Foundation Cardiovascular Statistics Unit, University of Nottingham, Nottingham NG7 2RD.

**Nigel Brown,**[1] Research Fellow in Cardiology

**Martin Melville,**[1] Research Assistant

**David Gray,**[1] Reader in Medicine

**Tracey Young,**[2] Research Assistant

**Allan M. Skene,**[2] Director

**John R. Hampton,**[1] Professor of Cardiology

Address correspondence to Dr N. Brown.

Sickness Impact Profile (SIP)[6] are three of the most widely evaluated. There is considerable merit in using a generic instrument – it is easier for analysts first to become familiar with a single questionnaire than with a range of disease-specific instruments and second to resolve difficulties that may arise in coding and scoring systems resulting from incomplete or missing responses. Results can also be compared with other disease states and with normative controls.

Developed in the United States as part of the Medical Outcomes Study,[4] the SF-36 has been validated in a British population,[7,8] and although to date there are few studies in patients with coronary heart disease, Murdoch et al. showed significant, perhaps unsuspected impairment in health-related quality of life in a group of patients with stable angina not being actively considered for further intervention.[9] The SIP has been used widely for cardiovascular disease,[10–12] but it does take 20–30 minutes to complete its 136 items and we are not aware of any UK population norms. The NHP was developed in Nottingham from factors considered by lay people to be relevant to quality of life; local community norms are available.[13] Widely tested in cardiovascular disease, the NHP appears to correlate strongly with exercise testing in chronic stable angina[14] and with severity of angina as assessed by New York Heart Association criteria.[15] The NHP, however, has been recently criticized for failing to detect lower but potentially important levels of morbidity.[7]

The generic SF-36 and the NHP are user-friendly; even so, there are few data available from comparative studies that indicate the strengths and weaknesses of each questionnaire. Where comparisons have been made using both the SF-36 and NHP they have revealed conflicting results, as both questionnaires may differ in their discriminant ability, depending on the patient population under study. According to the SF-36, mental health scores of patients severely disabled with chronic obstructive pulmonary disease were no different from normative data, whereas the NHP suggested that patients were worse than norms.[16] Both questionnaires, however, appear to discriminate different levels of respiratory impairment,[17] at least in men with chronic lung disease. However, all individual patient populations have their own qualities pertaining to the underlying disease process and consequently questionnaires may be themselves population sensitive.

The aim of our study was to compare directly health-related quality of life, as determined by the SF-36 and the NHP, of patients who had survived a myocardial infarction and whose current morbidity state was known. Previous studies, using different single tools and a selective population of patients who either had been recruited into clinical trials or had been admitted to a coronary care unit, have revealed variable results.[18–20] A recent study of just 28 patients undergoing cardiac rehabilitation suggested that the SF-36 was the preferred, more sensitive instrument compared with the NHP.[21] We are not aware of any similar detailed comparison of the SF-36 and the NHP in a large unselected population of patients with a previous myocardial infarction.

## Methods

### Patients

The methods of data collection for the Nottingham Heart Attack Register, which monitors all patients admitted to the two Nottingham hospitals with suspected acute myocardial infarction, have been described in detail elsewhere.[22] All patients admitted in 1992 with an acute myocardial infarction were identified from the Register. District Health records were scrutinized to ascertain which patients were alive and which dead by August 1996, a median of 4 years after the index event.

The baseline demographic characteristics of those who were still alive were identified from the admission record. Subsequent management and outcome over the 4 years following the index infarction were determined retrospectively from a combination of detailed review of hospital medical records and the general practitioner (GP) notes, the Coroners' reports and information from the Office for National Statistics.

All survivors were invited to complete and return by post a questionnaire containing: (1) a list of basic demographic questions; (2) the Modified Rose angina and dyspnoea scales;[20] (3) the SF-36; (4) the NHP. A covering letter in large type was enclosed, outlining the purpose of the study and including a contact number for enquiries. Respondents were advised that if they needed help to complete the form, this should be documented. A reminder letter with a second questionnaire was sent to non-responders after 2 weeks. The study was approved by the hospital ethical committee.

The SF-36 questionnaire consists of 36 questions or items in eight sections, or domains, and a single question on change in health during the preceding year. Domains measured are: physical functioning (10 items), social functioning (two items), physical role limitations (four items), emotional role limitations (three items), mental health (five items), energy/vitality (four items), bodily pain (two items) and general health perception (five items). In six out of eight domains, responses are recorded on multi-point scales. Each of the scores for the domains were coded, summed and transformed on to a scale from zero (worst possible health) to 100 (best possible health).

The Nottingham Health Profile consists of 38 items categorized into six domains: energy, pain, emotional reactions, sleep, social isolation and physical mobility. The NHP consists of dichotomous 'yes/no' answers to each item. Scores for the NHP are computed and weighted, giving rise to a range of scores from zero (best possible health) to 100 (worst possible health). The scales for the questionnaires run in opposite directions; the maximum score equating to 'best possible health' is thus 100 for the SF-36 and zero for the NHP.

The advice notes supplied with each questionnaire were followed when results were being coded and analysed.[25,26] Provided certain criteria are met, the SF-36 allows the use of averaged scores when some domains have not been fully answered.

Five of the domains of the SF-36 and NHP are similar and these form the basis for the direct comparison reported here. Response and completion rates, validity, correlation coefficients, and the sensitivity and discriminatory ability of the two questionnaires were assessed, together with current cardiovascular symptoms. To estimate the impact of a myocardial infarction on long-term outcome we compared patient scores on the SF-36 for those under 65 years with normative data from Oxford.[27] No definitive normative data exist in the United Kingdom to date for those over 65 years; patient mean scores were compared with baseline data from 8117 respondents to a postal survey of 10 619 patients randomly selected from 12 family doctor registers in Sheffield to be potentially eligible for a randomized trial of exercise in the elderly (J. Munro, unpublished data). NHP scores were compared with 'norms' from Nottingham and Derby.[13]

## SF-36 scores and cardiovascular symptoms when the NHP indicates good health-related quality of life

If the SF-36 and NHP were equivalent in their ability to measure health-related quality of life, patients whose scores indicate good health-related quality of life on one test would record similar scores on the other. At the same time, a clinically useful test would correlate well with cardiovascular symptoms that have previously been shown to be closely associated with health-related quality of life,[19,28] so that patients with angina or breathlessness (or both) would be unlikely to achieve perfect scores on measures of health-related quality of life. Respondents whose NHP score suggested 'good health-related quality of life' were identified and compared with their SF-36 score and symptom ratings. This allowed an assessment of the sensitivity of each tool for each of the comparable domains.

## Statistical analysis

The $\chi^2$ test was used when comparing response rates and the Wilcoxon sign rank test when comparing differences in scores between groups. It was necessary to have some measurement of internal validity because questions on health-related quality of life were not mutually exclusive and some overlap was inevitable; validity was determined using Cronbach's alpha coefficient.[29] Correlation between domains was measured using Spearman's rank correlation coefficient. All tests were two-tailed with a $p$ value <0.05 considered statistically significant. The S-Plus[30] statistical package was used for all analysis.

# Results

## The patient cohort

A total of 960 patients were admitted to the Nottingham hospitals with an acute myocardial infarction in 1992. Of these, 60 patients were excluded from further study, 21 because the index admission had been for a second episode of myocardial

infarction that year and 39 because they lived outside the Nottingham Health District or had been only temporarily resident, or had been miscoded. A total of 205 patients (22.8 per cent) died in hospital during the index admission. Of the 695 who survived to be discharged, follow-up data were obtained on all but one patient. Over a median of 4 years, a further 207 patients died (mortality 16 per cent in the under 65s and 42 per cent in the over 65s), leaving 488 survivors. Nine of these were deemed unable to complete the questionnaire because of serious mental handicap or psychiatric illness and were classified as non-responders. The remaining 479 patients were sent the study questionnaire, although three died after dispatch of, but before being able to complete, the questionnaire, making the number of potential responders 476.

## Demographic characteristics

There were no significant differences in the characteristics of responders and non-responders. Patients who answered both questionnaires had a mean age of 65.98 (SD = 10.29), 274 (66.3 per cent) were male and 51 (12.3 per cent) had a previous myocardial infarction. One hundred and two (24.7 per cent) returned to work following the infarction, 55 (13.3 per cent) could not work as a result of ill health and 231 (55.9 per cent) were retired.

## Response rate to questionnaires

Overall response rates to the full four-part questionnaire were high. A total of 424 patients (89.1 per cent of recipients) returned the questionnaire booklet, 421 of whom had attempted the SF-36 and 413 the NHP. Females under the age of 65 were slightly less likely to respond to the SF-36 questionnaire than those over 65 (78.0 versus 91.2 per cent, $p = 0.045$) although there were no other differences in response rate by age or gender for the health-related quality of life questionnaires. Response rates to the Rose angina and dyspnoea questionnaires were 414 (84.8 per cent) and 407 (83.4 per cent), respectively.

To allow a direct comparison of the SF-36 and the NHP, subsequent results refer only to those 421 patients who attempted both of these questionnaires.

There were no significant differences in response rates for the various comparable domains of the two questionnaires for those aged under and over 65 years (Table 1). The SF-36 was completed by 266 patients (63.2 per cent of recipients of the questionnaire); 304 questionnaires (72.2 per cent) were available for analysis when averaged scores were applied to missing data. All items of the NHP were answered by 306 (74.1 per cent). Patients who completed the whole SF-36 or NHP tended to be younger and were more likely to be male.

## Internal consistency and correlation between quality of life instruments

For the SF-36, with one exception, Cronbach's alpha exceeded the value of 0.8 recommended as indicating internal consistency

**Table 1** Comparison of response rates by age in comparable domains of the SF-36 and Nottingham Health Profile in 4 year survivors of a myocardial infarction (numbers, with percentages given in parentheses)

| | SF-36 | | | | | NHP | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Physical functioning | Bodily pain | Vitality | Social functioning | Mental health | Physical mobility | Pain | Energy | Social isolation | Emotional reaction |
| Under 65 years | 158 (95.2) | 166 (100.0) | 161 (97.0) | 166 (100.0) | 160 (96.4) | 144 (86.7) | 142 (85.5) | 151 (91.0) | 149 (89.8) | 144 (86.7) |
| 65 years or over | 236 (95.5) | 246 (99.6) | 231 (93.5) | 244 (98.8) | 227 (91.9) | 215 (87.0) | 200 (81.0) | 219 (88.7) | 213 (86.2) | 205 (83.0) |
| $p$ | 0.948 | n.a. | 0.179 | n.a. | 0.103 | 0.951 | 0.283 | 0.558 | 0.360 | 0.371 |

n.a., not applicable (numbers too small for $\chi^2$ test to be valid).

**Table 2** Spearman rank-correlation coefficients for the comparable scales of the SF-36 and NHP in 4 year survivors of acute myocardial infarction (coefficients between domains for the two questionnaires are negative as scales run in opposite directions; see text)

| | SF-36 | | | | | NHP | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Physical functioning | Bodily pain | Vitality | Social functioning | Mental health | Physical mobility | Pain | Energy | Social isolation | Emotional reaction |
| *SF-36* | | | | | | | | | | |
| Physical functioning | 1.00 | | | | | | | | | |
| Bodily pain | 0.63 | 1.00 | | | | | | | | |
| Vitality | 0.58 | 0.57 | 1.00 | | | | | | | |
| Social functioning | 0.63 | 0.68 | 0.61 | 1.00 | | | | | | |
| Mental health | 0.40 | 0.42 | 0.60 | 0.59 | 1.00 | | | | | |
| *NHP* | | | | | | | | | | |
| Physical mobility | **−0.73** | −0.68 | −0.52 | −0.61 | −0.40 | 1.00 | | | | |
| Pain | −0.63 | **−0.70** | −0.48 | −0.57 | −0.38 | 0.78 | 1.00 | | | |
| Energy | −0.57 | −0.60 | **−0.65** | −0.61 | −0.50 | 0.69 | 0.66 | 1.00 | | |
| Social isolation | −0.41 | −0.44 | −0.41 | **−0.52** | −0.49 | 0.56 | 0.54 | 0.62 | 1.00 | |
| Emotional reactions | −0.44 | −0.51 | −0.50 | −0.59 | **−0.61** | 0.56 | 0.57 | 0.67 | 0.65 | 1.00 |

Correlation coefficients for comparable domains of the two questionnaires are shown in bold type.

**Table 3** Descriptive statistics for the comparable domains of the SF-36 and NHP in 4 year survivors of a myocardial infarction

| | Physical functioning/ mobility | | Bodily pain/ Pain | | Vitality/ Energy | | Social functioning/ Social isolation | | Mental health/ Emotional reaction | |
|---|---|---|---|---|---|---|---|---|---|---|
| | SF-36 | NHP | SF-36 | NHP | SF-36 | NHP | SF-36 | NHP | SF-36 | NHP |
| n | 350 | 350 | 341 | 341 | 357 | 357 | 359 | 359 | 337 | 337 |
| Mean | 57.86 | 82.01 | 66.81 | 84.03 | 50.63 | 69.64 | 75.87 | 91.84 | 73.14 | 86.75 |
| SD | 31.91 | 24.58 | 29.34 | 26.67 | 22.95 | 36.92 | 28.18 | 19.07 | 18.76 | 21.49 |
| Median | 65 | 100 | 72 | 100 | 50 | 76 | 88 | 100 | 76 | 100 |
| IQR | 30, 69 | 67, 100 | 41, 100 | 79, 100 | 35, 65 | 39, 100 | 63, 100 | 100, 100 | 60, 88 | 83, 100 |
| Range | 0, 100 | 0, 100 | 0, 100 | 0, 100 | 0, 100 | 0, 100 | 0, 100 | 0, 100 | 8, 100 | 0, 100 |
| % ceiling | 6.00 | 51.14 | 30.21 | 56.30 | 0.56 | 48.46 | 44.46 | 78.83 | 3.86 | 53.12 |
| % floor | 5.71 | 0.57 | 2.05 | 3.52 | 1.96 | 15.13 | 1.67 | 1.11 | 0.30 | 1.19 |
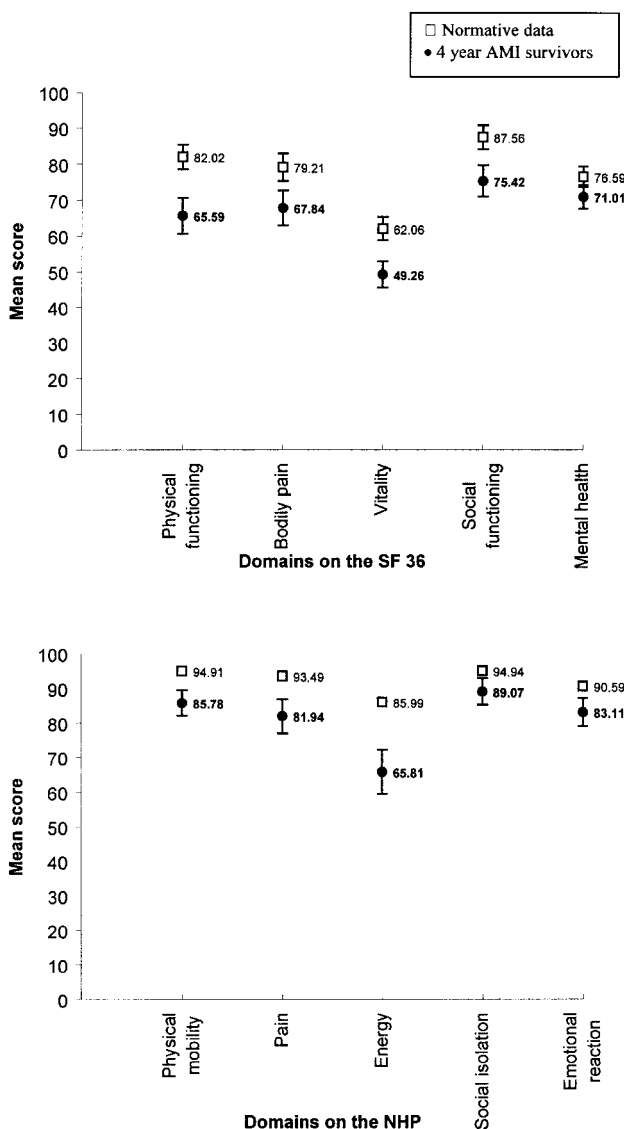


**Figure 1** Comparison of SF-36 and NHP mean scores (95 per cent CI) for 4 year acute myocardial infarction (AMI) survivors aged under 65 years with general population 'norms' adjusted to have a similar age and sex distribution.

of items in the same domain.[31] The exception was the mental health domain for patients over 65 years, where Cronbach's alpha was 0.74.

For the Nottingham Health Profile, the internal validity of items in the domains energy and social isolation was less than 0.8 but still exceeded 0.7.

For all but one of the comparable domains, alpha coefficients of the SF-36 were higher than those for the NHP. Emotional reaction on the NHP had a higher alpha coefficient than the SF-36's mental health domain.

All domains were significantly correlated with each other, with Spearman's correlation coefficients exceeding 0.3 for all domains in both the SF-36 and NHP (Table 2). Correlation coefficients were highest for comparable domains with the exception of the social functioning/isolation domain, suggesting that the constituent items may be addressing somewhat different aspects of social 'health'.

### Prevalence of symptoms of angina and dyspnoea

Four years after the acute admission, 46 (11.1 per cent) patients had grade 1 (mild angina) angina classified according to the Rose questionnaire, 42 (10.1 per cent) grade 2 (moderate to severe) angina and 71 (17.1 per cent) 'possible angina'.[32] Seventy-four patients (17.9 per cent) had non-exertional chest pain and 181 (43.7 per cent) survivors reported that they were free of chest pain symptoms. Of 159 patients with chest pain on exertion, 42 (26.9 per cent) had pain less than once a week, 57 (36.7 per cent) once or twice a week, 51 (32.7 per cent) had chest pain at least three times a week and nine patients did not record frequency. One hundred and fifty-six (37.8 per cent) patients had no symptoms of dyspnoea, 72 (17.4 per cent) had mild (grade 1) breathlessness and 170 (41.2 per cent) more severe symptoms. More patients were free from chest pain in the over 65 cohort than those under 65 years (47.0 vs 36.1 per cent, $p < 0.001$). However, more patients under 65 years were free from dyspnoea compared to the older cohort (45.2 vs 32.8 per cent, $p = 0.011$). Sixteen per cent of patients described their main limitation as unrelated to chest pain or dyspnoea. The majority of these patients had arthritis.
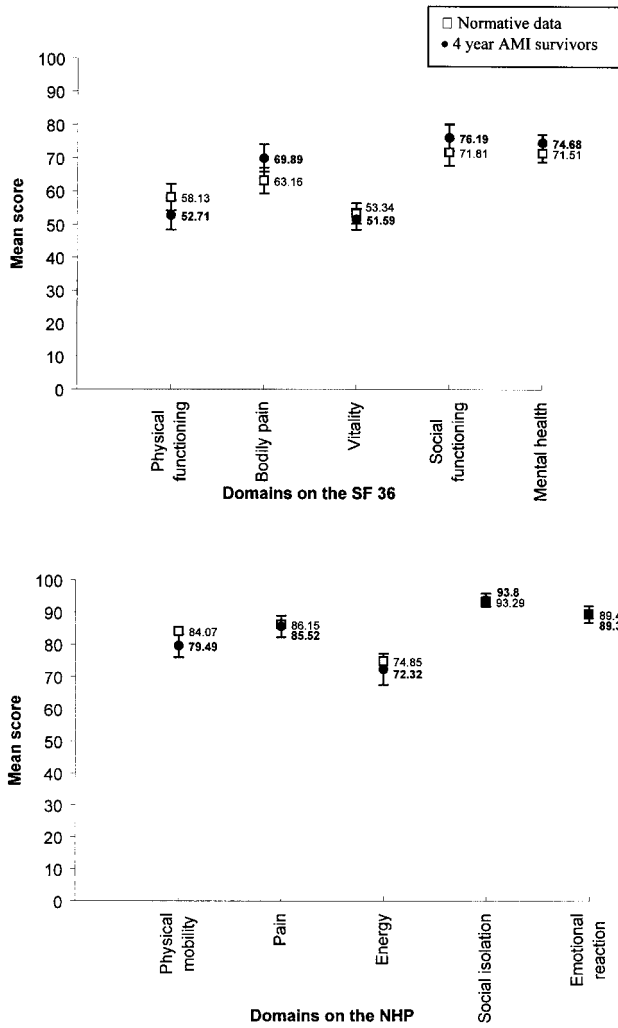
**Figure 2** Comparison of SF-36 and NHP mean scores (95 per cent CI) for 4 year acute myocardial infarction (AMI) survivors aged 65 years or over with general population 'norms' adjusted to have a similar age and sex distribution.

## Health-related quality of life scores

Table 3 details the distribution of scores recorded for those domains of the SF-36 and the NHP that were comparable. As the SF-36 and NHP scoring scales run in opposite direction, scores for the NHP were subtracted from 100 to allow direct comparison. The distributions of the SF-36 scores were in general less skewed than those of the NHP scores. For all domains, both mean and median domain scores were higher for the NHP than the SF-36. For the domains physical mobility, bodily pain, social isolation and emotional reaction, the NHP showed a marked 'ceiling effect' – that is, most respondents achieved the maximum score, indicating that their health-related quality of life was good. Few respondents achieved a maximum score on the SF-36, so few felt that they enjoyed 'best possible' health.

**Table 4** Mean scores (standard deviation) for patients with variable cardiac symptoms for comparable domains of the SF-36 and NHP in 4 year survivors of a myocardial infarction

| | SF-36 Physical functioning | NHP Physical mobility | SF-36 Bodily pain | NHP Pain | SF-36 Vitality | NHP Energy | SF-36 Social functioning | NHP Social isolation | SF-36 Mental health | NHP Emotional reaction |
|---|---|---|---|---|---|---|---|---|---|---|
| *Dyspnoea* | | | | | | | | | | |
| Grade 0 | 74.8 (28.3) | 91.5 (19.6) | 78.2 (26.3) | 90.0 (24.1) | 61.6 (20.6) | 86.4 (26.7) | 84.2 (24.4) | 93.3 (17.7) | 76.4 (17.8) | 91.0 (17.0) |
| Grade 1 | 65.4 (23.7) | 90.7 (17.6) | 68.8 (28.8) | 91.1 (21.1) | 55.4 (16.9) | 86.0 (21.7) | 86.0 (18.0) | 97.3 (9.8) | 77.9 (16.4) | 93.3 (12.6) |
| Grade ≥2 | 37.7 (26.3) | 69.1 (24.7) | 53.6 (26.9) | 75.4 (27.6) | 38.6 (21.0) | 46.8 (38.1) | 63.7 (29.3) | 88.5 (22.1) | 68.1 (19.8) | 90.2 (25.9) |
| *Angina* | | | | | | | | | | |
| No pain | 69.1 (30.6) | 88.0 (22.3) | 76.5 (29.6) | 87.5 (26.5) | 60.1 (20.6) | 83.7 (28.7) | 83.3 (26.2) | 92.8 (18.2) | 77.3 (16.9) | 91.2 (17.7) |
| Non-exertional pain | 61.9 (32.8) | 80.6 (27.1) | 65.6 (30.4) | 82.6 (30.1) | 47.0 (21.6) | 71.2 (37.6) | 73.0 (30.5) | 90.9 (20.6) | 69.8 (19.0) | 83.7 (22.3) |
| Grade 1 | 58.5 (22.2) | 87.8 (17.4) | 64.2 (22.2) | 90.0 (14.7) | 51.6 (20.6) | 65.4 (35.7) | 78.1 (23.4) | 94.2 (13.8) | 72.9 (18.4) | 87.7 (17.3) |
| Grade 2 | 32.1 (24.5) | 67.6 (25.1) | 49.2 (20.3) | 77.0 (26.4) | 35.8 (22.3) | 44.4 (40.3) | 61.4 (23.3) | 93.6 (16.6) | 73.0 (17.2) | 86.8 (21.8) |
| Possible angina | 39.4 (26.2) | 72.7 (24.4) | 49.9 (24.7) | 75.8 (27.6) | 39.2 (21.9) | 52.6 (39.1) | 63.9 (31.1) | 88.3 (24.2) | 65.1 (23.1) | 76.2 (30.6) |
| *Frequency of pain/week* | | | | | | | | | | |
| <1 per week | 53.9 (25.5) | 84.0 (22.8) | 71.8 (21.6) | 91.3 (12.5) | 55.0 (18.0) | 67.6 (36.7) | 76.7 (28.6) | 92.8 (19.6) | 74.6 (19.6) | 86.8 (21.5) |
| 1–2 times per week | 41.9 (24.9) | 74.7 (22.3) | 52.5 (18.4) | 79.5 (26.3) | 40.6 (20.1) | 55.6 (38.3) | 66.8 (27.1) | 90.4 (20.9) | 69.3 (20.1) | 84.4 (24.6) |
| ≥3 times per week | 32.5 (24.9) | 68.9 (24.9) | 43.1 (21.7) | 74.8 (26.2) | 31.9 (21.8) | 41.1 (37.4) | 61.3 (25.0) | 91.4 (18.9) | 66.2 (21.1) | 78.9 (26.4) |

**Table 5** Analysis of cardiovascular symptoms for patients scoring zero (best possible health) and less than 100 (less than best possible health) according to the NHP: comparison of patients with a SF-36 score of 100 (best possible health) and less than 100 (less than best possible health) (numbers, with percentages given in parentheses, unless stated otherwise)

| | Mean (SD) SF-36 score | n | Dyspnoea (if <100) | Angina grade ≥2 | Angina grade 1 | Atypical grade 2 | Pain frequency chest pain | Pain frequency 1–2 times/week | ≥3 times/week |
|---|---|---|---|---|---|---|---|---|---|
| Physical functioning score | 100 | 21 | – | 0 | 1 (4.8) | 0 | 2 (9.5) | 0 | 0 |
| | <100 | 158 | 77.4 (18.0) | 26 (16.5) | 19 (12.0) | 7 (4.4) | 40 (25.3) | 14 (8.9) | 8 (5.1) |
| Bodily pain score | 100 | 96 | – | 13 (13.5) | 4 (4.2) | 1 (1.0) | 14 (14.6) | 0 | 1 (1.0) |
| | <100 | 96 | 67.4 (16.8) | 23 (24.0) | 12 (12.5) | 9 (9.4) | 36 (37.5) | 19 (19.8) | 8 (8.3) |
| Vitality score | 100 | 2 | – | 0 | 0 | 0 | 0 | 0 | 0 |
| | <100 | 171 | 65.94 (15.37) | 26 (15.2) | 13 (7.6) | 8 (4.7) | 46 (26.9) | 15 (8.8) | 7 (4.1) |
| Social functioning score | 100 | 155 | – | 31 (20.0) | 14 (9.0) | 5 (3.2) | 39 (25.2) | 13 (8.4) | 5 (3.2) |
| | <100 | 128 | 62.7 (20.6) | 67 (52.3) | 19 (14.8) | 22 (17.2) | 47 (36.7) | 27 (21.1) | 30 (23.4) |
| Mental health score | 100 | 12 | – | 2 (16.7) | 0 | 2 (16.7) | 2 (16.7) | 1 (8.3) | 1 (8.3) |
| | <100 | 167 | 81.8 (11.9) | 50 (29.9) | 18 (10.8) | 13 (7.8) | 43 (25.7) | 25 (15.0) | 10 (6.0) |

*Comparison with normative data*

Figure 1 shows clearly that according to the SF-36 patients under the age of 65 years exhibit significant impairment in quality of life in all domains except mental health. Although data to calculate confidence intervals for the NHP normative data are unavailable, the figure shows that differences with lower scores are likely in the domains physical mobility, pain and energy, but not social isolation or emotional reaction.

Both the SF-36 and NHP provide similar results for those over 65 years, with no difference between patient scores and 'normals' (Fig. 2).

*Sensitivity and discriminatory power of SF-36 and NHP in detecting cardiovascular symptoms*

Table 4 details mean scores for patients with various degrees of cardiovascular symptoms as judged by the modified Rose angina and dyspnoea questionnaires and documented pain frequency. Comparing physical functioning/physical mobility, bodily pain/pain and vitality/energy domains, the SF-36 was, and the NHP was not, able to distinguish patients with no breathlessness compared with those with mild symptoms of breathlessness ($p$ ranging from <0.05 to <0.001 for SF-36 domains/not significant for NHP domains). There were no major differences in the questionnaires' ability to distinguish patients with varying degrees of angina severity or frequency in these domains, both tools showing in general lower scores with increasing severity and frequency of angina.

Results comparing the social functioning/isolation domains revealed striking differences; although both tools could identify patient groups with more severe breathlessness, only the SF-36 was able to distinguish patients with varying degrees of severity of chest pain.

There were few differences in the mental health/emotional role domain for patients with chest pain, although the SF-36 was again better at distinguishing the effects of dyspnoea on mental health.

Many respondents scored a maximum on the NHP (implying good health) when their corresponding SF-36 scores for comparable domains were not maximum. Table 5 details mean SF-36 scores for these patients confirming that a substantial number would be classed as having best possible health according to the NHP despite having poorer health-related quality of life according to the SF-36 and an appreciable prevalence of angina, dyspnoea or both. Only a small number ($n = 13$) had best possible health according to the SF-36 but not the NHP. Very few patients with best possible health on both tools had cardiovascular symptoms.

## Discussion

Life-threatening illness affects patients very differently. Co-morbid conditions, pre-morbid activities, current lifestyle and personal (and family) expectations are so diverse that a brief

review of symptoms in a hospital clinic or GP surgery gives a limited perspective of the impact of a major illness such as myocardial infarction on health-related quality of life.

Few patients will have any experience of health-related quality of life questionnaires so we were reassured to see the high response rates for both the SF-36 and the NHP; this suggests that questionnaires of this type would be acceptable to patients, even those whose event was some time previously. Elderly patients were more likely to leave either questionnaire incomplete, in particular the SF-36. The SF-36 was initially developed as an administered rather than self-completed questionnaire so completion rates might be improved by inter-viewer administration, particularly in the elderly, as suggested elsewhere.[33] Our study used averaged scores for missing data, which allowed domain scores to be calculated for those who answered more than 50 per cent of items per domain; never-theless, mean scores were reassuringly very similar irrespective of whether averaged scores were computed or not. Concentra-tion is clearly important when filling in forms. The SF-36 appeared in our booklet before the NHP, which may explain the slightly higher response rate in SF-36. Placing the NHP before the SF-36 might have had some impact on response rates.

Clinical assessment is the standard method of determining whether a patient has made a full recovery from illness. Our study has shown that patients are generally capable of com-pleting a fairly complex batch of questionnaires reliably, providing current clinical information in addition to an assess-ment of their heealth-related quality of life. In particular, the SF-36 does correlate well with varying degrees of symptom severity and appears to have sufficient sensitivity (at least in 4 year survivors of an infarct) to be clinically useful and could be considered an adjunct to clinical review. Rose angina and dyspnoea questionnaires were used as a marker of clinical symptomatology, as without interview on the day of ques-tionnaire completion it would be impossible to be confident that symptoms had not changed since last clinical review. Although criticism has previously been directed at the Rose angina tool for only identifying patients with classical angina,[34] the questions are little different to those asked in clinical practice and we feel are a useful if not perfect substitute under these circumstances. Furthermore, conventional clinical status assessment is not without limitation.[35]

Both the SF-36 and NHP reveal that, at least in 4 year survivors over 65 years, there are no detectable differences between patients and 'norms', although this could relate to a 'healthy survivor effect' and/or differing expectations of the elderly. For those patients aged under 65 years both the SF-36 and NHP suggest significant differences, with lower health-related quality of life compared with norms in the physical functioning, pain and energy domains, but only the SF-36 shows worse scores in social functioning/isolation. Of all comparable domains the correlation coefficient is lowest here and the two tools are likely to be measuring different aspects of social functioning. Whilst there are some issues concerning the

representativeness of the Oxford norms and possible regional differences,[36] comparable Oxford and Sheffield data for the under 65s are more notable for similarities rather than differences in domain scores.[37]

Patients with previous myocardial infarction may have risk factors such as diabetes, hypertension, obesity, smoking and other co-morbidity. A small proportion of patients (16 per cent) described their main limitation as unrelated to chest pain or dyspnoea, many citing 'arthritis' or mechanical back pain as limiting physical activity. The addition of a disease specific questionnaire to a single generic tool may allow determination of the contribution of co-morbidity to health-related quality of life in future work but was felt impractical in the present study. Our questionnaire was already lengthy and addition of a further questionnaire would have increased the likelihood of lower completion rates and non-response. Nevertheless, the SF-36 appears to be a more sensitive tool than the Nottingham Health Profile, which failed to identify people still troubled with angina or breathlessness (or both), who managed to achieve a maximum score, indicating best possible health, on the NHP. Furthermore, the sensitivity of the SF-36 in detecting lower levels of morbidity as shown in other patient groups[7] was highlighted. Our study suggests that among survivors of acute myocardial infarction, the SF-36 offers clinically relevant and important advantages over the NHP. If one tool were to be recommended for routine use in post-infarct patients, and so more likely to be adopted for formal routine assessment of quality of life, the SF-36 appears to be more useful than the NHP.

## Acknowledgements

## References

1 Wenger NK, Mattson ME, Furberg CD, Elinson J. *Assessment of quality of life in clinical trials of cardiovascular therapies.* New York: Le Jacq, 1984.

2 Hillers TK, Guyatt GH, Oldridge N, *et al.* Quality of life after myocardial infarction. *J Clin Epidemiol* 1994; **47:** 1287–1296.

3 Lim LLY, Valenti LA, Knapp JC, *et al.* A self-administered quality-of-life questionnaire after acute myocardial infarction. *J Clin Epidemiol* 1993; **46:** 1249–1256.

4 Ware JE, Jr, Sherbourne CD. The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. *Med Care* 1992; **30:** 473–483.

5 Hunt SM, McEwen J, McKenna SP. *Measuring health status.* London: Croom Helm, 1986.

6 Bergner M, Bobbitt RA, Carter WB, Gilson BS. The Sickness Impact Profile: development and final version of a health status measure. *Med Care* 1981; **19:** 787–805.

7 Brazier JE, Harper R, Jones NMB, *et al*. Validating the SF-36 health survey questionnaire: new outcome measure for primary care. *Br Med J* 1992; **305:** 160–164.

8 Ruta D, Garratt A, Abdalla M, Buckingham K, Russell I. The SF-36 health survey questionnaire: a valid measure of health status . . . (21). *Br Med J* 1993; **307:** 448–449.

9 Murdoch DL, Lawrence A, Henderson E, *et al*. Quality of life in chronic stable angina. *Eur Heart J* 1996; **17**(Abstr. Suppl.): 240.

10 Vandenburg MJ. Measuring quality of life of patients with angina. In: Walker SR, Rosser RM, eds. *Quality of life assessment: key issues in the 1990s*. Dordrecht: Kluwer Academic, 1993.

11 Ott CR, Sivarajan ES, Newton KM, *et al*. A controlled randomized study of early cardiac rehabilitation: the Sickness Impact Profile as an assessment tool. *Heart Lung* 1983; **12:** 162–170.

12 Bergner L, Hallstrom AP, Bergner M, *et al*. Health status of survivors of cardiac arrest and of myocardial infarction controls. *Am J Publ Hlth* 1985; **75:** 1321–1323.

13 Hunt SM, McEwen J, McKenna SP. Perceived health: age and sex comparisons in a community. *J Epidemiol Commun Hlth* 1984; **38:** 156–160.

14 Permanyer-Miralda G, Alonso J, Anto JM, Alijarde-Guimera M, Soler-Soler J. Comparison of perceived health status and conventional functional evaluation in stable patients with coronary artery disease. *J Clin Epidemiol* 1991; **44:** 779–786.

15 Visser MC, Fletcher AE, Parr G, Simpson A, Bulpitt CJ. A comparison of three quality of life instruments in subjects with angina pectoris: the sickness impact profile, the Nottingham health profile, and the quality of well being scale. *J Clin Epidemiol* 1994; **47:** 157–163.

16 Crockett AJ, Cranston JM, Moss JR, Alpers JH. The MOS SF-36 health survey questionnaire in severe chronic airflow limitation: comparison with the Nottingham Health Profile. *Quality Life Res* 1996; **5:** 330–338.

17 Prieto L, Alonso J, Ferrer M, *et al*. Are results of the SF-36 health survey and the Nottingham Health Profile similar?: a comparison in COPD patients. *J Clin Epidemiol* 1997; **50:** 463–473.

18 Glasziou PP, Bromwich S, Simes RJ. Quality of life six months after myocardial infarction treated with thrombolytic therapy. AUS-TASK Group. Australian arm of International tPA/SK Mortality Trial. *Med J Australia* 1994; **161:** 532–536.

19 Wiklund I, Herlitz J, Hjalmarson A. Quality of life five years after myocardial infarction. *Eur Heart J* 1989; **10:** 464–472.

20 Finlayson A, McEwen J. *Coronary heart disease and patterns of living*. London: Croom Helm, 1977.

21 Dempster M, Bradley J, Wallace E, McCoy P. Measuring quality of life in cardiac rehabilitaion: comparing the Short Form 36 and the Nottingham Health Profile. *Coronary Health Care* 1997; **1:** 211–217.

22 Gray D, Keating NA, Murdock J, Skene AM, Hampton JR. Impact of hospital thrombolysis policy on out-of-hospital response to suspected myocardial infarction. *Lancet* 1993; **341:** 654–657.

23 Rose G, McCartney P, Reid DD. Self-administration of a questionnaire on chest pain and intermittent claudication. *Br J Prev Social Med* 1977; **31:** 42–48.

24 Rose GA. *Cardiovascular survey methods*. 2nd edn. Geneva: World Health Organization, 1982.

25 Hunt S, McKenna S. *The Nottingham health profile user's manual*. Manchester: Galen Research and Consultancy, 1991.

26 Ware JE, Snow KK, Kosinski M, Gandek B. *SF-36 health survey manual and interpretation guide*. Boston, MA: The Health Institute, 1993.

27 Jenkinson C, Coulter A, Wright L. Short form 36 (SF-36) health survey questionnaire: normative data for adults of working age. *Br Med J* 1993; **306:** 1437–1440.

28 Pocock SJ, Henderson RA, Seed P, Treasure T, Hampton JR. Quality of life, employment status, and anginal symptoms after coronary angioplasty or bypass surgery: 3-year follow-up in the randomized intervention treatment of angina (RITA) trial. *Circulation* 1996; **94:** 135–142.

29 Cronbach LJ. Coefficient alpha and the internal structure of tests. *Psychometrica* 1951; **16:** 297–333.

30 *S-plus guide to statistical and mathematical analysis* (program), version 3.2. Seattle: Statistical Sciences, Inc., 1993.

31 Bland JM, Altman DG. Cronbach's alpha. *Br Med J* 1997; **314:** 572.

32 Cook DG, Shaper AG, Macfarlane PW. Using the WHO (Rose) angina questionnaire in cardiovascular epidemiology. *Int J Epidemiol* 1989; **18:** 607–613.

33 Brazier JE, Walters SJ, Nicholl JP, Kohler B. Using the SF-36 and Euroqol on an elderly population. *Quality Life Res* 1996; **5:** 195–204.

34 Berman DM, Brook RH, Lohr KN, *et al. Conceptualisation and measurement of physiologic health for adults: Vol. 4, Angina.* Santa Monica, CA: Rand Corporation, 1981.

35 Goldman L, Hashimoto B, Cook EF, Loscalzo A. Comparative reproducibility and validity of systems for assessing cardiovascular functional class: advantages of a new specific activity scale. *Circulation* 1981; **64:** 1227–1234.

36 Sheldon T. Measuring patients' views of their health: Reliability of SF 36 remains uncertain (11). *Br Med J* 1993; **307:** 125–126.

37 Jenkinson C, Wright L, Coulter A. The SF 36 health survey questionnaire: . . . if used within its limits (22). *Br Med J* 1993; **307:** 449.