Chapter 9: Knee Study: Baseline Findings

Introduction:

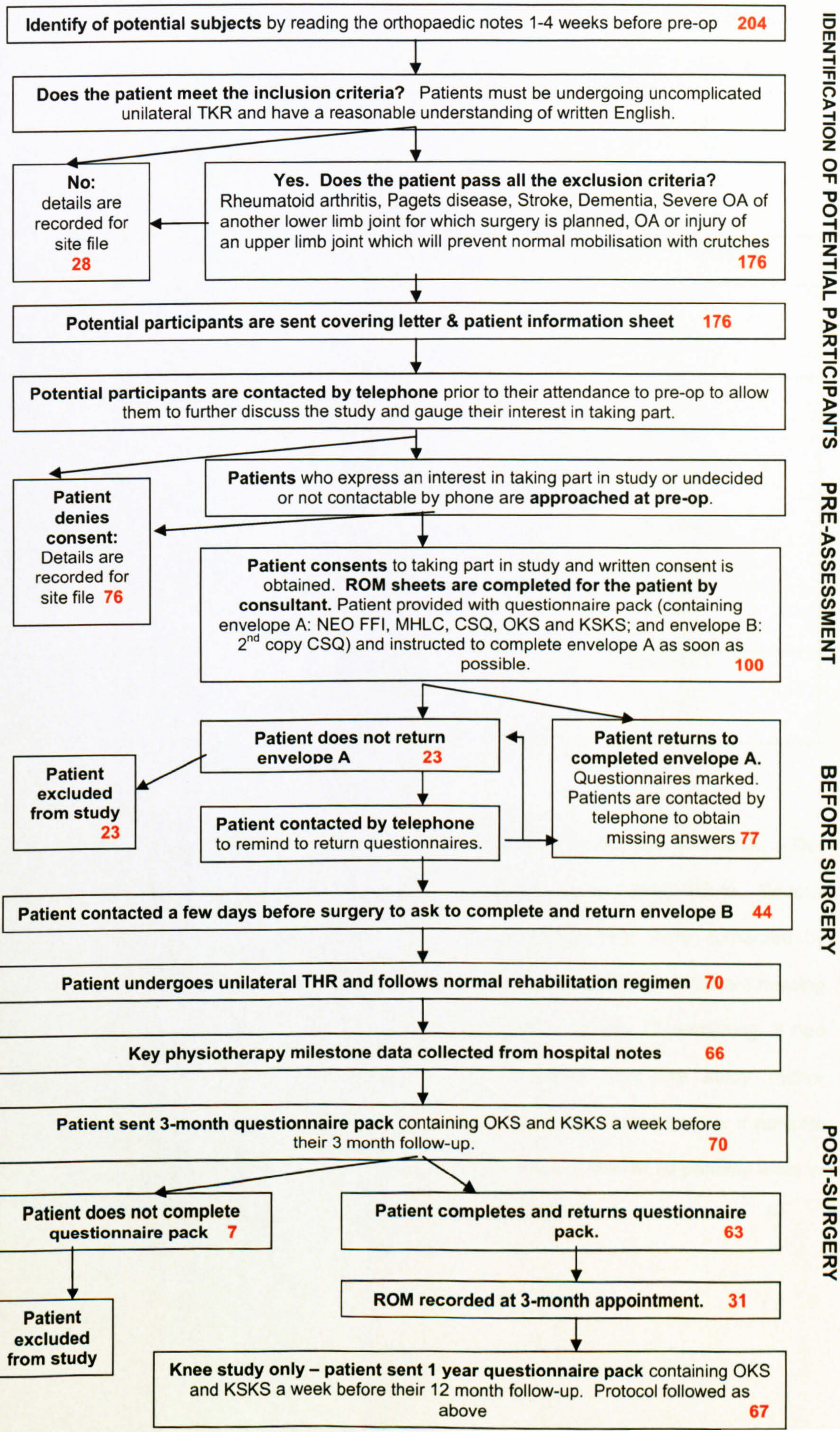
This chapter will report the:

- Recruitment and retention of participants in the knee study.
- Demographics of participants in the knee study.
- Baseline orthopaedic characteristics of participants in the knee study.
- Psychological characteristics of participants in the knee study.
- The relationship between psychological factors and activity limitation and participation restriction pre-operatively.
- The relationship between psychological factors and pain with activity limitation and participation restriction pre-operatively.

Recruitment and Retention of Study Participants

Figure 9.1 summarises the number of patients recruited to and retained on the knee study. The numbers of participants at each stage are in red. Note: participants were sent the 1-year questionnaire for completion independent of whether they returned their three-month post-operative questionnaire.

Figure 9.1: Flow chart of patient recruitment and retention to knee study (shown in red)



Demographics

One hundred patients were recruited to the study. Details of the recruitment process can be found in Chapter 3. The demography of this group of patients is summarised in Table 9.1.

Table 9.1: Demography of subjects consented to study

Demographic Factor		Number of Subjects
Gender	Male	44 (44%)
	Female	56 (56%)
Age category	40-49	1 (1%)
	50-59	8 (8%)
	60-69	36 (36%)
	70-79	38 (38%)
	80-89	16 (16%)
	90+	1(1%)
Ethnicity	White	99 (99%)
	Black or Black British	1 (1%)

Of the 100 patients consented to the study, 20 failed to return their questionnaires. This included the lady of Black ethnic origin thus making the study sample entirely White. Several patients returned incomplete questionnaires. In these instances they were contacted by telephone in order to obtain missing answers. In 3 cases it was not possible to obtain missing data and therefore these patients were excluded from the study. Of the 77 remaining, 3 had their surgery cancelled and further 4 patients were excluded from the study (either retrospectively and excluded for reasons that were missed at the time of consent or if patients did not have their surgery within the timeframe of the study). Thus, a total of 70 patients were in this study population. The demography is summarised in Table 9.2.

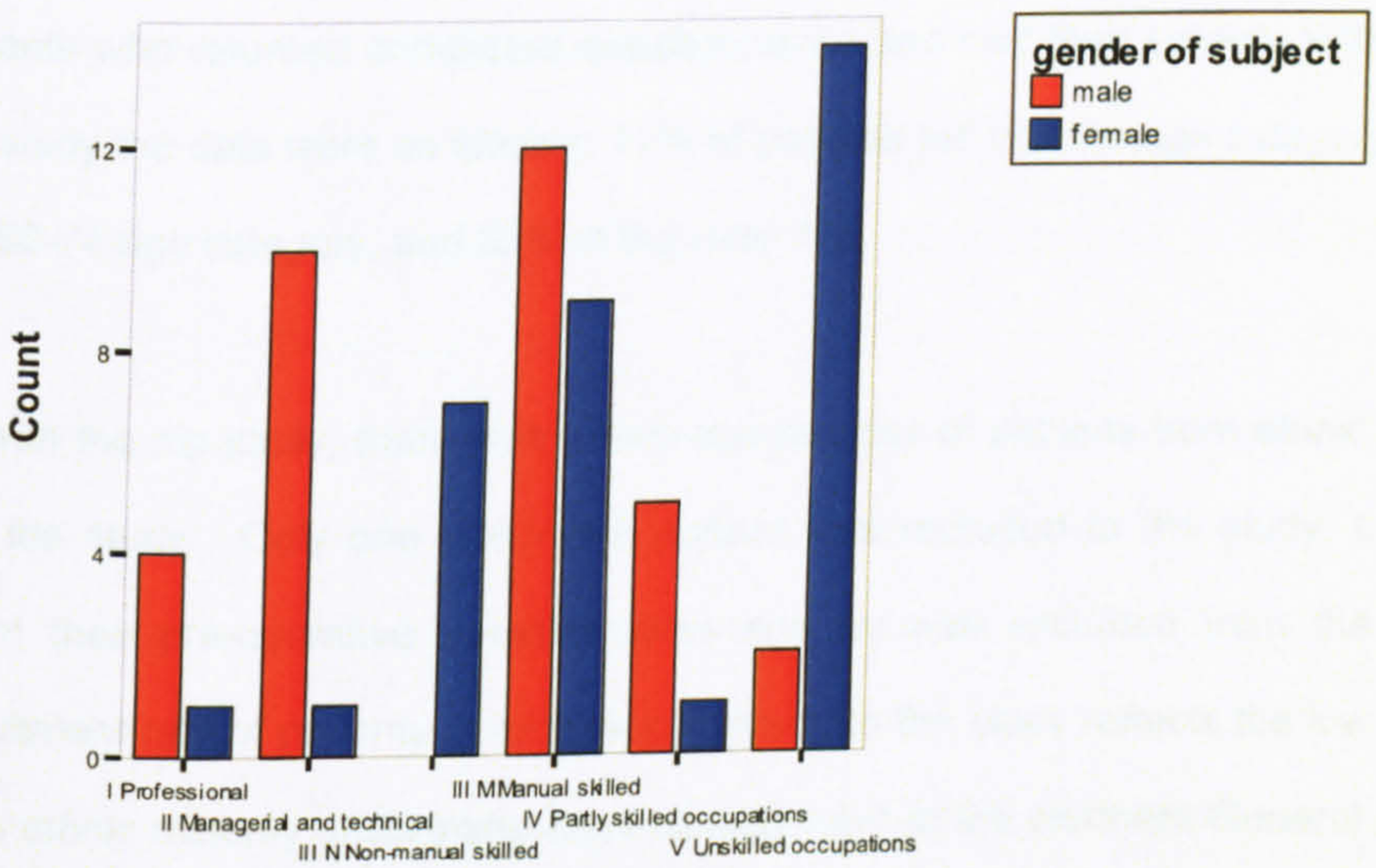
Table 9.2: Demography of subjects who returned completed questionnaires and had their surgery within the timeframe of the study

Demographic Factor		Number of Subjects
Gender	Male	34 (49%)
	Female	36 (51%)
Age category	40-49	1 (1%)
	50-59	7 (10%)
	60-69	26 (37%)
	70-79	27 (39%)
	80-89	9 (13%)
Employment status of subject	Employed	10 (14%)
	Unemployed	3 (4%)
	Retired	57 (82%)
Highest education level achieved	No further education	32 (46%)
	Other	24 (34%)
	'A' level	9 (13%)
	Degree	2 (3%)
	Post-graduate	3 (4%)
Social Class	I Professional	5 (7%)
	II Managerial and technical	11 (16%)
	III N Non-manual skilled	7 (10%)
	III M Manual skilled	21 (30%)
	IV Partially skilled occupations	6 (9%)
	V Unskilled occupations	16 (23%)
	Missing	4 (5%)

Note: No further education refers to education after leaving school. Age left school in this population ranged between 13-17. Other education refers to any other education (e.g. professional exams etc.) not covered by 'A' level degree and post-graduate.

The social class classification is based on an individual's employment or previous employment for retired participants. It was not possible to classify participants who had never worked. These are summarised in Table 9.2 as missing. These individuals will be excluded from regression analyses involving social class as the independent variable

Figure 9.2: Gender difference in social class groupings



Discussion

As in the hip study, the reasons for recording of demographic variables in this study were twofold: first, it would enable the assessment of whether the results are applicable to the wider population of total knee replacement patients, and second, some demographic variables are associated with different outcomes, and so these will be entered into the multiple regression analyses. The discussion here deals with the first of these reasons.

The gender split of patients in the study (49% male, 51% female) is similar to the age-standardized rates per 100,000 population of primary knee replacements for the Trent region reported by Dixon et al. (2006). They reported that 72.2 males per 100,000 population and 80.0

females per 100,000 population underwent total knee replacements in the year 2000. This equates to 47% of total knee replacements being carried out on male patients and 53% female patients.

The distribution of subjects across different age categories is comparable with the information published on the age categories of patients undergoing total prosthetic replacement of knee joint (W40-W42) from the Hospital Episode Statistics (HES) for NHS hospitals in England for the year 2004-05 (Department of Health 2005). HES reported that 13% of the patients are aged 15 to 59, 52% are aged 60-74, and 35% fall into the over 75 category. Comparatively, for the study patients who returned completed questionnaires and had their surgery within the time frame of the study the data were as follows: 11% of patients fell into the age category of 15-59, 53% into the 60-74 age category, and 36% in the over 75s.

As with the hip study, there was a very low number of patients from ethnic minorities recruited into the study. Only one non-White patient was recruited to the study; this patient failed to return their pre-operative questionnaires and so was excluded from the study. The low recruitment rate of patients of an ethnic minority to the study reflects the low number of patients of an ethnic minority undergoing knee replacement at the Northern General Hospital. Only two patients of an ethnic minority (Black or Black British) met the inclusion criteria, a further two patients of an ethnic minority (both Asian) were excluded from partaking in the study as they did not speak English. The low rate of uptake of knee replacement among ethnic minorities has been frequently noted in the literature, and several theories as for the reason to this have been put forward.

Ibrahim et al. (2002) suggested that the difference of uptake of TJA is a result of lower levels of familiarity with TJA in Black populations. They reported that Black patients were less likely to be familiar with TJA expecting more severe post-surgical pain and difficulty walking. In addition, Ibrahim et al. (2001) reported that African American patients were more likely (than White patients) to consider other treatments such as over the counter remedies, applying medicated

cream, seeking advice from friends and family, and seeking treatment by a chiropractor or physical therapist treatment.

Many of these findings were replicated by Figaro et al. (2004) who completed a qualitative analysis exploring reasons why urban African Americans are unwilling to undergo TKR. The analysis yielded 6 themes which were: preference for natural remedies, negative expectations of surgery, beliefs about God's control, preferences for continuing in their current state, relationships with specialists, and fear of surgery or death. The authors identified "I don't want to be cut" as the overarching theme. Forster (2005) commented that this key theme "*signifies a cultural belief in body integrity and acceptance of degenerative joint change as a part of aging.*"

Ibrahim (2003) suggested yet another reason for the difference in utilization of TJA between different races. It was reported that Black and White patients with OA of the hip or knee describe their pain differently. In addition, Black patients did not relate the quality of their pain to their quality of life whereas white patients did. A change in quality of life may be responsible for the utilization of TJA in White patients.

Finally, Ang et al. (2002) suggest that differences in the perception of usefulness of prayer may affect the uptake of TJA. The authors reported that Black patients were more likely that White patients to pray with respect to their OA and to view prayer as helpful in dealing with their OA.

As stated in Chapter 5 (Baseline hip) the social class recorded in the study is based on the Registrar General's social class classification. In 2001 this become obsolete and therefore the social class has been compared with that recorded in 2000 (Labour Force Survey 2000). In the knee study, the number of males with manual skilled jobs is higher than expected, and the number of males with non-manual skilled jobs is lower than excepted when compared with the national averages. The percentage of women working (or previous occupation if retired) in manual skilled and unskilled jobs is much higher than those reported and consequently percentages falling into the other social class categories are lower than expected. It is not surprising that many patients have/had occupations which were classified as manual skilled or

unskilled as occupations that are physically demanding on the knee are associated with osteoarthritis (Anderson and Felson 1998;Sandmark et al. 2000). Rossignol et al. (2003;2005) reported that blue collar workers in general were at a greater risk of developing osteoarthritis of the knee. Particular risky occupations were cleaning, work in construction or mechanics and farming.

The percentage of subjects educated to degree level or above is lower than expected when comparing it to the percentage in Sheffield from data published by the National Statistics Office (Office for National Statistics 2001). This may be age-dependent as the education levels in Sheffield are dependent on age with older individuals having fewer qualifications than younger individuals (Office for National Statistics 2005).

Baseline psychological characteristics

Tables 9.3 – 9.6 summarise the scores for each of psychological constructs studied.

Table 9.3: Summary of scores on the Multidimensional Health Locus of Questionnaire

Component	N	Range	Mean (+ SD)	Median	Mode
Internal subscale	70	15 – 36	26.80 ± 5.47	27.50	30
Chance Subscale	70	6 – 36	16.49 ± 8.62	14.00	8, 10
Doctors Subscale	70	3 – 18	14.49 ± 3.24	15.5	18
Others Subscale	70	4 – 18	13.40 ± 3.30	14	14

Note: the possible range of scores for Internal and chance subscales is 6 – 36, possible range of scores for doctors and others subscales is 3 – 18.

The discrepancy between the three measures of central tendency for the chance and doctors subscales indicate that they are not normally distributed. Therefore, histograms showing the spread of scores for these coping strategies have been included below (see Fig 9.3 and 9.4).

Figure 9.3: Histogram showing the spread of scores for the chance locus of control scale

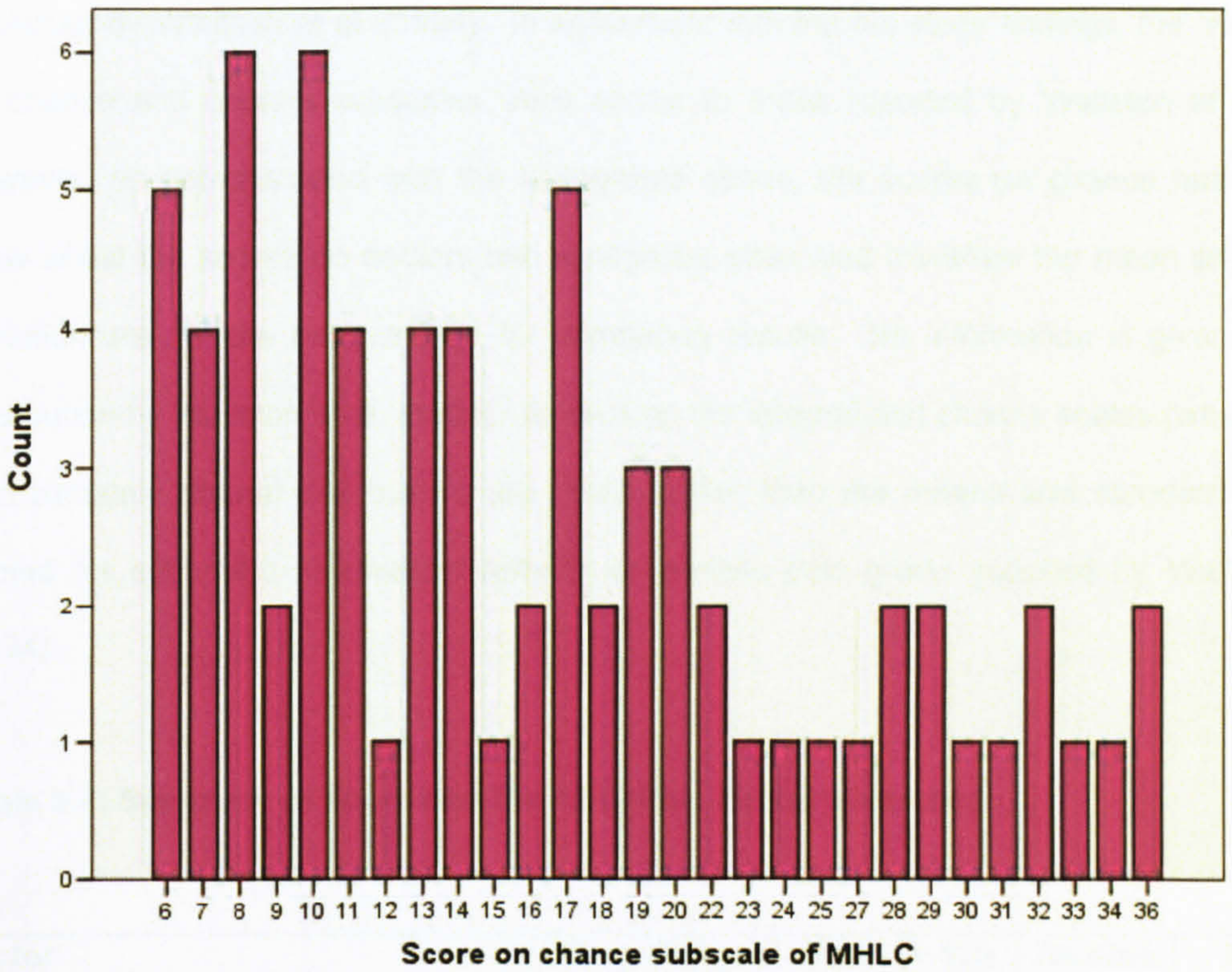
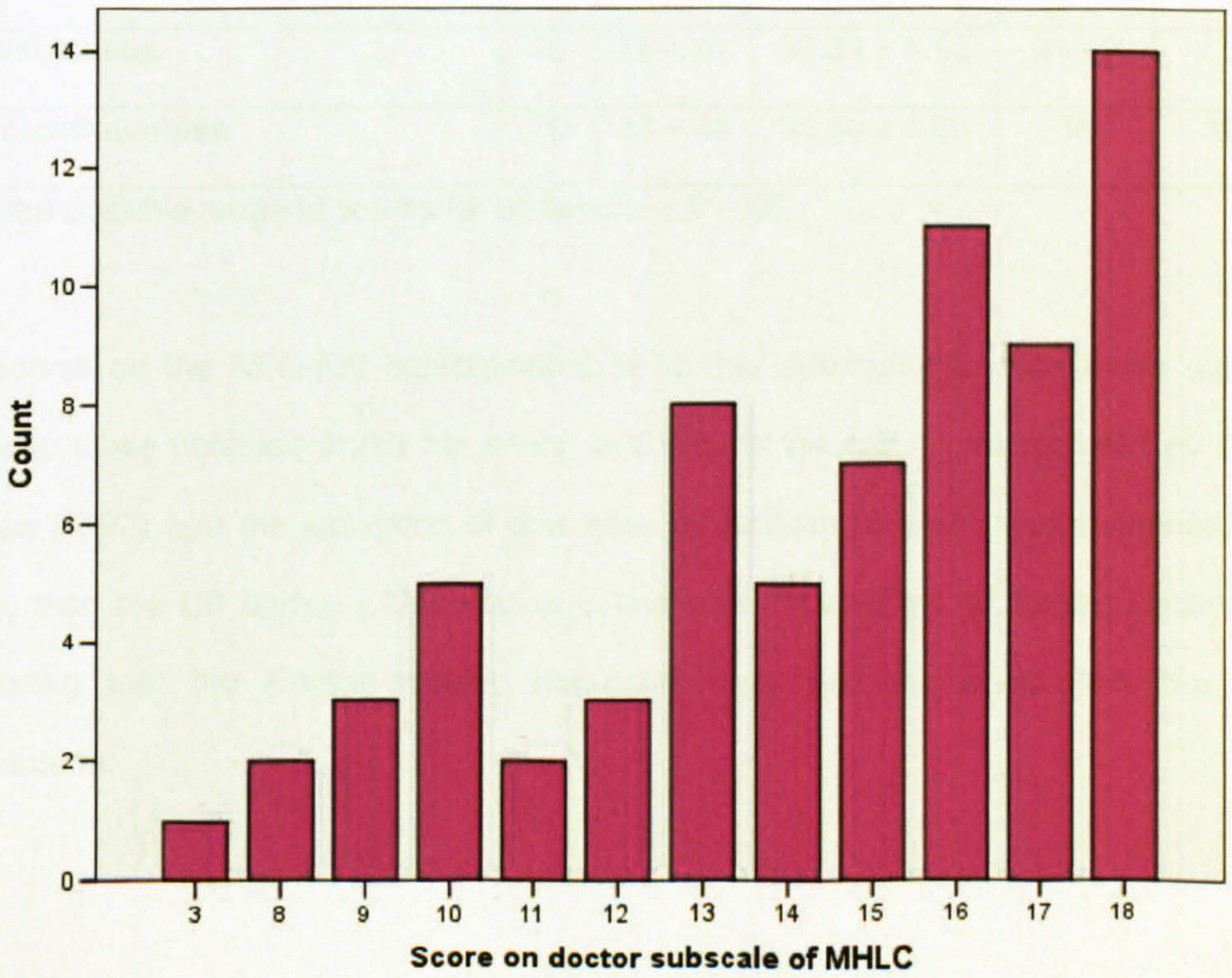


Figure 9.4: Histogram showing the spread of scores for the doctors locus of control scale



The means and standard deviations for the MHLC scales with the means and standard deviations for the subscales of form C for rheumatoid arthritis patients and chronic pain patients published by Walltson et al. (1994). In agreement with the hip study findings, the mean scores for chance and doctors subscales were similar to those reported by Wallston et al. (1994). However, as demonstrated with the histograms above, the scores on chance had a positive skew whilst the scores on doctors had a negative skew and therefore the mean and standard deviation are not the best method for comparing results. No information is given about the distribution by Wallston et al. (1994). Scores on the internal and chance scales (which have an approximately normal distribution) are much higher than the means and standard deviations quoted for either the rheumatoid arthritis or chronic pain group supplied by Wallston et al. (1994).

Table 9.4: Summary of scores on the NEO-Five Factor Inventory

Factor	N	Range	Mean (+ SD)	Median	Mode
Neuroticism	70	0 – 36	16.51 ± 7.61	16.00	17
Extraversion	70	15 – 39	27.30 ± 5.65	27.00	27
Openness to Experience	70	8 – 39	23.16 ± 5.64	23.00	22, 29
Agreeableness	70	20 – 44	33.33 ± 5.16	34.00	36
Conscientiousness	70	23 – 48	35.80 ± 5.68	36	32, 36

Note: the possible range of scores for all factors is 0 – 48.

The scores on the NEO-FFI approximated to normal distributions. The mean scores were similar to those obtained in the hip study, and also to the US norms reported by Costa and McCrae (1992) with the exception of openness to experience which was marginally lower (4 points) than the US norms. This finding is line with the findings of Jerram Coleman (1999) suggesting that the English elderly population may be less open than the American counterparts.

It is possible to categorise patients as very low, low, average, high or very high for each of the five factors in the NEO-FFI using the scoring form. Table 9.5 contains the number and percentage of patients scoring in each category on each factor.

Table 9.5: Number and percentage of patients scoring in each category of each factor of the NEO-FFI

Factor	Very low	Low	Average	High	Very High
Neuroticism	8 (11.4%)	23 (32.9%)	25 (35.7%)	12 (17.1%)	2 (2.9%)
Extraversion	6 (8.6%)	14 (20.0%)	35 (50.0%)	12 (17.1%)	3 (4.3%)
Openness to Experience	15 (21.7%)	23 (33.3%)	26 (37.7%)	4 (5.8%)	1 (1.4%)
Agreeableness	6 (8.6%)	12 (17.4%)	30 (43.5%)	17 (24.6%)	4 (5.8%)
Conscientiousness	2 (2.9%)	10 (14.3%)	34 (48.6%)	17 (24.3%)	7 (10.0%)

Table 9.6: Summary of scores on the Coping Strategies of the Coping Strategies Questionnaire

Coping Strategy	N	Range	Mean (+ SD)	Median	Mode
Diverting Attention	70	0 – 34	14.44 ± 7.92	15.00	15
Reinterpreting Pain Sensations	70	0 – 30	8.83 ± 8.05	8.50	0
Coping Self Statements	70	8 – 36	24.74 ± 7.82	26.00	27,28, 36
Ignoring Sensations	70	0 – 36	16.43 ± 8.16	17.00	20
Praying/Hoping	70	0 – 36	19.16 ± 7.88	18.50	21
Catastrophizing	70	0 – 36	9.00 ± 9.38	6.00	0
Increasing Behavioural Activities	70	0 – 35	16.13 ± 8.04	16.00	21

Note: the possible range of scores for coping strategies is 0 – 36.

Table 9.7: Summary of scores on the Pain Control Efficacy Scales of the Coping Strategies Questionnaire

Pain Control Efficacy Rating	N	Range	Mean (+ SD)	Median	Mode
Controlling Pain	64	0 – 6	3.34 ± 1.52	3.00	3
Decreasing Pain	64	0 – 5	2.59 ± 1.25	3.00	3

Note: the possible range of scores for pain control efficacy ratings is 0 – 6.

The wide difference between the mean, median and mode obtained for some of the coping strategies highlights that these scores have not followed a normal distribution curve. Therefore histograms showing the spread scores have been included below for each of the coping strategies (see figures 9.5-9.11).

Figure 9.5: Histogram showing spread of scores for diverting attention

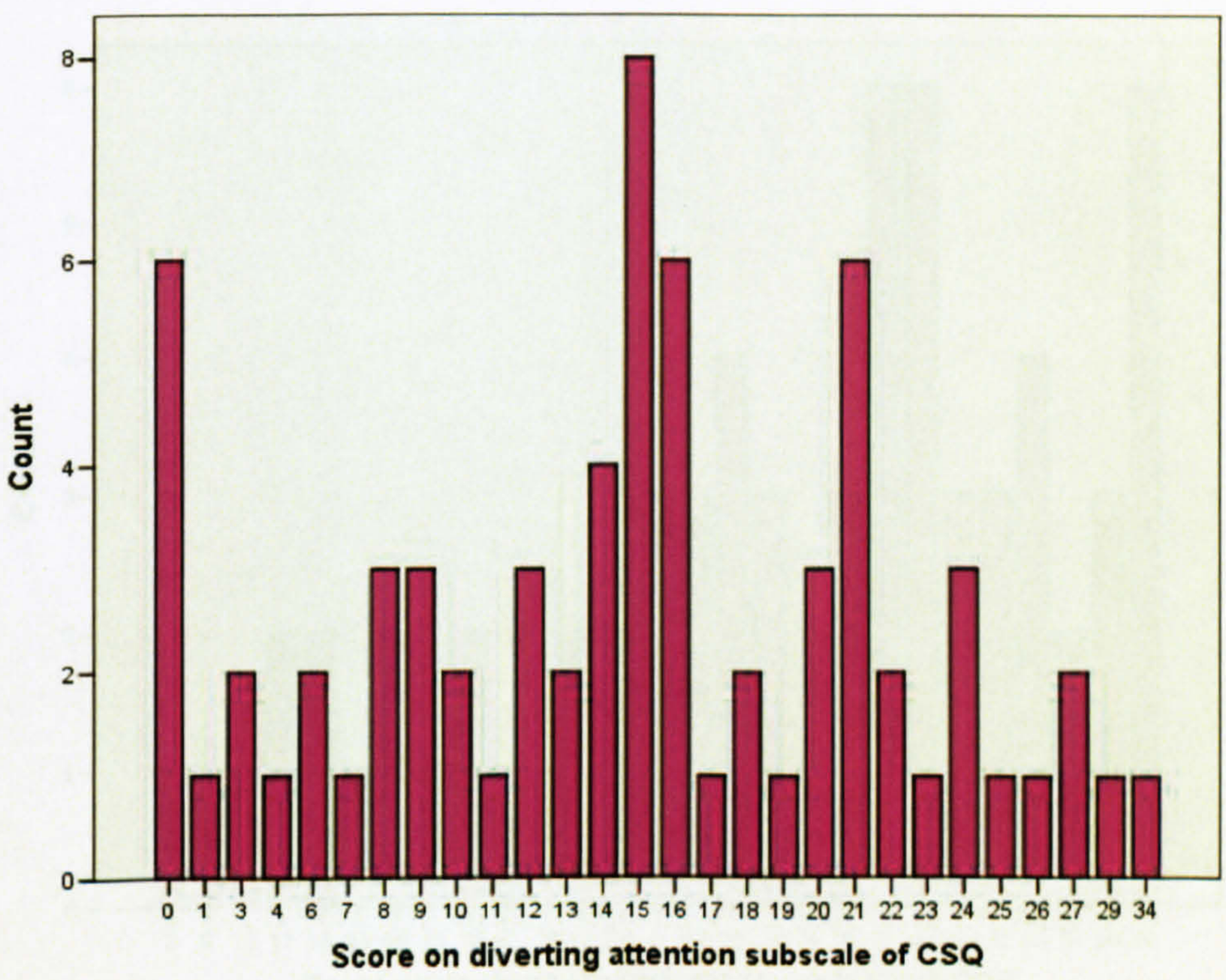


Figure 9.6: Histogram showing spread of scores for reinterpreting pain sensations

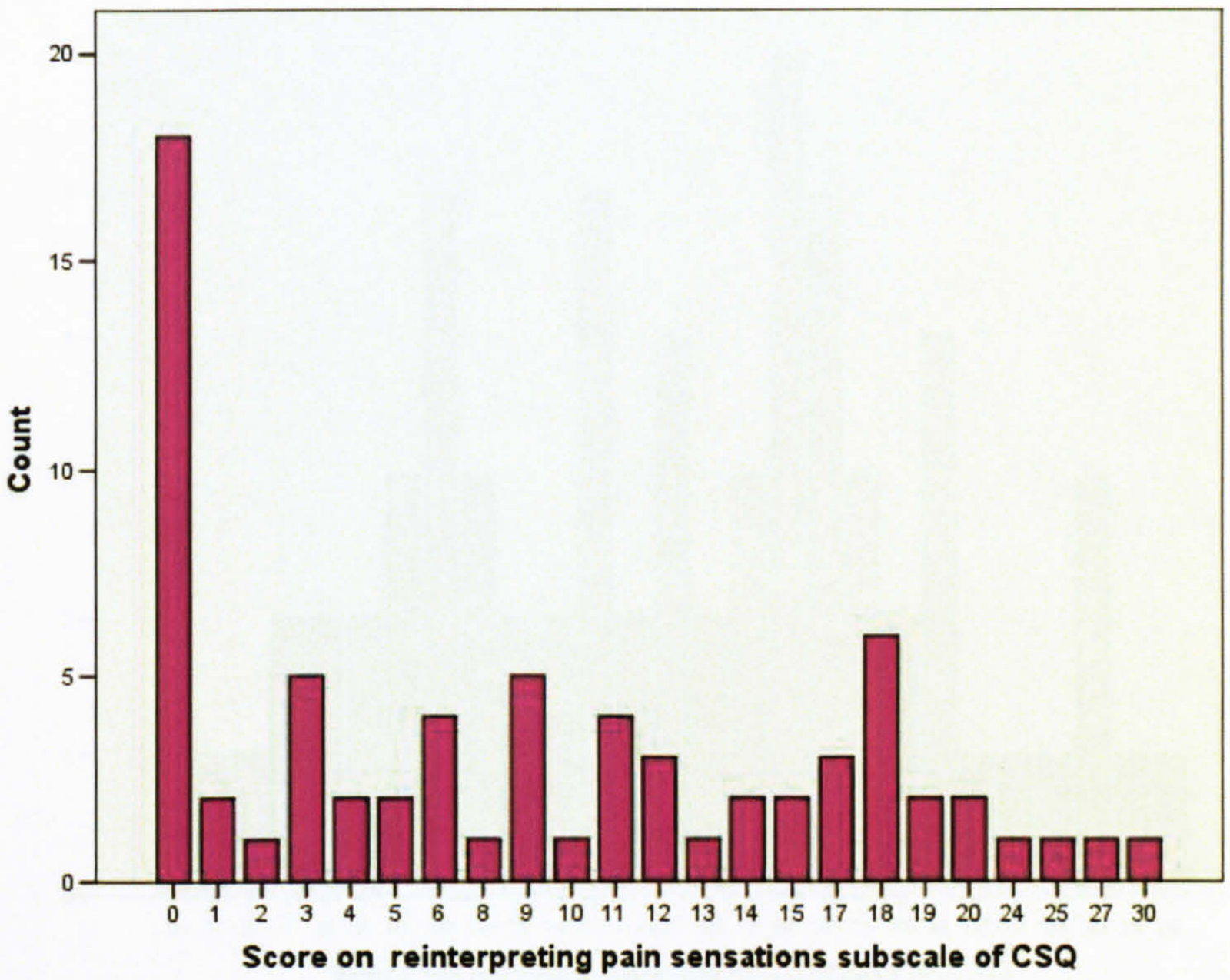


Fig 9.7: Histogram showing spread of scores for coping self statements

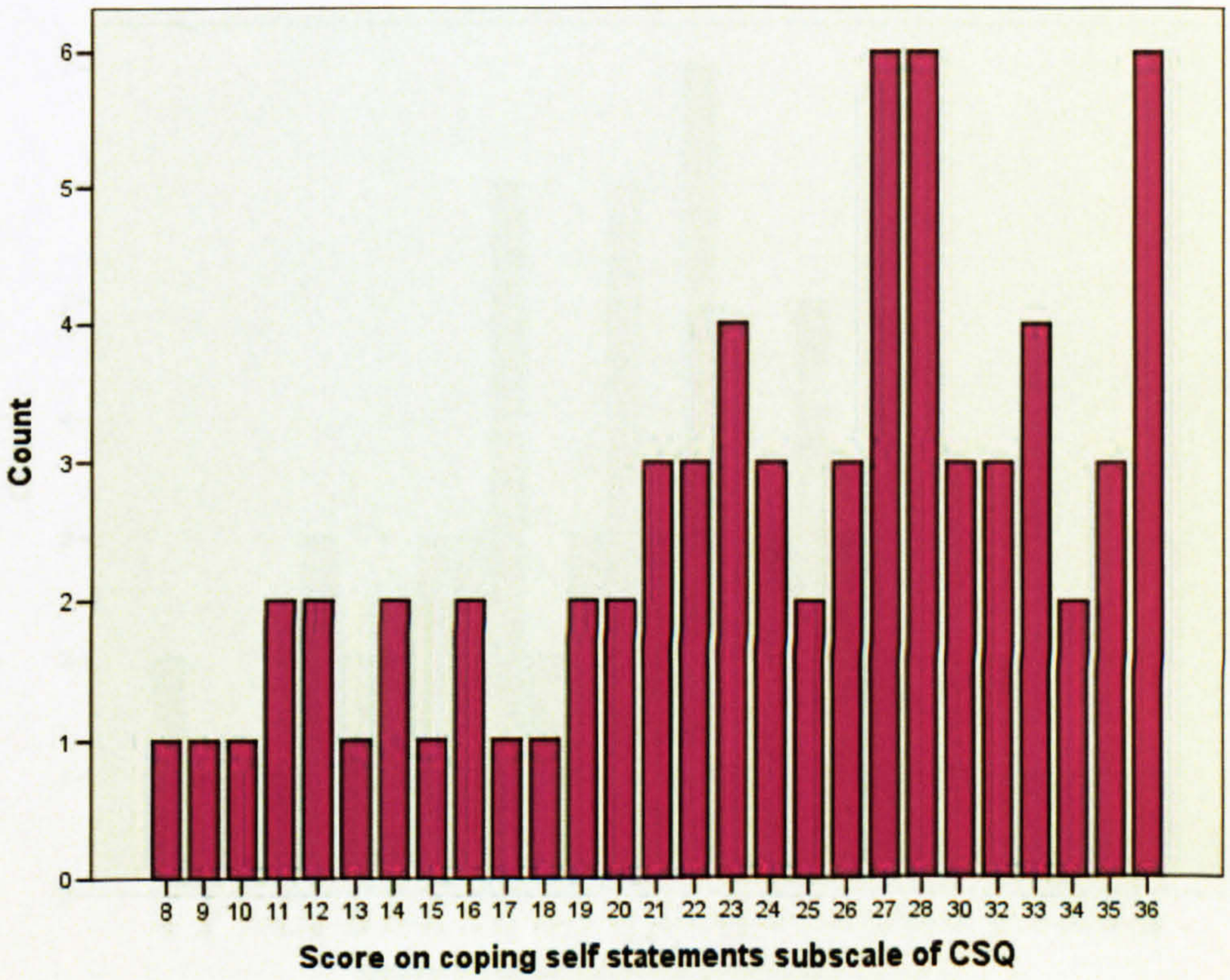


Figure 9.8: Histogram showing spread of scores for ignoring sensations

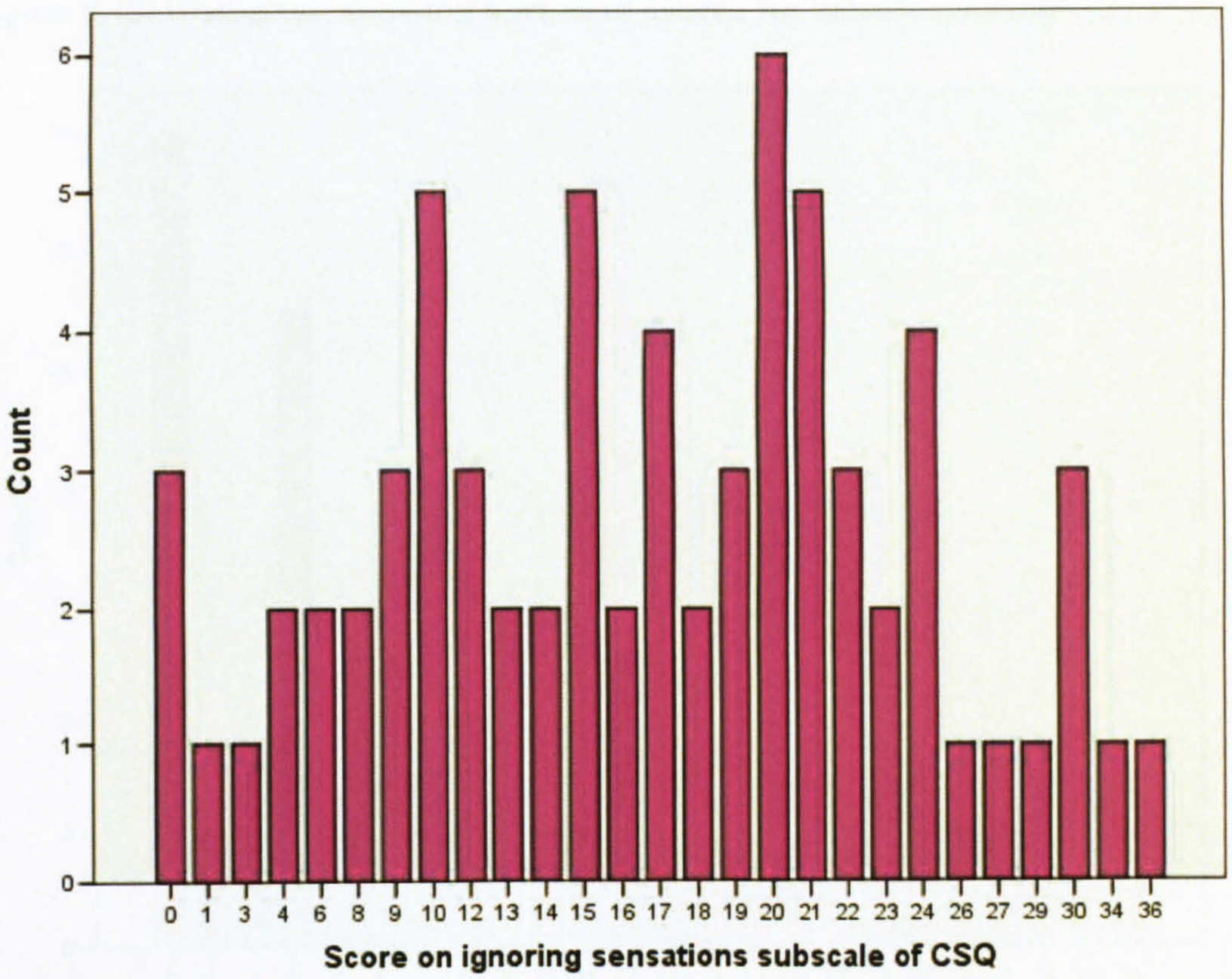


Figure 9.9: Histogram showing spread of scores for praying/hoping

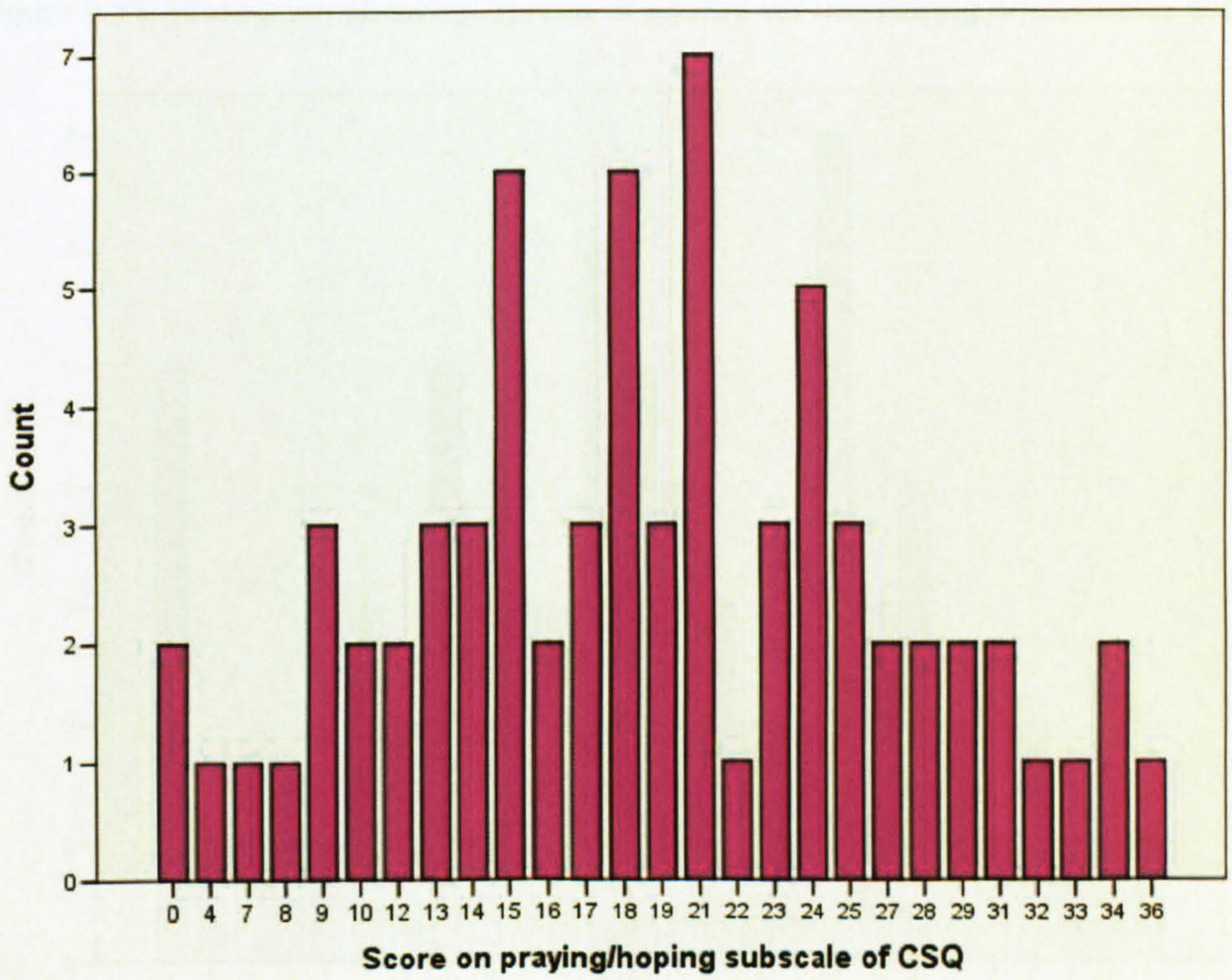


Figure 9.10: Histogram showing spread of scores for catastrophizing

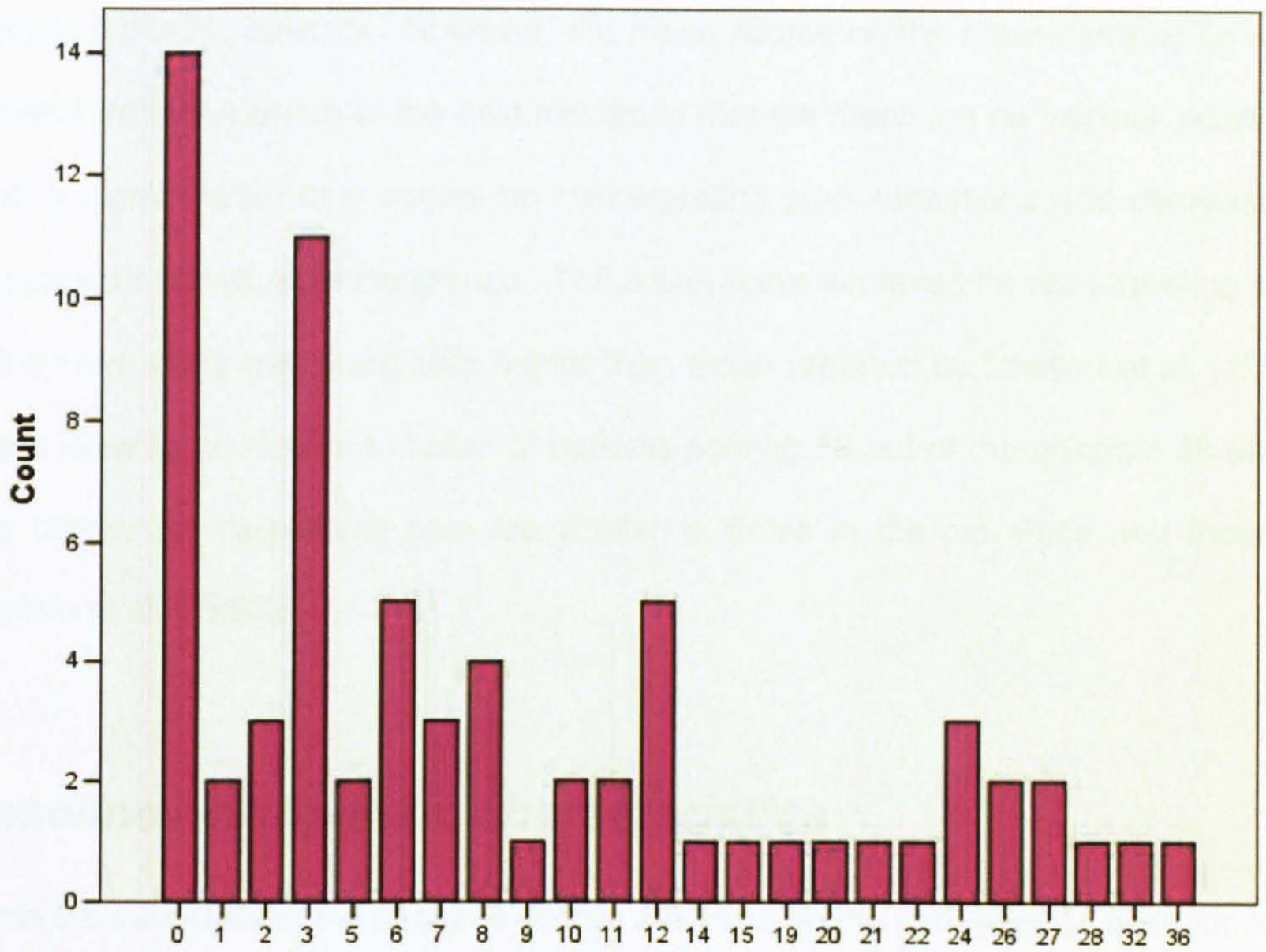
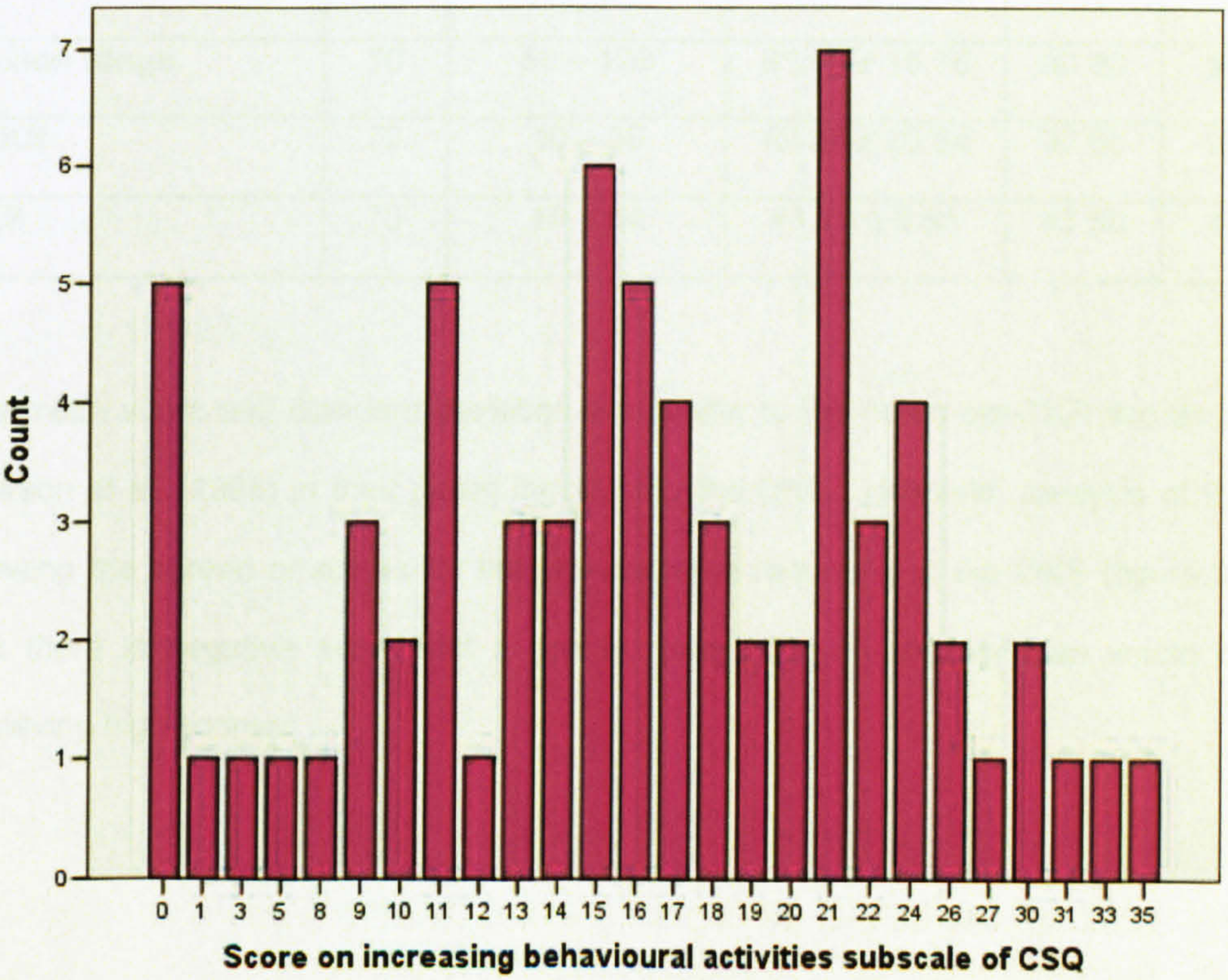


Figure 9.11: Histogram showing spread of scores for increasing behavioural activities



As stated in Chapter 5, there is no specific normative data available for the CSQ, however, means and standard deviations have been published by Lawson et al. (1990) for five different groups of chronic patients. However, the mean scores on the coping strategies was significant different from one group to the next indicating that the there are no 'normal' scores. In Lawson et al.'s study (1990) only scores on reinterpreting pain sensations and decreasing pain were comparable across all of the groups. The mean score achieved for reinterpreting pain sensation in the knee study was marginally higher than those reported by Lawson et al. (1990), however, this is likely to be due to a cluster of patients scoring 18 out of the possible 36 (see figure 9.4). The scores for decreasing pain are similar to those in the hip study and those reported by Lawson et al. (1990).

Baseline orthopaedic characteristics

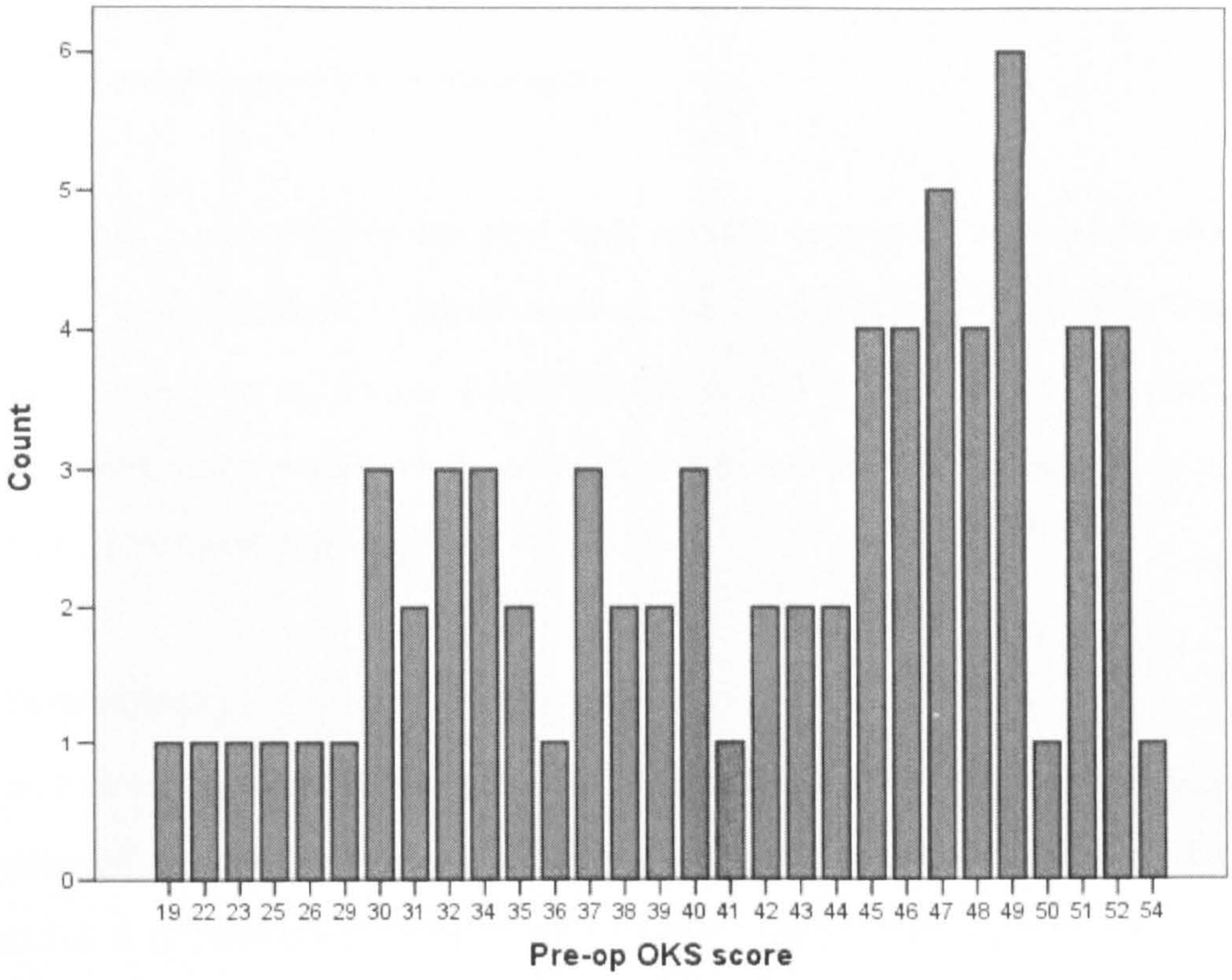
Table 9.8 summarises the baseline scores achieved on the joint-specific questionnaires.

Table 9.8: Baseline Characteristics of Knee OA severity

Score	N	Range	Mean (+ SD)	Median	Mode
Flexion range	70	50 – 120	91.00 ± 15.76	90.00	90
KSKS	70	10 – 95	42.47 ± 22.54	37.50	28
OKS	70	19 – 54	41.21 ± 8.51	43.50	49

The mean score and standard deviation are similar to the mean pre-TKR scores published by Dawson et al. (1998) in their paper introducing the OKS. However, analysis of the histogram showing the spread of scores for the pre-operative recording of the OKS (figure 9.12) reveals that there is negative skew with a greater proportion of patients than would be expected achieving high scores.

Figure 9.12: Histogram showing spread of scores of pre-operative recording of the OKS



The mean and standard deviation for KSKS was similar to that reported for pre-operative TKR patient by Lingard et al. (2001).

The Relationship between Psychological Factors and Pre-operative Scores on the Components of the Joint-Specific Questionnaires

As with the hip analysis, the analysis into the relationship between activity limitation and participation restriction, ROM and pain revealed pain to be strongly correlated with self-reported activity limitation and participation restriction. From the correlations recorded it is apparent that pain is likely to be an important predictor in the regression models predicting the components of the joint-specific questionnaires. However, the original aim of the research was to assess the relationship between psychological factors and disability as recorded by the joint-specific questionnaires. Therefore, as in the hip chapters, the regression analyses are first conducted

using only the psychological, demographic, and medical variables in the model. The regression analyses are then repeated including reported level of pain and range of motion; this will be reported and discussed later in the chapter.

In order to assess whether the data were normally distributed, z-scores for skewness and kurtosis were calculated. Transformations were carried out on the data which had an unacceptable skew or kurtosis. Pages 638-648 in the Appendix detail the z-scores on the raw data, transformations used and the z-scores post-transformation. The regression models below are using the transformed data.

Correlations

The Pearson correlations conducted to identify independent variables for inclusion in the regression analysis are summarised in Tables 9.9 (demographic variables), 9.10 (medical factors), 9.11 (Multi-dimensional Health Locus of Control), 9.12 (NEO Five Factor Inventory), and 9.13 (Coping Strategies Questionnaire). Independent variables which correlated significantly with the dependent variable ($p < .05$) were included in the subsequent multiple regression analysis.

Table 9.9: Correlations between the demographic factors and the dependent variables

	KSKS F	KSKS P	OKS	OKS P1	OKS F1	OKS P2	OKS F2
Age	-.12	.04	.09	-.02	.15	-.17	.13
Gender	-.35**	-.25*	.37***	.33**	.36**	.29*	.38***
No. in house	.16	-.07	-.12	-.16	-.08	-.14	-.10
Help at discharge	.09	-.10	.03	-.02	.05	.08	.00
Employment	-.24*	-.09	.23	.11	.28*	.01	.26*
Social class	-.16	-.27*	.32**	.35**	.28*	.24*	.32**
Education	.23	.20	-.29*	-.34**	-.23	-.22	-.29*
School	.22	.23	-.33**	-.27*	-.32**	-.21	-.31*

Note: * $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$.

Abbreviation: No. in house = Number of people living in patient's house; Education = highest education level achieved; School = age left school; KSKSF – Knee Society Knee Score functional component; KSKS P – KSKS pain component; OKS – Oxford Knee Score; OKS P1 – OKS pain component 1; OKS F1 – OKS functional component 1; OKS P2 – OKS pain component 2, OKS F2 – OKS functional component 2.

Gender correlated significantly with all of the dependent variables. Highest education level achieved, employment status, social class and age left school correlated significantly with a number (but not all) of the dependent variables.

Table 9.10: Correlations between medical factors and dependent variables

	KSKS F	KSKS P	OKS	OKS P1	OKS F1	OKS P2	OKS F2
BMI	-.29*	-.21	.19	.22	.15	.14	.21
Co-morbidity	-.24*	.01	-.03	-.03	-.07	-.00	-.05
Referral to physician	-.09	-.03	.01	.02	.01	.05	.00
Previous TJA	-.03	-.03	.04	.00	.06	-.01	.02

Note: $p < .05$.

Abbreviations: BMI = Body Mass Index, Referral to physician = Referral to Physician to check for suitability for surgery, Previous TJA = Number of previous total joint arthroplasties. Abbreviations for joint-specific questionnaires as noted in Table 9.9.

Significant correlations were found between BMI and KSKS functional component, and co-morbidity and KSKS functional component. Both correlations were weak and only just achieved significance and therefore these may be due to type I error.

Table 9.11: Correlations between dependent variables and Multi-dimensional Health Locus of Control (MHLC) variables

	KSKS F	KSKS P	OKS	OKS P1	OKS F1	OKS P2	OKS F2
Internal	.09	.04	.03	.06	.01	.01	.05
Chance	-.32**	-.35**	.40***	.34**	.39***	.36**	.36**
Doctors	-.24*	-.18	.24*	.28*	.19	.16	.27*
Others	-.13	-.19	.15	.22	.08	.11	.13

Note: * $p < .05$, ** $p < .01$, *** $p < .001$. Abbreviations for joint-specific questionnaires as noted in Table 9.9.

The chance subscale of MHLC correlated significantly with every dependent variable with a higher chance locus of control relating to worse function and greater pain. The doctors subscale correlated weakly but significantly with four of the outcome measures predicting worse function and greater pain.

Table 9.12: Correlations between the NEO- Five Factor Inventory (NEO-FFI) and the dependent variables

	KSKS F	KSKS P	OKS	OKS P1	OKS F1	OKS P2	OKS F2
Neuroticism	-.39***	-.22	.41***	.36**	.39***	.31**	.41***
Extraversion	.30*	.17	-.23	-.14	-.27*	-.07	-.25*
Openness	.36**	.38***	-.36**	-.30*	-.36**	-.21	-.36**
Agreeableness	.05	.19	-.21	-.23	-.18	-.20	-.18
Conscientiousness	.05	.06	-.09	-.09	-.08	-.12	-.09

Note: * $p < .05$, ** $p < .01$, *** $p < .001$.

Abbreviations: Openness = openness to experience. Abbreviations for joint-specific questionnaires as noted in Table 9.9.

Both neuroticism and openness to experience correlated significantly with most of the dependent measures. A higher score on neuroticism was associated with worse functioning and greater pain whereas a higher score on openness to experience was associated with less pain and better functioning. Extraversion correlated significantly with all three of the functional components. A higher score on extraversion was associated with better functioning. Agreeableness and conscientiousness did not correlate significantly with any of the dependent variables.

Table 9.13: Correlations between factors in the Coping Strategies Questionnaire (CSQ) and the dependent variables

	KSKS F	KSKS P	OKS	OKS P1	OKS F1	OKS P2	OKS F2
DA	.01	.15	-.09	-.13	-.05	-.17	-.06
RPS	.08	.16	-.24*	-.28*	-.19	-.22	-.21
CSS	.24*	.20	-.21	-.24*	-.17	-.18	-.20
IS	.26*	.19	-.26*	-.30*	-.20	-.21	-.25*
P/H	-.41***	-.22	-.40***	.29*	.43***	.14	.44***
C	-.34**	-.41***	.38***	.38***	.33**	.39***	.36**
IBA	-.02	.11	.00	-.01	.01	-.01	.03
CP	.16	.26*	-.40***	-.38***	-.36**	-.43***	-.35**
DP	.14	.24*	-.27*	-.24*	-.26*	-.21	-.24*

Note: * $p < .05$, ** $p < .01$, *** $p < .001$.

Abbreviations: DA = diverting attention; RPS = reinterpreting pain sensations; CSS = coping self statements; IS = ignoring sensations; P/H = praying/hoping; C = catastrophizing; IBA = increasing behavioural activities; CP = controlling pain; DP = decreasing pain. Abbreviations for joint-specific questionnaires as noted in Table 9.9.

As in the hip study, catastrophizing correlated significantly with all of the dependent variables, associating with worse function and greater pain. Praying/hoping and controlling pain both correlated significantly with most of the outcome measures. Praying/hoping was associated with greater pain and worse functioning whereas controlling pain was associated with less pain and better functioning. Significant correlations were also recorded between reinterpreting pain sensations, coping self statements, ignoring sensations, decreasing pain and some of the dependent variables. Neither diverting attention nor increasing behavioural activities had significant relationships with any of the outcome measures.

Forward Stepwise Multiple Regressions

Predictors of the Pre-operative Knee Society Knee Score Function Component

A stepwise regression analysis was performed to predict pre-operative scores on the KSKS functional component from gender, employment, BMI, co-morbidity, chance (MHLC), doctors (MHLC), neuroticism (NEO-FFI), extraversion (NEO-FFI), openness to experience (NEO-FFI), coping self statements (CSQ), ignoring sensations (CSQ), praying/hoping (CSQ), and catastrophizing (CSQ). The regression model explained **51%** of the variance, adjusted $R^2 = .47$, $F(6,60) = 10.59$, $p < .001$. Openness to experience, praying/hoping, coping self statements, gender, BMI and co-morbidities were found to make significant contributions to the regression model (see Table 9.14)

Table 9.14: Summary of forward stepwise regression analysis for variables predicting pre-operative scores on KSKS functional component

Variable	B	SE B	95% CI		ß
			Lower	Upper	
Openness	.09	.03	.04	.14	.31****
Praying/Hoping	-.08	.02	-.12	-.04	-.39***
Coping Self State.	.05	.02	.01	.09	.22*
Gender	-.70	.33	-1.36	-.05	-.22*
BMI	-.06	.03	-.12	.01	-.17**
Co-morbidity	-.28	.13	-.54	-.02	-.22*

Note: * $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$, $R^2 = .51$, $p < .001$. Abbreviations: Openness = openness to experience, Coping Self State. = coping self statements.

Predictors of the Pre-operative Knee Society Knee Score Pain Component

A stepwise regression analysis was performed to predict pre-operative scores on the KSKS pain component from gender, social class, chance (MHLC), openness to experience (NEO-FFI), catastrophizing (CSQ), controlling pain (CSQ), and decreasing pain (CSQ). The regression model explained **30%** of the variance, adjusted $R^2 = .27$, $F(3,62) = 8.80$, $p < .001$. Openness to experience, catastrophizing and gender of subject were found to make significant contributions to the regression model (see Table 9.15).

Table 9.15: Summary of forward stepwise regression analysis for variables predicting pre-operative scores on KSKS pain component

Variable	B	SE B	95% CI		ß
			Lower	Upper	
Catastrophizing	-3.16	1.22	-5.60	-.72	-.28**
Openness	.95	.31	.33	1.56	.34**
Gender	-8.54	3.37	15.28	-1.80	-.28**

Note: ** $p \leq .01$, *** $p \leq .001$, $R^2 = .30$, $p < .001$. Abbreviation: Openness = openness to experience.

Predictors of the Pre-operative Oxford Knee Score

A stepwise regression analysis was performed to predict pre-operative scores on the Oxford Knee Score from gender, social class, education, age left school, chance (MHLC), doctors (MHLC), neuroticism (NEO-FFI), openness to experience (NEO-FFI), reinterpreting pain sensations (CSQ), praying/hoping (CSQ), catastrophizing (CSQ), controlling pain (CSQ), and decreasing pain (CSQ). The regression model explained **48%** of the variance, adjusted $R^2 = .44$, $F(5, 59) = 11.04$, $p < .001$. Openness to experience, praying/hoping, controlling pain and gender were found to make significant contributions to the regression model (see Table 9.16). Neuroticism became non-significant on inclusion of praying and hoping as a predictor in the regression model.

Table 9.16: Summary of forward stepwise regression analysis for variables predicting pre-operative scores on the OKS

Variable	B	SE B	95% CI		ß
			Lower	Upper	
Neuroticism	.19	.13	-.07	.44	.16
Openness	-.42	.15	-.73	-.11	-.27**
Praying/Hoping	.30	.12	.06	.54	.26*
Controlling Pain	-1.44	.56	-2.56	-.33	-.26**
Gender	5.49	1.66	2.18	8.80	.32**

Note: * $p \leq .05$, ** $p \leq .01$, $R^2 = .48$, $p < .001$. Abbreviation: Openness = openness to experience.

Predictors of the Pre-operative Oxford Knee Score Function Component type 1

A stepwise regression analysis was performed to predict pre-operative scores on the OKS functional component type 1 from gender, employment, social class, age left school, chance (MHLC), neuroticism (NEO-FFI), extraversion (NEO-FFI), openness to experience (NEO-FFI), praying/hoping (CSQ), catastrophizing (CSQ), controlling pain (CSQ), and decreasing pain (CSQ). The regression model explained **49%** of the variance, adjusted $R^2 = .44$, $F(6, 58) = 9.33$, $p < .001$. Openness to experience, praying/hoping, controlling pain, gender and employment status were found to make significant contributions to the regression model (see Table 9.17). Chance (MHLC) became non-significant in the model on the inclusion of controlling pain and praying and hoping as variables in the regression model.

Table 9.17: Summary of forward stepwise regression analysis for variables predicting pre-operative scores on OKS functional component type 1

Variable	B	SE B	95% CI		ß
			Lower	Upper	
Openness	-.30	.10	-.49	-.10	-.31**
Chance	.07	.07	-.01	.21	.10
Praying/Hoping	.17	.07	.02	.32	.23*
Controlling Pain	-.88	.35	-1.58	-.17	-.25*
Gender	3.27	1.08	1.10	5.43	.30***
Employment	1.58	.72	.14	3.03	.22*

Note: * $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$, $R^2 = .49$, $p < .001$. Abbreviation: Openness = openness to experience.

Predictors of the Pre-operative Oxford Knee Score Pain Component Type 1

A stepwise regression analysis was performed to predict pre-operative scores on OKS pain component type 1 from gender, social class, highest education level achieved, age left school, chance (MHLC), doctors (MHLC), neuroticism (NEO-FFI), openness to experience (NEO-FFI). reinterpreting pain sensations (CSQ), coping self statements (CSQ), ignoring sensations (CSQ), praying/hoping (CSQ), catastrophizing (CSQ), controlling pain (CSQ), and decreasing pain (CSQ). The regression model explained **46%** of the variance, adjusted $R^2 = .42$, $F(5, 59) = 10.23$, $p < .001$. Neuroticism, reinterpreting pain sensations, praying/hoping, catastrophizing, and gender were found to make significant contributions to the regression model (see Table 9.18)

Table 9.18: Summary of forward stepwise regression analysis for variables predicting pre-operative scores on OKS pain component type 1

Variable	B	SE B	95% CI		ß
			Lower	Upper	
Neuroticism	.11	.06	.00	.22	.23*
Reinterpreting	-.17	.05	-.26	-.07	-.36***
Praying/Hoping	.12	.06	.01	.23	.25*
Catastrophizing	.58	.28	.02	1.14	.22*
Gender	1.64	.71	.22	3.06	.23*

Note: * $p \leq .05$, *** $p \leq .001$, $R^2 = .46$, $p < .001$. Abbreviation: Reinterpreting = reinterpreting pain sensations.

Predictors of the Pre-operative Oxford Knee Score Function Component Type 2

A stepwise regression analysis was performed to predict pre-operative scores on the OKS functional component type 2 from gender, employment, social class, highest education level achieved, age left school, chance (MHLC), doctors (MHLC), neuroticism (NEO-FFI), extraversion (NEO-FFI), openness to experience (NEO-FFI), ignoring sensations (CSQ), praying/hoping (CSQ), catastrophizing (CSQ), controlling pain (CSQ), and decreasing pain (CSQ). The regression model explained **50%** of the variance, adjusted $R^2 = .46$, $F(59, 5) = 11.71$, $p < .001$. Openness to experience, praying/hoping, controlling pain, and gender were found to make significant contributions to the regression model (see Table 9.19). Neuroticism became non-significant on the inclusion of controlling pain as a variable in the regression model.

Table 9.19: Summary of forward stepwise regression analysis for variables predicting pre-operative scores on OKS functional component type 2

Variable	B	SE B	95% CI		ß
			Lower	Upper	
Neuroticism	.16	.11	-.06	.39	.16
Openness	-.41	.14	-.68	-.13	-.29**
Praying/Hoping	.31	.11	.10	.52	.30**
Controlling Pain	-1.01	.50	-2.08	-.10	-.22*
Gender	5.03	1.47	2.90	7.98	.33***

Note: * $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$, $R^2 = .50$, $p < .001$. Abbreviation: Openness = openness to experience.

Predictors of the Pre-operative Oxford Knee Score Pain Component Type 2

A stepwise regression analysis was performed to predict pre-operative scores of OKS pain component type 2 from gender, social class, chance (MHLC), neuroticism (NEO-FFI), catastrophizing (CSQ), and controlling pain (CSQ). The regression model explained **29%** of the variance, adjusted $R^2 = .25$, $F(3, 62) = 8.26$, $p < .001$. Neuroticism, controlling pain, and gender were found to make significant contributions to the regression model (see Table 9.20)

Table 9.20: Summary of forward stepwise regression analysis for variables predicting pre-operative scores on OKS pain component type 2

Variable	B	SE B	95% CI		ß
			Lower	Upper	
Neuroticism	.02	.01	.00	.03	.23*
Controlling Pain	-.11	.04	-.18	-.04	-.34***
Gender	.23	.11	.02	.44	.24*

Note: * $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$, $R^2 = .25$, $p < .001$.

Summary of results

Tables 9.21 (KSKS components), 9.22 (OKS), 9.23 OKS (functional components), and 9.24 (OKS pain components) summarises the percentage of variance explained and the direction of effect for each of the factors in the model, for each of the regression analyses.

Table 9.21: Summary of forward stepwise analyses for KSKS components

Outcome	% variance explained	Factors in model	Direction of effect
KSKS function	51%	Openness to Experience (NEO-FFI)	A greater score on openness to experience was associated with better functioning.
		Praying/Hoping (CSQ)	A greater score on praying/hoping was associated with worse functioning.
		Coping Self Statements (CSQ)	A greater score on coping self statements was associated with better functioning.
		Gender	Being female was associated with worse functioning.
		Body Mass Index	A greater body mass index was associated with worse functioning.
		Co-morbidity	Co-morbidity was associated with worse functioning.
KSKS pain	30%	Openness to Experience (NEO-FFI)	A greater score on openness to experience was associated with less pain.
		Catastrophizing (CSQ)	A greater score on catastrophizing was associated with more pain.
		Gender	Being female was associated with more pain.

Note: neuroticism non-significant.

Table 9.22: Summary of forward stepwise analyses for OKS

Outcome	% variance explained	Factors in model	Direction of effect
OKS	48%	Neuroticism (NEO-FFI)	A greater score on neuroticism was associated with worse functioning and more pain.
		Openness to Experience (NEO-FFI)	A greater score on openness to experience was associated with better functioning and less pain.
		Praying/Hoping (CSQ)	A greater score on praying/hoping was associated with worse functioning and more pain.
		Controlling Pain (CSQ)	A greater perceived ability to control pain was associated with better functioning and less pain.
		Gender	Being female was associated with worse functioning and more pain.

Table 9.23: Summary of forward stepwise analyses for OKS functional components

Outcome	% variance explained	Factors in model	Direction of effect
OKS function 1	49%	Openness to Experience (NEO-FFI)	A greater score on openness to experience was associated with better functioning.
		Chance (MHLC)	A greater score on chance was associated with worse functioning.
		Praying/Hoping (CSQ)	A greater score on praying/hoping was associated with worse functioning.
		Controlling Pain (CSQ)	A greater perceived ability to control pain was associated with better functioning.
		Gender	Being female was associated with worse functioning.
		Employment Status	Being employed was associated with better functioning.
OKS function 2	50%	Neuroticism (NEO-FFI)	A greater score on neuroticism was associated with worse functioning.
		Openness to Experience (NEO-FFI)	A greater score on openness to experience was associated with better functioning.
		Praying/Hoping (CSQ)	A greater score on praying/hoping was associated with worse functioning.
		Controlling Pain (CSQ)	A greater perceived ability to control pain was associated with better functioning.
		Gender	Being female was associated with worse functioning.

Note: Chance and neuroticism are non-significant.

Table 9.24: Summary of forward stepwise analyses for OKS pain components

Outcome	% variance explained	Factors in model	Direction of effect
OKS pain 1	46%	Neuroticism (NEO-FFI)	A greater score on neuroticism was associated with more pain.
		Reinterpreting Pain Sensations (CSQ)	A greater score on reinterpreting pain sensations was associated with less pain.
		Praying/Hoping (CSQ)	A greater score on praying/hoping was associated with more pain.
		Catastrophizing (CSQ)	A greater score on catastrophizing was associated with more pain.
		Gender	Being female was associated with more pain.
OKS pain 2	25%	Neuroticism (NEO-FFI)	A greater score on neuroticism was associated with more pain.
		Controlling Pain (CSQ)	A greater perceived ability to control pain was associated with less pain.
		Gender	Being female was associated with more pain.

Tables 9.21-9.24 identify openness to experience (NEO-FFI), praying and hoping (CSQ) and gender as important predictors of pre-operative function as these variables are significant predictors for all three components relating to function (KSKS functional component and OKS functional components type 1 & 2). Perceived ability in controlling pain (CSQ) was found to be a significant predictor in both of the OKS functional components.

Neuroticism, (NEO-FFI) chance (MHLC), coping self statements (CSQ), employment status, BMI and co-morbidity were each a significant predictor for one of the models relating to function.

It is possible these were chance findings as a result of completing a study with multiple outcome measures.

Catastrophizing (CSQ), neuroticism (NEO-FFI) and gender were found to be important predictors of pain. Additionally, openness to experience (NEO-FFI), praying and hoping (CSQ), reinterpreting pain sensations (CSQ), and controlling pain (CSQ) were significant predictors for one of the components relating to pain. Again, these may be chance findings as a result of conducting a study with multiple outcome measurements.

Each of the variables implicated in predicting pain and/or function will be discussed in Chapter 12 (Knee Discussion).

The Relationship between Psychological Factors and Pain with Pre-operative Scores on the Components of the Joint-Specific Questionnaires

One of the aims of study was to examine the relationship between pre-operative impairment (measured with ROM), limitations of activity and participation restriction. In Chapter 4 it has been discussed how only a weak relationship was found between these measures; however strong correlations were found between patients' reported levels of pain and reported limitation of activity and restriction of participation (recorded using the joint-specific questionnaires). As such pain is likely to be an important predictor of the pre-operative outcome variables. The recordings of pain were not included in the multiple regression analyses above as one of the original aims of the study was to assess whether psychological factors affected pre-operative disability (activity limitation and participation restriction). However, given the findings that pain influences this, the analyses will now be repeated including the scores on the pain components. The other dependent factors entered into the models are the same as above. The multiple regression analyses are only repeated for the functional components. This is to prevent overlap

between the pain component and questions in the complete instruments referring to pain. The KSKS pain component is used as the measure of pain.

Predictors of the Pre-operative KSKS Function Component

A stepwise regression analysis was performed to predict pre-operative scores on the KSKS functional component from gender, employment, BMI, co-morbidity, pain measured using KSKS pain component, chance (MHLC), doctors (MHLC), neuroticism (NEO-FFI), extraversion (NEO-FFI), openness to experience (NEO-FFI), coping self statements (CSQ), ignoring sensations (CSQ), praying/hoping (CSQ), and catastrophizing (CSQ). The regression model explained **56%** of the variance, adjusted R^2 = .53, F(4, 62) = 19.86 , p < .001. Pain, praying/hoping, coping self statements, and co-morbidities were found to make significant contributions to the regression model (see Table 9.25)

Table 9.25: Summary of forward stepwise regression analysis for variables predicting scores on KSKS functional component including pain as a variable

Variable	B	SE B	95% CI		ß
			Lower	Upper	
Pain	.05	.01	.03	.07	.50***
Praying/Hoping	-.07	.02	-.11	-.04	-.35***
Coping Self State.	.05	.02	.01	.08	-.25**
Co-morbidity	-.35	.12	-.59	-.11	.21*

Note: * p ≤ .05, ** p ≤ .01, *** p ≤ .001, R^2 = .56, p < .001. Abbreviation: Coping Self State. = coping self statements.

Predictors of the OKS Function Component Type 1

A stepwise regression analysis was performed to predict pre-operative scores on the OKS functional component type 1 from gender, employment, social class, age left school, pain measured using KSKS pain component, range of motion, chance (MHLC), neuroticism (NEO-

FFI), extraversion (NEO-FFI), openness to experience (NEO-FFI), praying/hoping (CSQ), catastrophizing (CSQ), controlling pain (CSQ), and decreasing pain (CSQ). The regression model explained **65%** of the variance, adjusted R^2 = .63, F(4, 60) = 27.88, p < .001. Pain, praying/hoping, controlling pain, and employment status were found to make significant contributions to the regression model (see Table 9.26)

Table 9.26: Summary of forward stepwise regression analysis for variables predicting scores on OKS functional component type 1 including pain as a variable

Variable	B	SE B	95% CI		ß
			Lower	Upper	
Pain	-.21	.03	-.27	-.16	-.61***
Praying/Hoping	.16	.06	.04	.28	.22**
Controlling Pain	-.77	.28	-1.32	-.21	-.22**
Employment	1.19	.58	.03	2.36	.16*

Note: * p ≤ .05, ** p ≤ .01, *** p ≤ .001, R^2 = .65, p < .001.

Summary of results

Table 9.27 summarises the percentage of variance explained and the direction of effect for each of the factors in the model, for each of the regression analyses conducted.

Table 9.27: Summary of forward stepwise regression analyses for functional components including pain as a predictor

Outcome	% variance explained	Factors in model	Direction of effect
KSKS function	56%	Pain	Less pain was associated with better functioning.
		Praying/Hoping (CSQ)	A greater score on praying/hoping was associated with worse functioning.
		Coping Self Statements (CSQ)	A greater score on coping self statements was associated with better functioning.
		Co-morbidity	Co-morbidity was associated with worse functioning.
OKS function 1	65%	Pain	Less pain was associated with better functioning.
		Praying/Hoping (CSQ)	A greater score on praying/hoping was associated with worse functioning.
		Controlling Pain (CSQ)	A greater perceived ability to control pain was associated with better functioning.
		Employment	Being in employment was associated with better functioning.

The inclusion of a measurement of pain and range of motion as predictors of function increased the percentage variance explained in each of the regression models for the dependent variables.

Including pain as a predictor in the regression analysis resulted in some independent variables becoming non-significant in the models. Table 9.28 compares the factors which are significant in the regression models when including or excluding pain as a predictor.

Table 9.28: Comparison of predictors of regression analysis for functional components when including or excluding pain and range of motion as predictors

Outcome	Factors in regression model including pains as a predictor	Factors in regression model excluding pain as a predictor
KSKS Function	Pain Praying/Hoping Coping Self Statements Co-morbidity	Openness to Experience Praying/Hoping Coping Self Statements Gender BMI Co-morbidity
OKS Function 1	Pain Praying/Hoping Controlling Pain Employment Status	Openness to Experience Praying/Hoping Controlling Pain Gender Employment Status

Including pain as a variable in the regression analysis for the functional components caused gender to become non-significant for both components. Gender was found to be a significant predictor of KSKS pain component (which is used here as the pre-operative measure of pain) and therefore genders actions on function may be mediated through pain.

Including pain as a variable in the regression analysis for KSKS function caused both BMI and co-morbidity to become non-significant. Both these variables were only a predictor of KSKS function and not the other functional components measured and therefore we cannot be sure that in the analysis where pain was not a predictor that they had not occurred due to chance as a result of multiplicity.

Including pain as an independent variable in the regression model for OKS functional component type 1 caused openness to experience to become non-significant. Openness to experience was a significant predictor in the regression analysis for KSKS pain and therefore it is not overly surprising that it has become non-significant.

Summary of Chapter

This chapter has reported:

- Recruitment and retention of participants to the knee study.
- The demographics of participants in the knee study.
- Baseline characteristics of participants on the knee study.
- Psychological characteristics of participants in the knee study.
- That openness to experience, praying and hoping, controlling pain and gender are important predictors of self-reported activities limitation and participation restriction.
- That catastrophizing, neuroticism, and gender are important predictors of reported pain pre-operatively.
- That pain is an important predictor of self-reported activities limitation and participation restriction pre-operatively.

Chapter 10: Knee Study: Physiotherapy Key Milestones Findings

Introduction

This chapter will report the relationships between the independent variables (demographic, medical and psychological) and the key physiotherapy milestones. For this analysis, patients experiencing post-operative complications were excluded.

In order to assess whether the data were normally distributed, z-scores for skewness and kurtosis were calculated. Transformations were carried out on the data which had an unacceptable skew or kurtosis. Pages 638-648 in the Appendix details the z-scores on the raw data, transformations used and the z-scores post-transformation. The results reported below used the transformed variables.

Patient Characteristics

Six patients experienced serious post-operative complications which caused them to be excluded from this section of the study (the descriptive statistics do not include these patients). The majority of the patients (89.1%) received their treatment at the Northern General Hospital (NGH). 4.7% of patients received their treatment at Thornbury Hospital (TBH), whilst 6.3% received their treatment at Claremont Hospital (CMH). Further descriptive statistics of patients inpatient stay are contained in Tables 10.1 and 10.2.

Table 10.1: Statistics on patient's hospital stay

	Range	Mean (+ SD)	Median	Mode
Number of physiotherapy session	3 – 32	8.20 ± 4.27	8.00	7
Average number of physiotherapy sessions per day	0.44 – 1.29	0.79 ± 0.18	0.75	1
Length of Stay	3 – 20	7.24 ± 3.35	6.50	6

Table 10.2: Statistics on the achievement of inpatient key physiotherapy milestones

Key Milestone	Range	Mean (+ SD)	Median	Mode
Straight leg raise	1 – 12	4.04 ± 2.34	4.00	2
90° bend	2 – 7	4.10 ± 1.45	4.00	3
Bed transfer	2 – 8	3.61 ± 1.51	3.00	3
Chair transfer	1 – 16	3.43 ± 2.22	3.00	3
Independence with frame	2 – 7	4.04 ± 1.37	4.00	3
Independence with crutches	2 – 19	5.71 ± 2.61	5.00	4

The Outcome Measures

As with the hip study, the key physiotherapy milestones chosen for analysis in the knee study represent the inpatient recovery pattern. It is assumed that achievement of these milestones would be interrelated i.e. an earlier achievement of one key milestone should be associated with earlier achievement of another. In order to assess this, Pearson correlations were conducted between the transformed outcome measures. They are summarised in Table 10.3.

Table 10.3: Correlations between the physiotherapy key milestones

90°	BT	CT	IF	IC	PD	LOS	
.76***	.30	.42**	.24	.61***	.68***	.56***	**SLR[a]**
	.56*	.22	.48*	.69***	.65***	.41	**90° [b]**
		.65***	.82***	.79***	.73***	.69***	**BT[c]**
			.64***	.65***	.66***	.58***	**CT[d]**
				.77***	.68***	.63***	**IF[e]**
					.87***	.80***	**IC[f]**
						.86* **	**PD[g]**
							LOS[h]

Note: * p < .05, ** p < .01, *** p < .001, a: n = 51, b: n = 21, c: n = 41, d: n = 47, e: n = 48, f: n = 52, g: n = 55, h: n = 54.

Abbreviations: SLR = straight leg raise, 90° = 90° bend of knee, BT = bed transfer, CT = chair transfer, IF = independence with Zimmer frame, IC = independence with crutches, PD = physiotherapy discharge, LOS = post-surgical length of stay.

There are strong correlations between most of the key physiotherapy milestones suggesting that they are measuring a similar outcome. As in the hip study, the correlations between the key milestones and physiotherapy discharge are slightly stronger than those recorded between the milestones and length of stay. This is because length of stay is not just dependent upon readiness for discharge but also many other factors such as availability of transport etc.

Time taken to achieve 90° flexion of knee was included as key milestone as according to the hospital care pathway this should be achieved prior to discharge. However, on collecting the data it became apparent that many patients were discharged prior to achievement of this milestone. In fact this milestone was only recorded for 21 out of the 64 patients completing their surgery post-operative complication free. This milestone is still included as a dependent variable in the regression analysis, however, results must be viewed with caution as the

analysis is very underpowered. As an alternative, number of degrees flexion that the patient had achieved by discharge from inpatient physiotherapy (which ranged from 50-90° degrees) was recorded and also included as a dependent variable in the regression analysis. Pearson calculations were conducted between this and the other key physiotherapy milestones to assess the interrelationship of the factors (see Table 10.4).

Table 10.4: Correlations between degrees flexion achieved at inpatient physiotherapy discharge and the other physiotherapy key milestones

	SLR	90°	BT	CT	IF	IC	PD	LOS
Disc°	-.50***	.01	.20	-.23	-.04	-.07	-.28*	-.18

Note: * $p < .05$, *** $p < .001$.

Abbreviations: Disc° = number of degrees of flexion at physiotherapy discharge, SLR = straight leg raise, 90° = 90° bend of knee, BT = bed transfer, CT = chair transfer, IF = independence with Zimmer frame, IC = independence with crutches, PD = physiotherapy discharge, LOS = post-surgical length of stay

A moderate negative correlation is recorded between time taken to achieve straight leg raise (SLR) and number of degrees of flexion at discharge from inpatient physiotherapy. This correlation suggests that an earlier achievement of SLR is associated with greater flexibility. Apart from this relationship, the only other milestone that number of degrees of flexion at discharge from inpatient physiotherapy significantly correlates with is physiotherapy discharge.

Correlations

The Pearson correlations conducted to identify independent variables for inclusion in the regression analysis are summarised in Tables 10.5 (demographic variables), 10.6 (medical factors), 10.7 (Multi-dimensional Health Locus of Control), 10.8 (NEO Five Factor Inventory), and 10.9 (Coping Strategies Questionnaire). Independent variables which correlated significantly with the dependent variable ($p < .05$) are included in the subsequent multiple

regression analysis. The abbreviations for the key milestones in each of the tables are as noted above in Table 10.4.

Table 10.5: Correlations between the demographic factors and the dependent variables

	SLR	T90°	Disc°	BT	CT	IF	IC	PD	LOS
Age	.01	-.13	.07	.27	.09	.26	.21	.22	.29*
Gender	.12	.01	-.07	.23	.17	.31*	.22	.26	.17
No. in house	.03	-.07	-.07	.01	.16	.02	.05	.05	-.07
Help Disch.	-.05	.02	.20	.11	-.06	-.09	.06	.01	-.10
Employment	.12	-.23	.10	.25	.17	.24	.20	.16	.29*
Social class	.16	-.06	-.16	.00	-.05	-.06	.02	.05	.00
Education	-.29*	-.01	.19	.11	-.06	.02	-.00	-.04	-.07
School	-.32*	-.23	.31*	-.34*	-.13	-.23	-.24	-.26	-.32*

Note: * $p \leq .05$.

Abbreviations: No. in house = Number of people living in patient's house; Help Disch. = category of help available to patient after discharge; Education = highest education level achieved; School = age left school.

Age left school correlated significantly with number of days taken to achieve SLR, number of degrees of flexion at inpatient physiotherapy discharge, number of days taken to independently bed transfer, and post-operative LOS. There are a few other sporadic correlations (between age and LOS, gender and independence with frame, employment and LOS and education and SLR). As the physiotherapy milestones are highly inter-correlated, it is possible that the aforementioned correlations are a result of multiplicity.

Table 10.6: Correlations between medical factors and dependent variables

	SLR	90°	Disc°	BT	CT	IF	IC	PD	LOS
Hospital	-.06	-.02	-.06	-.26	-.17	-.05	-.32*	-.22	-.32*
BMI	.19	.36	-.14	.03	.17	.31*	.26	.19	.19
Co-morbid.	.13	.09	-.01	.23	.14	.19	.19	.18	.14
Referral	-.18	N/A	-.17	.21	.06	.06	.06	.08	.10
Prev. TJA	-.19	-.38	-.05	-.11	.02	-.02	-.20	-.19	-.04
Phys. Inten.	-.28*	-.51*	.26	.07	-.07	.12	.02	-.09	.03

Note: * $p \leq .05$.

Abbreviations: Co-morbid = co-morbidity; Referral = referral to physician to check suitability for surgery; Prev. TJA = previous TJA; Complic. = post-operative complications; Phys. Inten. = physiotherapy intensity. No patients who achieved 90° flexion as an inpatient had previously been referred to a clinician to check for suitability of surgery and therefore this correlation is marked as not applicable.

Physiotherapy intensity significantly negatively correlated with both time taken to achieve to SLR and time taken to achieve 90° bend. Hospital in which the patient was treated significantly correlated with time taken to achieve independence with crutches and LOS. BMI significantly positively correlated with time taken to achieve independence with Zimmer frame.

Table 10.7: Correlations between dependent variables and Multi-dimensional Health Locus of Control (MHLC) variables

	SLR	T90°	Disc°	BT	CT	IF	IC	PD	LOS
Internal	-.24	-.44*	-.06	-.01	.08	.10	-.17	-.19	-.22
Chance	.02	.13	-.24	.22	.15	.33	.10	.08	.15
Doctors	.02	-.18	-.22	-.19	-.19	-.18	-.17	-.10	.06
Others	.06	-.26	.15	-.21	-.21	-.23	-.09	-.10	-.01

Note: * $p \leq .05$.

Only one significant correlation was recorded between the MHLC subscales and the physiotherapy key milestones; this was between scores on the internal subscale and number of days taken to achieve 90° bend. This may be a chance finding as a result of conducting a study with multiple end-points.

Table 10.8: Correlations between the NEO- Five Factor Inventory (NEO-FFI) and the dependent variables

	SLR	T90°	Disc°	BT	CT	IF	IC	PD	LOS
N	.21	-.18	-.25	-.20	.01	-.10	.10	.12	.16
E	-.23	-.24	.19	-.19	-.17	-.21	-.31*	-.24	-.32*
O	-.14	-.06	.09	-.03	-.12	.14	-.10	-.10	-.11
A	-.15	-.08	.15	-.03	-.02	.02	-.05	-.03	-.11
C	-.21	.05	.02	-.03	.00	-.14	-.19	-.17	-.22

Note: * $p \leq .05$.

Abbreviations: N = neuroticism; E = extraversion; O = openness to experience; A = agreeableness; C = conscientiousness.

Extraversion significantly negatively correlated with time taken to achieve independence with crutches and post-operative LOS.

Table 10.9: Correlations between factors in the Coping Strategies Questionnaire (CSQ) and the dependent variables

	SLR	T90°	Disc°	BT	CT	IF	IC	PD	LOS
DA	.12	-.10	-.40**	-.05	.18	-.09	-.11	.03	.01
RPS	-.01	-.01	-.17	-.07	-.02	-.13	-.14	.01	-.04
CSS	-.24	-.51*	.03	.11	.13	-.03	-.16	-.17	-.15
IS	-.07	-.30	-.03	.19	.12	.01	-.10	-.07	-.05
P/H	.16	-.22	-.35**	-.01	.30*	.01	.11	.21	.19
C	.10	.46*	-.11	.09	-.01	-.00	.08	.07	.10
IBA	.10	-.11	.21	.06	.28	.03	.01	.09	.08
CP	-.07	-.07	-.09	.01	.17	.04	-.13	-.07	-.15
DP	-.26	-.27	.06	-.15	.05	-.11	-.18	-.12	-.20

Note: * $p \leq .05$, ** $p \leq .01$.

Abbreviations: DA = diverting attention; RPS = reinterpreting pain sensations; CSS = coping self statements; IS = ignoring sensations; P/H = praying/hoping; C = catastrophizing; IBA = increasing behavioural activities; CP = controlling pain; DP = decreasing pain.

Praying/hoping correlated significantly with number of degrees of flexion at inpatient physiotherapy discharge and chair transfer. Diverting attention also significantly negatively correlated with number of degrees of flexion at inpatient physiotherapy discharge i.e. a greater score on diverting attention is associated with lower flexion range at discharge. Catastrophizing significantly positively correlated with time taken to achieve 90° bend whilst coping self statements positively correlated with this milestones. As each coping strategy only correlated significantly with one or two of the key physiotherapy milestones, it can not be ruled out that these correlations are a result of multiplicity.

Forward Stepwise Regression Analyses

Predictors of Time Taken to Achieve Straight Leg Raise

A stepwise regression analysis was performed to predict time (in days) taken to achieve straight leg raise from highest education level achieved, age left school, and physiotherapy intensity. The regression model explained **19%** of the variance, adjusted R^2 = .15, $F(2, 45) = 5.24$, $p < .01$. Age left school and physiotherapy intensity were found to make significant contributions to the regression model (see Table 10.10).

Table 10.10: Summary of forward stepwise regression analysis for variables predicting time taken to achieve straight leg raise

Variable	B	SE B	95% CI		ß
			Lower	Upper	
Age Left School	-.67	.29	-1.25	-.08	-.31*
Physiotherapy Int.	-3.63	1.69	-7.02	-.22	-.29*

Note: * $p \leq .05$, $R^2 = 10$, $p < .01$. Abbreviation: Physiotherapy Int. = physiotherapy intensity.

Predictors of Time Taken to Achieve 90° Bend

A stepwise regression analysis was performed to explain time (in days) taken to achievement of 90° bend from the internal subscale of MHLC, coping self statements (CSQ), catastrophizing (CSQ), and physiotherapy intensity. The regression model explained **26%** of the variance, adjusted R^2 = .22, $F(1, 17) = 6.11$, $p < .05$. Physiotherapy intensity was found to make a significant contribution to the regression model (see Table 10.11).

Table 10.11: Summary of forward stepwise regression analysis for variables predicting time taken to achieve 90° bend

Variable	B	SE B	95% CI		ß
			Lower	Upper	
Physiotherapy Int.	-4.32	1.75	-8.00	-.63	-.51*

Note: * $p \leq .05$,, $R^2 = .26$, $p < .05$. Abbreviation: Physiotherapy Int. = physiotherapy intensity.

Predictors of Number of Degrees of Flexion of Knee at Inpatient Physiotherapy Discharge

A stepwise regression analysis was performed to predict the number of degrees of flexion of the knee at the time of inpatient physiotherapy discharge from age left school, diverting attention (CSQ), and praying/hoping (CSQ). The regression model explained **22%** of the variance, adjusted $R^2 = .19$, $F(2, 50) = 6.92$, $p < .01$. Diverting attention and age left school were found to make significant contributions to the regression model (see Table 10.12).

Table 10.12: Summary of forward stepwise regression analysis for variables predicting number of degrees flexion of knee at time of inpatient physiotherapy discharge

Variable	B	SE B	95% CI		ß
			Lower	Upper	
Diverting Attention	-.07	.02	-.11	-.02	-.35**
Age Left School	.42	.19	.04	.81	.28*

Note: * $p \leq .05$, ** $p \leq .01$, $R^2 =$,.22 $p < .01$.

Predictors of Time taken to Achieve Independence in Bed Transfer

A stepwise regression analysis was performed to predict time taken to achieve independence in bed transfer from age left school. The regression model explained **12%** of the variance, adjusted R^2 = .10, F(1, 39) = 5.20, p < .05. Age left school was found to make a significant contribution to the regression model (see Table 10.13).

Table 10.13: Summary of forward stepwise regression analysis for variables predicting time taken to achieve independence in bed transfer

Variable	B	SE B	95% CI		ß
			Lower	Upper	
Age Left School	-.47	.21	-.89	-.05	-.34*

Note: * p ≤ .05, R^2 = .12, p < .05.

Predictors of Time Taken to Achieve Independence in Chair Transfer

A stepwise regression analysis was performed to explain time taken to achieve independence in chair transfer from praying/hoping (CSQ). The regression model explained **9%** of the variance, adjusted R^2 = .07, F(1,46) = 4.51, p < .05. Praying/hoping was found to make a significant contribution to the regression model (see Table 10.14).

Table 10.14: Summary of forward stepwise regression analysis for variables predicting time taken to achieve independence in chair transfer

Variable	B	SE B	95% CI		ß
			Lower	Upper	
Praying/Hoping	.01	.00	.00	.02	.30*

Note: * p ≤ .05, R^2 =.09, p < .05.

Predictors of Time Taken to Achieve Independence with Zimmer Frame

A stepwise regression analysis was performed to predict time taken to achieve independence with Zimmer frame from gender, and BMI. The regression model explained **11%** of the variance, adjusted $R^2 = .09$, $F(1, 46) = 5.42$, $p < .05$. Gender of subject was found to make a significant contribution to the regression model (see Table 10.15).

Table 10.15: Summary of forward stepwise regression analysis for variables predicting time taken to achieve independence with Zimmer frame

Variable	B	SE B	95% CI		ß
			Lower	Upper	
Gender	.89	.38	.12	1.66	.33*

Note: * $p \leq .05$, $R^2 = .11$, $p < .05$.

Predictors of Time Taken to Achieve Independence with Crutches

A stepwise regression analysis was performed to explain time taken to achieve independence with crutches from extraversion (NEO-FFI) and hospital in which the patient had their surgery. The regression model explained **10%** of the variance, adjusted $R^2 = .08$, $F(1, 50) = 5.51$, $p < .05$. Hospital was found to make a significant contribution to the regression model (see Table 10.16).

Table 10.16: Summary of forward stepwise regression analysis for variables predicting time taken to achieve independence with crutches

Variable	B	SE B	95% CI		ß
			Lower	Upper	
Hospital	-.11	.05	-.20	-.02	-.32*

Note: * $p \leq .05$, $R^2 = .10$, $p < .05$.

Predictors of Number of Days Post-surgery until Inpatient Physiotherapy Discharge

No significant correlations were recorded between any of the independent variables and this milestone, and therefore a regression analysis was not conducted for this.

Predictors of Post-operative Length of Stay

A stepwise regression analysis was performed to predict post-operative length of stay from age, employment status, age left school, extraversion (NEO-FFI), and hospital in which the patient had their surgery. The regression model explained **21%** of the variance, adjusted $R^2 = .18$, $F(2, 50) = 6.76$, $p < .01$. Age left school and hospital in which the patient was treated were found to make significant contributions to the regression model (see Table 10.17).

Table 10.17: Summary of forward stepwise regression analysis for variables predicting post-operative length of stay

Variable	B	SE B	95% CI		ß
			Lower	Upper	
Age Left School	-.06	.02	-.10	-.01	-.34**
Hospital	-.11	.04	-.20	-.03	-.33**

Note** $p \leq .01$, $R^2 = .21$, $p < .01$.

Summary of Results

Table 10.18 summarises the percentage of variance explained and the direction of effect for each of the factors in the model, for each of the regression analyses conducted.

Table 10.18: Summary of stepwise regression analyses

Milestone	% variance explained	Factors in model	Direction of effect
Straight leg raise	19%	Age Left School	Leaving school at an earlier age was associated with slower achievement of SLR.
		Physiotherapy Intensity	A greater physiotherapy intensity was associated with earlier achievement of SLR.
90° bend	26%	Physiotherapy Intensity	A greater physiotherapy intensity was associated with earlier achievement of 90° bend.
Flexion at discharge	22%	Diverting Attention (CSQ)	A greater score on diverting attention was associated with less flexibility.
		Age Left School	Leaving school at an earlier age was associated with less flexibility.
Bed transfer	12%	Age Left School	Leaving school at an earlier age was associated with slower achievement of independence with bed transfer.
Chair transfer	9%	Praying/Hoping (CSQ)	A greater score on praying/hoping was associated with slower achievement of independence with chair transfer.
Zimmer frame	11%	Gender	Being female was associated with slower achievement of independence with frame.
Crutches	10%	Hospital	TBH < CMH < NGH.
LOS	21%	Age Left School	Leaving school at an earlier age was associated with longer post-operative LOS.
		Hospital	TBH < CMH < NGH.

Note: Abbreviations: TBH: Thornbury Hospital, CMH = Claremont Hospital, NGH = Northern General Hospital.

The analysis revealed that few psychological variables were important in the immediate post-operative recovery period. Diverting attention was found to be a significant predictor of number of degrees flexion at discharge, and praying/hoping a predictor of number of days taken to independently chair transfer. However, as the physiotherapy outcome measures are highly correlated (see Tables 10.3) and both psychological factors were predictive of only one outcome measure, it is likely that these were chance findings as a result of conducting a study with multiple outcomes. It is very unlikely that different psychological mechanisms would be employed in achievement of the physiotherapy key milestones. For example, one might expect that an individual employs that same coping mechanism in both chair transfer and bed transfer.

Age left school, hospital in which the patient had their surgery, and physiotherapy intensity were found to be predictors of the physiotherapy outcome measures; these shall be discussed in Chapter 12 (Knee Discussion).

Summary

The analysis of factors which influence time taken to achieve key physiotherapy milestones as an inpatient following total knee replacement revealed that few psychological variables were important. However, age left school, physiotherapy intensity and hospital at which the patient had their surgery were found to be important predictors.

Chapter 11: Knee Study: Three-month Post-operative Findings

This chapter will report:

- Three-month post-operative orthopaedic characteristics.
- Relationship between psychological factors and post-operative recordings of self-reported disability (activities limitation and participation restriction).
- Relationship between psychological factors and post-operative recordings activities limitation and participation restriction.
- Relationship between psychological factors and pain with post-operative self-reported disability (activities limitation and participation restriction).

3-month Post-Operative Orthopaedic Characteristics

Table 11.1 summarises the scores achieved on the joint-specific questionnaires three-months post-surgery.

Table 11.1: 3-month Knee Scores

Score	N	Range	Mean (+ SD)	Median	Mode
Flexion range	31	52 – 120	99.39 ± 15.74	100	95, 115
KSKS	57	20 – 100	63.16 ± 21.07	62	42
KSKS improvement	57	-36 – 65	19.71 ± 22.55	14	0, 11, 14
OKS	57	12 – 53	27.89 ± 9.46	28	19, 30, 31
OKS improvement	57	-3 – 31	12.98 ± 9.86	12	-1, 3, 12

The Relationship between Psychological Factors and Scores on Components of the Joint-Specific Questionnaires

Chapter 4 discusses the relationship between activities limitation and participation restriction (as recorded by the joint specific questionnaires), range of motion and pain (impairment). From the correlations recorded it is apparent that both pain and ROM may be important predictors in the regression model explaining three-month post-operative disability (activities limitation and participation restriction). However, the original aim of the research was to assess the relationship between psychological factors and post-operative recordings of disability (activities limitation and participation restriction). Therefore, the regression analysis is first conducted using only the psychological, demographic, and medical variables in the model.

As in the hip 3-month results chapter (Chapter 7), the regression models are repeated with the pre-operative score for the variable included in the model. Where a transformation (i.e. square root or log) had been applied to the post-operative data in order to normalise it, the same transformation was applied to the pre-operative data to allow comparison, or vice versa.

The regression analysis will then be repeated including reported level of pain and ROM; this will be reported and discussed later in the chapter.

In order to assess whether the data were normally distributed, z-scores for skewness and kurtosis were calculated. Transformations were carried out on the data which had an unacceptable skew or kurtosis. Pages 638-648 in the Appendix detail the z-scores on the raw data, transformations used and the z-scores post-transformation. The results below (including the regressions involving pain) are using the transformed data.

Correlations

The Pearson correlations conducted to identify independent variables for inclusion in the regression analysis are summarised in Tables 11.2 (demographic variables), 11.3 (medical factors), 11.4 (Multi-dimensional Health Locus of Control), 11.5 (NEO Five Factor Inventory), and 11.6 (Coping Strategies Questionnaire). Independent variables which correlated significantly with the dependent variable ($p < .05$) are included in the subsequent multiple regression analysis. The correlations between the pre-operative outcome measure and post-operative outcome measure are included in the medical factors table.

Table 11.2: Correlations between the demographic factors and the dependent variables

	KSKS F	KSKS P	OKS	OKS P1	OKS F1	OKS P2	OKS F2
Age	-.26	.23	-.10	-.11	-.09	-.12	-.09
Gender	-.16	-.13	.09	.02	.14	.05	.09
No. in house	.19	-.07	.04	.03	.05	.01	.05
Help at discharge	-.05	-.12	.14	.13	.12	.13	.13
Employment	-.28*	-.30	.20	.17	.20	.16	.20
Social class	-.07	-.08	.13	.09	.16	.23	.09
Education	-.00	-.00	.08	.11	.05	.02	.10
School	.30	.09	-.19	-.26	-.14	-.17	-.17

Note: * $p \leq .05$.

Abbreviations: KSKSF – Knee Society Knee Score functional component; KSKS P – KSKS pain component; OKS – Oxford Knee Score; OKS P1 – OKS pain component 1; OKS F1 – OKS functional component 1; OKS P2 – OKS pain component 2, OKS F2 – OKS functional component 2. No. in house = Number of people living in patient's house; Education = highest education level achieved; School = age left school.

Only one significant correlation was recorded; this was between employment status and KSKS functional component. This finding is likely to be a result of conducting a study with multiple endpoints.

Table 11.3: Correlations between medical factors and dependent variables

	KSKS F	KSKS P	OKS	OKS P1	OKS F1	OKS P2	OKS F2
BMI	-.16	-.12	.14	.13	.14	.09	.14
Co-morbidity	-.21	-.05	.04	.13	-.03	.14	.10
Referral to physician	-.25	.02	.08	.07	.07	.03	.08
Previous TJA	-.02	-.05	.08	-.01	.15	-.01	.10
Hospital	.27*	.11	-.21	-.19	-.20	-.10	-.23
Post-op Comp.	-.17	-.09	-.01	.07	-.07	.10	-.04
Pre-operative score	.42***	.22	.41**	.25	.47***	-34*	.38**

Note: * $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$.

Abbreviations: BMI = body mass index, Referral to physician = referral to physician to check for suitability for surgery, Previous TJA = Number of previous TJA. Abbreviations for joint-specific questionnaires as noted in Table 11.2.

A significant correlation existed between hospital in which patient had their surgery and the KSKS functional component. This may reflect the fact that younger, fitter patients were 'cherry-picked' to receive their surgery at one of the private hospitals. However, given that the correlation is weak and that hospital did not significantly correlate with any of the other outcome measures it is equally possible that this correlation is a result of multiplicity.

Correlations existed between all the pre-operative score and post-operative scores of the functional components suggesting that pre-operative functional ability influences post-operative functional ability. The same relationship does not appear to be true of pain; out of the three

pain components only OKS pain component type 2 significantly correlated with its pre-operative score.

Table 11.4: Correlations between dependent variables and Multi-dimensional Health Locus of Control (MHLC) variables

	KSKS F	KSKS P	OKS	OKS P1	OKS F1	OKS P2	OKS F2
Internal	.21	.15	-.08	-.10	.06	.10	.08
Chance	-.36**	-.36**	.35**	.37**	.30*	.32*	.33*
Doctors	-.22	-.07	.05	.05	.05	.07	.04
Others	-.17	-.12	.06	.09	.03	.12	.03

Note: * $p \leq .05$, ** $p \leq .01$. Abbreviations for joint-specific questionnaires as noted in Table 11.2.

Significant correlations existed between chance locus of control and all of the outcome measures: a higher score on the chance scale of MHLC is associated with less functional ability and more pain. This is the same as that recorded in the pre-operative correlations. None of the other scales on the MHLC significantly correlated with any of the outcome measures.

Table 11.5: Correlations between the NEO-Five Factor Inventory (NEO-FFI) and the dependent variables

	KSKS F	KSKS P	OKS	OKS P1	OKS F1	OKS P2	OKS F2
Neuroticism	-.39**	-.28*	.39**	.34**	.39**	.32*	.38**
Extraversion	.36**	.10	-.23	-.23	-.22	-.11	-.26
Openness	.30*	.15	-.23	-.24	-.20	.19	-.23
Agreeableness	-.06	.07	-.13	-.12	-.13	-.18	.11
Conscientiousness	-.02	.17	-.11	-.08	-.13	-.06	-.12

Note: * $p \leq .05$, ** $p \leq .01$. Abbreviations for joint-specific questionnaires as noted in Table 11.2.

Neuroticism significantly correlated with all of the outcome measures; a greater score on neuroticism was associated with worse functioning and more pain. Extraversion and openness to experience both significantly positively correlated with the KSKS functional component. Agreeableness and conscientiousness did not correlate significantly with any of the dependent variables.

Table 11.6: Correlations between factors in the Coping Strategies Questionnaire (CSQ) and the dependent variables

	KSKS F	KSKS P	OKS	OKS P1	OKS F1	OKS P2	OKS F2
DA	-.01	-.10	.10	.03	.14	.03	.11
RPS	.09	-.04	.07	.07	.06	.11	.06
CSS	.09	.13	-.14	-.13	-.14	-.19	-.13
IS	.09	.13	-.14	-.13	-.14	-.19	-.13
P/H	-.19	.08	.05	-.01	.10	.02	.05
C	-.32*	-.29*	.33*	.36**	.28*	.27*	.33*
IBA	-.07	-.12	.12	.08	.14	.10	.11
CP	.06	004	-.05	-.06	-.04	-.05	-.04
DP	.04	.02	-.08	-.11	-.04	-.15	-.04

Note: * $p \leq .05$, ** $p \leq .01$.

Abbreviations: DA = diverting attention; RPS = reinterpreting pain sensations; CSS = coping self statements; IS = ignoring sensations; P/H = praying/hoping; C = catastrophizing; IBA = increasing behavioural activities; CP = controlling pain; DP = decreasing pain. Abbreviations for joint-specific questionnaires as noted in Table 11.2.

Catastrophizing correlated significantly with all outcome measures, this is in agreement with pre-operative findings. However, pre-operatively, significant correlations were seen between several of the other coping strategies with the outcome measures; this is not replicated here.

Forward Stepwise Multiple Regression

Predictors of the Post-operative Knee Society Knee Score Function Component

A stepwise regression analysis was performed to predict scores on post-operative KSKS functional component from employment status of subject, chance (MHLC), neuroticism (NEO-FFI), extraversion (NEO-FFI), openness to experience (NEO-FFI), Catastrophizing (CSQ), and hospital where patient received treatment. The regression model explained **23%** of the variance, adjusted R^2 = .20, F(2, 54) = 8.12, p = .001. Neuroticism and hospital were found to make significant contributions to the regression model (see Table 11.7). The stepwise regression analysis was repeated including the pre-operative score on KSKS functional component as a variable. This regression explained **25%** of the variance, adjusted R^2 = .22, F (2, 54) = 8.86, p < .001. Extraversion and pre-operative function were found to make significant contributions to this regression model (see Table 11.8).

Table 9.12: Summary of forward stepwise regression analysis for variables predicting post-operative scores on KSKS functional component

Variable	B	SE B	95% CI		ß
			Lower	Upper	
Neuroticism	-1.12	.34	-1.79	-.45	-.40**
Hospital	12.33	5.11	2.08	22.58	.29*

Note: * p ≤ .05, ** p ≤ .01, R^2 = .23, p < .01.

Table 11.8: Summary of forward stepwise regression analysis for variables predicting post-operative scores on KSKS functional component including pre-operative function as a variable

Variable	B	SE B	95% CI		ß
			Lower	Upper	
Pre-op. KSKS Func	4.80	1.67	1.45	8.15	.36**
Extraversion	.93	.46	.01	1.85	.25*

Note: * $p \leq .05$, ** $p \leq .01$, $R^2 = .25$, $p < .001$. Abbreviation: Pre-op. KSKS Func. = score on pre-operative KSKS function component.

Predictors of the Post-operative Knee Society Knee Score Pain Component

A stepwise regression analysis was performed to predict post-operative scores on KSKS pain component from chance (MHLC), neuroticism (NEO-FFI), and catastrophizing (CSQ). The regression model explained **13%** of the variance, adjusted $R^2 = .11$, $F(1, 55) = 7.95$, $p < .01$. Chance was found to make a significant contribution to the regression model (see Table 11.9). As scores on the pre-operative pain component of the KSKS did not significantly correlated with scores on the post-operative pain component; there was no need to repeat the regression analysis including this variable.

Table 11.9: Summary of forward stepwise regression analysis for variables predicting post-operative scores on KSKS pain component

Variable	B	SE B	95% CI		ß
			Lower	Upper	
Chance	-.05	-.02	-.09	-.02	-.36**

Note: ** $p \leq .01$, $R^2 = .13$, $p \leq .01$.

Predictors of the Post-operative Scores on Oxford Knee Score

A stepwise regression analysis was performed to predict post-operative scores on the Oxford Knee Score from chance (MHLC), neuroticism (NEO-FFI), and catastrophizing (CSQ). The regression model explained **15%** of the variance, adjusted $R^2 = .15$, $F(1, 55) = 9.76$, $p < .01$. Neuroticism was found to make a significant contribution to the regression model (see Table 11.10). The stepwise regression analysis was repeated including the pre-operative score on OKS as a variable. This regression explained **16%** of the variance, adjusted $R^2 = .15$, $F(1,55) = 10.79$, $p < .01$. Only pre-operative score on OKS was found to make a significant contribution to this regression model (see Table 11.11).

Table 11.10: Summary of forward stepwise regression analysis for variables predicting post-operative scores on OKS

Variable	B	SE B	95% CI		ß
			Lower	Upper	
Neuroticism	.49	.16	.18	.80	.39**

Note: ** $p \leq .01$, , $R^2 = .16$, $p \leq .01$.

Table 11.11: Summary of forward stepwise regression analysis for variables predicting post-operative scores on OKS including pre-operative scores on OKS as a variable

Variable	B	SE B	95% CI		ß
			Lower	Upper	
Pre-operative OKS	.45	.14	.18	.72	.41**

Note: ** $p \leq .01$, $R^2 = .16$ $p < .01$.

Predictors of the Post-operative Scores on the OKS Function Component

Type 1

A stepwise regression analysis was performed to predict post-operative scores on OKS functional component type 1 from chance (MHLC), neuroticism (NEO-FFI), and catastrophizing (CSQ). The regression model explained **15%** of the variance, adjusted $R^2 = .14$, $F(1, 55) = 9.95$, $p < .01$. Neuroticism was found to make a significant contribution to the regression model (see Table 11.12). The stepwise regression analysis was repeated including the pre-operative score on OKS functional component as a variable. This regression explained **23%** of the variance, adjusted $R^2 = .21$, $F(1,55) = 15.95$, $p < .001$. Pre-operative function was found to make a significant contribution to this regression model (see Table 11.13).

Table 11.12: Summary of forward stepwise regression analysis for variables predicting post-operative scores on OKS functional component type 1

Variable	B	SE B	95% CI		ß
			Lower	Upper	
Neuroticism	.28	.09	.10	.46	.09**

Note: ** $p \leq .01$, $R^2 = .15$, $p < .01$.

Table 11.13: Summary of forward stepwise regression analysis for variables predicting post-operative scores on OKS functional component type 1 including pre-operative function as a variable

Variable	B	SE B	95% CI		ß
			Lower	Upper	
Pre-op. OKS Funct	.48	.12	.24	.72	.47***

Note: *** p≤ .001, R^2 = .23, p < .001. Abbreviation: Pre-op OKS Func. 1 = pre-operative scores on the OKS function component type 1.

Predictors of the Post-operative OKS Pain Component Type 1

A stepwise regression analysis was performed to predict post-operative scores on the OKS pain component type 1 from chance (MHLC), neuroticism (NEO-FFI), and catastrophizing (CSQ). The regression model explained **14%** of the variance, adjusted R^2 = .12, F(1, 55) = 8.86, p < .01. Chance was found to make a significant contribution to the regression model (see Table 11.14). As scores on the pre-operative score on OKS pain component type 1 did not significantly correlated with scores on the post-operative pain component; there was no need to repeat the regression analysis including this variable.

Table 11.14: Summary of forward stepwise regression analysis for variables predicting post-operative scores on OKS pain component type 1

Variable	B	SE B	95% CI		ß
			Lower	Upper	
Chance	.20	.07	.06	.33	.37**

Note: ** p ≤ .01, R^2 = .14, p < .01.

Predictors of the Post-operative OKS Functional Component Type 2

A stepwise regression analysis was performed to predict post-operative scores on the OKS functional component type 2 from chance (MHLC), neuroticism (NEO-FFI), and catastrophizing (CSQ). The regression model explained **15%** of the variance, adjusted R^2 = .13, F(1, 55) = 9.37, p < .01. Neuroticism was found to make a significant contribution to the regression model (see Table 11.15). The stepwise regression analysis was repeated including the pre-operative score on OKS functional component type 2 as a variable. This regression produced the same model as above (see Table 11.15).

Table 11.15: Summary of forward stepwise regression analysis for variables predicting post-operative scores on OKS functional component type 2

Variable	B	SE B	95% CI		ß
			Lower	Upper	
Neuroticism	.39	.13	.13	.64	.38**

Note: ** p ≤ .01, R^2 = .15, p < .01

Predictors of the Post-operative OKS Pain Component Type 2

A stepwise regression analysis was performed to predict post-operative scores on the OKS pain component type 2 from chance (MHLC), neuroticism (NEO-FFI), and catastrophizing (CSQ). The regression model explained **10%** of the variance, adjusted R^2 = .09, F(1, 56) = 6.38, p < .05. Neuroticism was found to make a significant contribution to the regression model (see Table 11.16). The stepwise regression analysis was repeated including the pre-operative score on the OKS pain component type 2 as a variable. This regression explained **11%** of the variance, adjusted R^2 = .09, F(1, 55), = 6.62, p < .05. Pre-operative pain was found to make a significant contribution to this regression model (see Table 11.17).

Table 11.16: Summary of forward stepwise regression analysis for variables predicting post-operative scores on OKS pain component type 2

Variable	B	SE B	95% CI		ß
			Lower	Upper	
Neuroticism	.010	.04	.02	.18	.32*

Note: * $p \leq .05$, $R^2 = .10$, $p < .05$.

Table 11.17: Summary of forward stepwise regression analysis for variables predicting post-operative scores on the OKS pain component type 2 including pre-operative pain scores as a variable

Variable	B	SE B	95% CI		ß
			Lower	Upper	
Pre-op. OKS Pain 2	1.45	.56	.32	2.57	.33*

Note: * $p \leq .05$, $R^2 = .11$, $p < .05$. Abbreviation: Pre-op. OKS Pain 2 = pre-operative scores on the OKS pain component type 2.

Summary of Results

Table 11.18 summarises the regression models produced which **did not include** the pre-operative scores for the outcome measure as a variable. The table summarises the percentage of variance explained and the direction of effect for each of the factors in the model, for each of the regression analyses conducted.

Table 11.18: Summary of regression analyses (excluding pre-operative scores as a predictor)

Outcome	% variance explained	Factors in model	Direction of effect
KSKS function	23%	Neuroticism (NEO-FFI)	A greater score on neuroticism was associated with a lower functional ability.
		Hospital	TBH > CMH > NGH for functional ability.
KSKS pain	13%	Chance (MHLC)	A greater score on the chance scale was associated with a lower functional ability.
OKS	15%	Neuroticism (NEO-FFI)	A greater score on neuroticism was associated with a lower functional ability and more pain.
OKS function 1	15%	Neuroticism (NEO- FFI)	A greater score on neuroticism was associated with a lower functional ability.
OKS pain 1	14%	Chance (MHLC)	A greater score on chance was associated with more pain.
OKS function 2	15%	Neuroticism (NEO-FFI)	A greater score on neuroticism was associated with a lower functional ability.
OKS pain 2	11%	Neuroticism (NEO-FFI)	A greater score on neuroticism was associated with more pain.

Note: TBH = Thornbury Hospital, CMH = Claremont Hospital, NGH = Northern General Hospital.

Table 11.18 reveals that, in general, neuroticism (NEO-FFI) predicts function whilst the chance (MHLC) is responsible for predicting pain.

Table 11.19 summarises the regression models produced which **included the pre-operative scores for the outcome measure as a variable**. The table summarises the percentage of variance explained and the direction of effect for each of the factors in the model, for each of the regression analyses conducted. These regression analyses including the pre-operative scores

as a variable were conducted for KSKS functional component, OKS, OKS functional component type 1, OKS functional component type 2 and OKS pain component type 2.

Table 11.19: Summary of regression analyses including pre-operative scores as a variable

Outcome	% variance explained	Factors in model	Direction of effect
KSKS function	25%	Pre-operative KSKS Function	Better functioning pre-operatively was associated with better functioning post-operatively.
		Extraversion (NEO-FFI)	A greater score on extraversion was associated with better functioning.
OKS	16%	Pre-operative OKS	Better functioning and less pain pre-operatively were associated with better pain and less pain post-operatively.
OKS function 1	23%	Pre-operative OKS Function 1	Better functioning pre-operatively was associated with better functioning post-operatively.
OKS function 2	15%	Neuroticism (NEO-FFI)	A greater score on neuroticism was associated with worse functioning.
OKS pain 2	11%	Pre-operative OKS Pain 2	Less pain pre-operatively was associated with less pain post-operatively

Table 11.19 reveals that pre-operative score is an important predictor of function; including function causes some of the psychological variables to become non-significant in the regression model. Pre-operative pain, as measured using OKS pain component type 2, influenced the post-operative recording. The other two pain components (KSKS pain and OKS pain component type 1) were not included in this second level of analyses as significant correlations were not recorded between the pre- and post-operative scores. Table 11.20 compares the

difference in variables in the regression models when pre-operative scores of the dependent factor are added as a variable in the model.

Table 11.20: Comparison of variables in regression models when excluding/including pre-operative scores on outcome as a predictor

Outcome	Factors in regression excluding pre-op scores	Factors in regression including pre-op scores
KSKS function	Neuroticism Hospital	Pre-operative score Extraversion
OKS	Neuroticism	Pre-operative score
OKS function 1	Neuroticism	Pre-operative score
OKS function 2	Neuroticism	Neuroticism
OKS pain 2	Neuroticism	Pre-operative score

Note: KSKS pain and OKS pain component type 1 are not included in this table as there were no significant correlations between them and pre-operative score and therefore this regression analysis was not repeated for these factors.

Inclusion of pre-operative status caused neuroticism to become non-significant in all of the regression models studied except OKS functional component type 2.

Tables 11.18-11.20 reveal that neuroticism (NEO-FFI) is an important predictor of post-operative pain whilst chance (MHLC) is a predictor of post-operative pain. These factors shall be discussed in Chapter 12 (Knee Discussion) and Chapter 13 (Compare and Contrast).

The Relationship between Psychological Factors and Pain with Post-operative Scores on the Components of the Joint-Specific Questionnaires

One of the aims of study was to examine the relationship between post-operative impairment, activity limitation and participation restriction. In Chapter 4 it has been discussed how correlations were recorded between ROM and function, and pain and function (activities limitation and participation restriction). As such pain and ROM may be important predictors of the post-operative outcome variables. The recordings of pain and ROM were not included in the multiple regression analyses above as one of the original aims of the study was to assess whether psychological factors affected post-operative activity limitation and participation restriction. However, given the findings that pain and ROM influences this, the analyses will now be repeated including the scores on the pain components and ROM. The other independent factors (including pre-operative status) are entered into the models as above. The multiple regression analyses are only repeated for the functional components. This is to prevent overlap between the pain component and questions in the complete instruments referring to pain. The KSKS pain component is used as a measure of pain.

Predictors of Post-operative Knee Society Knee Score Function Component

A stepwise regression analysis was performed to predict scores on post-operative KSKS functional component from employment status of subject, chance (MHLC), neuroticism (NEO-FFI), extraversion (NEO-FFI), openness to experience (NEO-FFI), catastrophizing (CSQ), hospital where patient received treatment, pre-operative scores on KSKS functional component, ROM, and pain assessed using the KSKS pain component. The regression model explained **23%** of the variance, adjusted $R^2 = .21$, $F(1, 30) = 8.79$, $p < .01$. Pre-operative function was found to make a significant contribution to the regression model (see Table 11.21).

Table 11.21: Summary of forward stepwise regression analysis for variables predicting post-operative scores on KSKS functional component including pre-operative score, ROM and post-operative pain as variables

Variable	B	SE B	95% CI		ß
			Lower	Upper	
Pre-op. KSKS Func	6.62	2.23	2.05	11.18	.48**

Note: ** $p \leq .01$, $R^2 = .23$, $p < .01$. Abbreviation: Pre-op. KSKS Func. = pre-operative scores on KSKS function component.

The lower number of patients in the analysis is a result of inclusion of ROM as a predictor. It was only possible to record post-operative ROM in 30 cases. As ROM was not found to be a predictor in the model, the regression analysis was repeated with this variable omitted in case the results were spurious as a result of this. The regression model explained **41%** of the variance, adjusted $R^2 = .39$, $F(2, 54) = 18.80$, $p < .001$. Post-operative pain and extraversion were found to make significant contributions to the regression model (see table 11.22).

Table 11.22: Summary of forward stepwise regression analysis for variables predicting post-operative scores on KSKS functional component including pre-operative score, and post-operative pain as variables

Variable	B	SE B	95% CI		ß
			Lower	Upper	
Post-operative Pain	8.76	1.74	5.28	12.24	.53***
Extraversion	1.14	.39	.37	1.92	.31**

Note: ** $p \leq .01$, **** $p \leq .001$, $R^2 = .41$, $p < .001$.

Predictors of Post-operative Scores on the OKS Function Component Type 1

A stepwise regression analysis was performed to predict post-operative scores on OKS functional component type 1 from chance (MHLC), neuroticism (NEO-FFI), catastrophizing (CSQ), pre-operative scores on OKS functional component type 1, ROM, and pain measured using KSKS pain component. The regression model explained **75%** of the variance, adjusted $R^2 = .74$, $F(2, 30) = 42.90$, $p < .001$. Post-operative pain and pre-operative scores on the OKS functional component type 1 were found to make significant contributions to the regression model (see Table 11.23).

Table 11.23: Summary of forward stepwise regression analysis for variables predicting post-operative scores on OKS functional component type 1 including pre-operative score, ROM and post-operative pain as variables

Variable	B	SE B	95% CI		ß
			Lower	Upper	
Post-operative Pain	-2.90	.40	-3.72	-2.09	-.71***
Pre-op. OKS Func.	.32	.09	.13	.51	.34***

Note: *** $p \leq .001$, $R^2 = .75$, $p < .001$. Abbreviation: Pre-op. OKS Func. = pre-operative scores on OKS function component type 1.

Again, the lower number of patients in the analysis is a result of inclusion of ROM as a predictor. As ROM was not found to be a predictor in the model, the regression analysis was repeated with this variable omitted in case the results were spurious as a result of this. The resulting regression is very similar to that recorded above ($R^2 = .74$, $F(2,54) = 77.84$, $p < .001$).

Summary of Results

Table 11.24 summarises the percentage of variance explained and the direction of effect for each of the factors in the model, for each of the regression analyses conducted. The results are

using the regression where range of motion has been excluded as a predictor thus increasing the sample size.

Table 11.24: Summary of regression analyses for function including pre-operative scores and post-operative pain as variables

Outcome	% variance explained	Factors in model	Direction of effect
KSKS function	41%	Post-operative Pain	Less pain was associated with better functioning.
		Extraversion	A greater score on extraversion was associated with better functioning.
OKS function 1	74%	Post-operative Pain	Less pain was associated with better functioning.
		Pre-operative function	Better functioning pre-operatively was associated with better functioning post-operatively.

Despite the strong correlations ROM was not found to be a predictor of post-operative function.

Extraversion was found to be a significant predictor of KSKS functional component. This may be a spurious result as extraversion was not shown to be a predictor in other regression models of post-operative function.

Pre-operative function was found to be a predictor of the OKS functional component. The finding that post-operative pain is a predictor of function (both KSKS functional component and OKS functional component type 1) is in agreement with the baseline knee results.

Seventy four percent of the variance in score of the OKS functional component was predicted by pre-operative function and post-operative pain. No psychological factors feature in this final regression model. However, the psychological factors were predictors of both pre-operative OKS functional component type 1 (openness to experience, chance, and praying and hoping) and the post-operative KSKS pain component (chance) and therefore indirectly may effect outcome.

Summary of Chapter

This chapter has reported:

- That neuroticism is an important predictor of post-operative function (when pre-operative status is excluded).
- That chance (MHLC) is an important predictor of post-operative pain.
- That pre-operative status is an important predictor of post-operative function.
- That post-operative pain is an important predictor of activities limitation and participation restriction post-operatively.

Chapter 12: Discussion of Findings of the Knee Study

This chapter will:

- Summarise the findings of the regression analyses at the three time points in the study.
- Relationship between the psychological factors, pain, activities limitation and participation restriction:
  - Neuroticism (NEO-FFI).
  - Openness to experience (NEO-FFI).
  - Praying/hoping (CSQ)
  - Catastrophizing (CSQ).
  - Controlling pain (CSQ).
  - Chance (MHLC).
- Discuss the relationship between demographic factors and pain and function (activities and participation).
- Discuss the relationship between pre-operative status and post-operative status.
- Discuss the relationship between pain and function (activities and participation).
- Provide a summary of the chapter.

Predictors of Knee Pain and Function

As the study was exploratory in nature, many variables were recorded in the study. Variables which significantly correlated with the outcome measures were included in the regression analyses. However, it is still possible that some of the findings of the multiple regression analysis occurred by chance as having many variables and multiple end-points in the study (Feise 2002). Therefore, in order to develop a picture of which variables are likely to be important predictors of pain and function (both pre- and post-operatively) it is important to look across the results in order to identify those which were repeatedly significant predictors in the regression models. For the benefit of the reader, the collated results are summarised in Tables 12.1 (combined results), 12.2 (functional components) and 12.3 (pain components). These data are generated from Tables 9.21-9.24, 10.18, and 1118.

Table 12.1: Summary of the number of outcome measures each independent variable predicts pre-operatively, during in-patient physiotherapy and at 3-months post-operatively

		No. of regression models in which the variable is a significant predictor			
Questionnaire	**Variable**	**Pre-op**	**Physio.**	**Post-op**	**Total**
NEO-FFI	Neuroticism	4*	-	5	**9**
	Openness to Experience	5	-	-	**5**
Coping Strategies Questionnaire	Diverting Attention	-	1	-	**1**
	Reinterpreting Pain Sens.	1	-	-	**1**
	Coping Self Statements	1	-	-	**1**
	Praying/Hoping	5	1	-	**6**
	Catastrophizing	2	-	-	**2**
	Controlling Pain	4	-	-	**4**
MHLC	Chance	1*	-	2	**3**
Demographics	Gender	7	1	-	**8**
	Age Left School	-	4	-	**4**
	Employment Status	1	-	-	**1**
Medical Factors	Co-morbidity	1	-	-	**1**
	Body Mass Index	1	-	-	**1**
	Hospital	-	2	1	**3**
	Physiotherapy Intensity	-	2	-	**2**

Note: The regression models used in summating the data are the regression models which exclude pain and pre-operative status as predictors. All components were included (i.e. complete questionnaires e.g. OKS, functional components (including socks question) and pain components. Abbreviations: Pre-op = pre-operative recordings; Physio. = inpatient post-operative recordings of achievement of key physiotherapy milestones; Post-op = 3-month post-

operative recordings: Reinterpreting Pain Sens. = reinterpreting pain sensations. * Variable became non-significant in the model on inclusion of other variables.

No variables predicted outcome at all three time points. Neuroticism (NEO-FFI) was a predictor of both pre- and post-operative status, however, the effect of neuroticism became non-significant in the pre-operative regression models when other psychological variables were included. Similarly, chance locus of control (MHLC) was a predictor in both pre- and post-operative regression models; however, it became non-significant in the pre-operative models on inclusion of other psychological factors. Openness to experience (NEO-FFI), catastrophizing (CSQ), controlling pain (CSQ), and gender were found to be important predictors in the pre-operative regression models.

The predictors of the physiotherapy key milestones tended to be medical or demographic in nature; age left school, hospital in which patient had surgery, and physiotherapy intensity were found to be important predictors of key physiotherapy milestones. Only two predictors were psychological; these were praying and hoping (CSQ) and diverting attention (CSQ). As has already been discussed in the physiotherapy Chapter (10), these findings may be a result of conducting a study with multiple end-points as each appears in only one regression model despite the key physiotherapy outcome measures being interrelated. However, praying/hoping was a frequent predictor of pre-operative status and therefore it is possible that it is a predictor of the physiotherapy key milestone.

Diverting attention (CSQ), reinterpreting pain sensations (CSQ), coping self statements (CSQ), employment status, co-morbidity, and body mass index each only appear in one regression model and therefore these findings may be type 1 errors.

Table 12.2: Summary of the number of outcome measures relating to function that each independent variable predicts pre-operatively and 3-months post-operatively

		No. of regression models in which the variable is a significant predictor		
Questionnaire	**Variable**	**Pre-op**	**Post-op**	**Total**
NEO-FFI	Neuroticism	1	3	**4**
	Openness to Experience	3	-	**3**
Coping Strategies Questionnaire	Coping Self Statements	1	-	**1**
	Praying/Hoping	3	-	**3**
	Controlling Pain	2	-	**2**
MHLC	Chance	1	-	**1**
Demographics	Gender	3	-	**3**
	Employment Status	1	-	**1**
Medical Factors	Co-morbidity	1	-	**1**
	Body Mass Index	1	-	**1**
	Hospital	-	1	**1**

Note: The regression models used in summating the data are the regression models which exclude pain and pre-operative status as predictors. All components relating to function were included (KSKS function, OKS functional component type 1, OKS functional component type 2). Abbreviations as noted in Table 12.1.

Neuroticism (NEO-FFI) was the only variable which was found to be a predictor of function both pre- and post-operatively. Openness to experience (NEO-FFI), praying/hoping (CSQ), controlling pain (CSQ) and gender were important predictors of function pre-operatively. Coping self statements (CSQ), chance (MHLC), employment status, co-morbidity, and body mass index were each a significant predictor in only one regression model predicting function and therefore these may be chance findings as a result of conducting a study with multiple end-points.

Table 12.3: Summary of number of outcome measures relating to pain that each independent variable predicts pre-operatively and 3-months post-operatively

		No. of regression models in which the variable is a significant predictor		
Questionnaire	**Variable**	**Pre-op**	**Post-op**	**Total**
NEO-FFI	Neuroticism	2	1	**3**
	Openness to Experience	1	-	**1**
Coping Strategies Questionnaire	Reinterpreting Pain Sens.	1	-	**1**
	Praying/Hoping	1	-	**1**
	Catastrophizing	2	-	**2**
	Controlling Pain	1	-	**1**
MHLC	Chance	-	2	**2**
Demographics	Gender	3	-	**3**

Note: The regression models used in summating the data are the regression models which exclude pain and pre-operative status as predictors. All components relating to pain were included (HHS pain, OKS pain component type 1, OKS Pain component type 2). Abbreviations as noted in Table 12.1.

Neuroticism (NEO-FFI) was the only variable to be found to be a predictor in both pre- and post-operative regression models predicting pain. Catastrophizing (CSQ) and gender were found to be important predictors pre-operatively, whilst chance locus of control (MHLC) was found to be an important predictor of pain post-operatively. Openness to experience (NEO-FFI), reinterpreting pain sensations (CSQ), praying/hoping (CSQ), and controlling pain (CSQ) were each only a predictor in one regression model for pain and therefore these may be chance findings.

To summarise, neuroticism (NEO-FFI) was the only predictor of pre-operative and post-operative pain and function. Praying/hoping (CSQ) was found to be a predictor of pre-operative

pain and function and the physiotherapy key milestone of time taken to independently chair transfer. Similarly, gender was a predictor of both pre-operative pain and function and the physiotherapy key milestone of time taken to achieve independence in use of Zimmer frame. Openness to experience (NEO-FFI) and controlling pain (CSQ) were predictors of pre-operative pain and function. Chance locus of control (MHLC) was found to be a predictor of pre-operative pain and post-operative function. Age left school and hospital were predictors of several of the physiotherapy outcome measures. In addition, hospital in which the patient had their surgery was found to be a predictor of post-operative function. The section below discusses these findings in relation to the current literature available.

Neuroticism

Introduction to Neuroticism

Neuroticism is one of the 'Big Five' personality traits which has been shown to be stable over long periods of time (Soldz and Vaillant 1999). Costa and McCrae (1992) define neuroticism as:

> *"the general tendency to experience negative affects such as fear, sadness, embarrassment, anger, guilt and disgust".* (Costa and McCrae 1992:14)

By contrast, they define individuals scoring low on neuroticism as:

> *"emotionally stable, calm, even tempered and relaxed. They are able to face stressful situations without becoming upset or rattled"* (Costa and McCrae 1992:15)

Neurotic individuals are anxious, self-pitying, tense, touchy, unstable and worrying (McCrae and John 1992). Neuroticism has been associated with depression (Lozano and Johnson 2001;Aben et al. 2002) and negative affect (McCrae and Costa 1991).

In my knee study, neuroticism was found to predict function and pain both pre- and post-operatively (although it became non-significant pre-operatively on the inclusion of other psychological variables in the regression model). A higher score on neuroticism was associated with a greater intensity of pain and more disability. These findings are in line with the literature

which has reported the relationship between neuroticism negative health behaviours, health perceptions, pain and disability. This shall now be discussed.

Neuroticism and Health

McCrae and Costa (1991) reported that neuroticism was related to lower general well-being. Related to this, Duberstein et al. (2003) reported that, when controlling for depression and demographic factors, neuroticism was predictive of lower levels of perceived health in elderly primary care patients.

Neuroticism has also been related to health behaviours. Booth-Kewley and Vickers (1994) reported that neuroticism was negatively correlated with healthy behaviours such as exercise and a healthy diet, negatively correlated with accident control, and positively correlated with traffic risk taking. Similarly, Lemos-Giráldez and Fidalgo-Aliste (1997) reported that higher levels of neuroticism were associated with unhealthy behaviours such as poor diet, smoking and alcohol consumption. In contrast, Vollrath et al. (1999) reported that neuroticism was not associated with risky behaviours such as smoking, excessive alcohol intake or risky sexual activities but neurotic individuals reported high perceived susceptibility to the possible consequences of these activities such as alcohol dependence, drink-driving and sexually transmitted diseases. This is indicative of excessive worrying, a trait related to neuroticism (Costa and McCrae 1992) and may relate to hypochondrical concerns (Ferguson 2000) (see below for further details).

Neuroticism has been shown to be related to the prevalence of conditions, and the severity of their symptoms. Goodwin et al. (2006) examined the relationship between neuroticism and physical disorders using participants enrolled on the National Comorbidity Survey. They reported that after controlling for co-morbid mental disorders and demographic factors, neuroticism was associated with an increased risk of having arthritis, diabetes, kidney or liver disease, stomach conditions and ulcers. Charles et al. (1999) completed a longitudinal study of the influences of genetic and behavioural factors (recorded in the 1970s) on development of joint pain in the 1990s. Neuroticism was found to be a predictor of joint pain in women. These

findings were not replicated in men. Kempen et al. (1997) investigated the impact of personality on health-related quality of life in elderly individuals. Neuroticism was found to be a predictor of social functioning, health perceptions, bodily pain, and mental health. In agreement with this, Jerram and Coleman (1999), who conducted a study assessing the relationship between 'the big five' and reporting of health problems in old age, reported that neuroticism was associated with poorer health perceptions, poorer mental health and greater physical role limitation. Neuroticism has been found to be a predictor of disability (using impairment in ability to complete activities of daily living as a measurement) in community-dwelling elderly people (Jang et al. 2003) and when controlling for objectively measured functional limitation and demographic variables (Kempen et al. 1999).

Persson and Sahlberg (2002) reported that, in individuals with RA, neuroticism was predictive of negative illness cognitions which in turn were predictive of subjective symptoms of the disease. Related to this, Affleck et al. (1992) reported that neuroticism was associated with severity of chronic pain. In agreement with this, it has been shown that patients with persistent pain one-year following cholecystectomy had significantly higher levels of neuroticism than patients who did not have persistent pain one-year following this procedure (Jess et al. 1998). Harkins et al. (1989) investigated the impact of personality on reports of pain intensity and affective pain. Scores on neuroticism did not affect reported levels of pain either in a laboratory or clinical situation. However, neurotic participants reported they viewed the pain as more upsetting or threatening (i.e. reported higher levels of affective pain) and reported more emotion related to the pain than participants scoring low on neuroticism.

Mechanisms of Action of Neuroticism

Based on the above literature, it appears that the findings of the knee study fit well. But by what mechanism does neuroticism exert its action on pain and disability? There are three alternative theories relating to this: through its impact on health behaviours; as a result of report bias or through its impact on coping strategy usage.

Neuroticism may affect levels of pain and disability through its **impact on health behaviours**. It has been noted above that neuroticism is negatively associated with positive health behaviours such as exercise and maintaining a healthy diet, and positively associated with unhealthy behaviours such as smoking, and excessive alcohol intake. These lifestyle choices may have an impact on the susceptibility of contracting a condition and on the severity of the associated symptoms.

Alternatively, neuroticism may not actually affect the symptom severity of a condition but it may be associated with an **over-reporting of symptoms**. This is cited as a possible reason for the apparent findings in the National Comorbidity Study (see above) that some diseases and conditions are more prevalent in highly neurotic individuals. In a study investigating the reporting of health problems in old age, Jerram and Coleman (1999) found that neuroticism was associated with reporting of a greater number of medical problems. Similarly, in a role play situation where students were asked to pretend that they were either reporting symptoms of appendicitis or a sore throat, highly neurotic individuals presented more medical information, more psychosocial information in a more angry way than individuals scoring low on neuroticism (Ellington and Weibe 1999). The role plays were recorded and general practitioners reviewed the tapes. Interestingly, they viewed neurotic individuals as more likely to be over-reacting, having an ulterior motive and having psychological factors that were primarily responsible for explaining their symptoms. This indicates that, either consciously or subconsciously, health care professionals view individuals displaying characteristics associated with neuroticism as having a report-bias. The presence of a report-bias has also been demonstrated in a laboratory situation where participants have been inoculated with the cold virus. Feldman et al. (1999) reported that neuroticism was associated with a greater frequency of report of symptoms and of more severe symptoms both pre- and post-inoculation. Over-reporting of symptoms may relate to neurotic individuals tendencies to have hypochondrical concerns. Ferguson (2000) reported that neuroticism was associated with the disease conviction, disease fear, perceived inadequacy of a physician's explanation and reassurances, symptom persistence, and somatosensory amplification; all of which are signs of hypochondria.

An alternative theory as to how neuroticism exerts its actions on pain and disability is through its **influence on coping mechanisms**. Bermúdez (1999) reported that neuroticism was a predictor of having a chance locus of control orientation and of using emotion-focussed coping. Ramírez-Maestre et al. (2004), reported that, in patients with chronic pain, neuroticism was associated with a greater use of passive coping strategies and reduced use of active coping strategies; coping strategy choice related to pain intensity. David and Suls (1999) reported that, in a study assessing usage of coping strategies to deal with everyday stressors, highly neurotic individuals used more catharsis (a coping technique which brings repressed feelings and fears to the consciousness). A growing body of literature suggests that catastrophizing may be responsible for mediating the relationship between neuroticism and pain and disability (Turner and Aaron 2001). For example, Affleck et al. (1992) (study discussed above) reported that pain catastrophizing mediated the relationship between neuroticism and intensity of chronic pain in patients with rheumatoid arthritis. Similarly, Benrud-Larson et al. (2003) reported that in patients with postural tachycardia syndrome, catastrophizing mediates the relationship between neuroticism and functional disability. Goubert et al. (2004) offer a possibility of how neuroticism and catastrophizing may interact. They suggest that

> *"Neuroticism is... a vulnerability factor; it lowers the threshold at which pain is perceived as threatening, and at which point catastrophic thoughts about pain emerge"* (Goubert et al. 2004:234).

If neuroticism does exert its action through catastrophizing, then despite the fact neuroticism is stable over time and can not be manipulated, then there is potential to modify outcome through therapies that are designed to target catastrophizing (see section on catastrophizing for further information).

Summary of Neuroticism

Neuroticism was found to predict pain and function pre- and post-operatively in the knee study. This finding is in line with the literature where the relationship between higher scores on neuroticism and more severe self-reported pain and disability have been well-documented. Neuroticism may not in fact predict worse pain and disability but be a result of over-reporting symptoms. Alternatively, neuroticism may exert its action through its negative impact on health

behaviours, or through its impact on coping strategy usage. Current literature suggests that neuroticism may be related to catastrophizing; if this is the mechanism by which catastrophizing exerts its action then there is potential through cognitive behavioural therapy to modify outcome.

Openness to Experience

Introduction to Openness to Experience

Individuals scoring highly on openness to experience on the NEO-FFI tend to be artistic, curious, imaginative, insightful, original, and have wide-spanning interests (McCrae and John 1992). Costa and MrCrae (1992) stated individuals scoring highly on openness to experience have aesthetic sensitiveness, attentiveness to inner feelings, preference for variety, intellectual curiosity and independence of judgement. Openness is stable over long periods of time and measurements of it have been shown to be predictive of creativity 45 years later (Soldz and Vaillant 1999).

McCrae and Costa (1991) suggest that openness to experience does not affect overall health-related quality of life as individuals scoring highly in openness to experience experience both high and lows more intensively thus having no overall impact on outcome. However, in my knee study, high scores on openness to experience were found to be predictive of greater levels of functioning and less pain pre-operatively, although these findings were not replicated post-operatively.

Openness to Experience and Health

The literature available on openness to experience is slightly confusing with reports of open individuals being more likely to engage in unhealthy behaviours along with reports of better perceived health and functioning. At first glance it seems that these findings are contradictory, as one would expect that unhealthy behaviours to be associated with worse health and functioning. However, it is the traits such as 'curiosity' and a 'willingness to experience new things' which allow these contrasting results to co-exist. The existing literature of openness to experience will now be explored in more detail.

Openness to experience has been associated with unhealthy behaviours such as poor diet, smoking and excessive alcohol intake in women (Lemos-Giráldez and Fidalgo-Aliste 1997), and substance risk taking (Booth-Kewley and Vickers 1994) and engagement in risky sexual behaviour (Vollrath et al. 1999). The unhealthy behaviours are related to the greater level of curiosity to try new things in individuals with high levels of openness to experience.

Openness to experience has also been linked to better perceptions of health and better functioning. Goodwin and Engstrom (2002) reported that, in the general population, openness to experience is associated with better health perceptions in individuals both with and without existing medical problems. Related to this, Jerram and Coleman (1999) reported that, in community dwelling elderly people, high levels of openness to experience in women were associated with better perceptions of health, better physical functioning, less physical role limitation and pain, and more vitality. Surprisingly, these findings were not replicated in the men in the study where a greater score on openness to experience was associated with less vitality.

Duberstein et al. (2003) reported that, in elderly primary care patients, openness to experience was related to better physical functioning. They provide the following rationale as a possible explanation for their findings:

> *"By choosing a life rich with opportunity for growth, development and change, open people are more likely to pursue personal development and engage in activities that help them to maintain physical strength and flexibility thereby maintaining a relatively high level of function".* (Duberstein et al. 2003:27)

Therefore, the traits of curiosity and openness to experience, despite having some negative impacts on healthy behaviours, may be responsible for maintenance of active lifestyles which reduce limitation in function and experience of pain.

Openness to Experience and Coping Strategy Usage

An alternative mechanism by which openness to experience may exert its action on function and pain is through coping strategy usage. David and Suls (1999) completed a study

examining the use of coping strategies to deal with daily stressors. They reported that openness to experience was negatively associated with use of distraction (akin to diverting attention) and positively with taking direct action (akin to increasing behavioural activities). Providing support for this theory, Steultjens et al. (2001) assessed the effect of coping style in patients with osteoarthritis of the knee, and reported that a passive coping style was found to predict greater levels of disability 36-weeks later.

Openness to Experience and Problem Solving Ability

Openness to experience may also impact on pain and function through problem solving ability. Ferguson and Patterson (1998) suggest that openness to experience measures something similar to typical intellectual engagement which assesses problem solving ability. Individuals scoring highly on openness to experience may be able to devise creative ways of continuing to perform activities of daily living and therefore limit the progression of disability. There is no literature available in the health psychology field to support this theory but research from occupational psychology suggests this may be a plausible theory. Le Pine et al. (2000) completed a study where participants where asked to make decisions about a series of problems. The participants were unaware the rules regarding the correct decisions would change at intervals throughout the task. Participants were monitored on their decision making ability. Individuals scoring high on openness to experience were able to adapt better to a changing task and made better decisions relating to this.

Summary of Openness to Experience

Openness to experience has been found to be related to levels of pain and function pre-operatively in the knee study. A greater openness was associated with less pain and greater functioning. This is in line with the literature which has reported that open individuals have greater function and greater perceptions of health. Openness may exert its actions by encouraging a life which maintains high levels of activity, through coping strategy usage or through problem-solving ability.

Praying/Hoping

Introduction to Praying/Hoping

Praying and hoping is a coping strategy defined as:

> *"telling oneself to hope and pray that the pain will get better some day"* (Rosenstiel and Keefe 1983:35)

Examples of items on the CSQ which assess this strategy are: *'I pray to God it won't last long'* and *'I have faith in doctors that someday there will be a cure for my pain'.*

In my knee study, praying/hoping was found to be predictive of levels of pain and function pre-operatively, and of time taken to independently chair transfer as inpatient following surgery. Praying/hoping was associated with worse pain and function and a longer time to achieve the key physiotherapy milestone.

Praying/Hoping, Pain and Function

Despite the wealth of research investigating spirituality and the use of prayer in chronic conditions, little research has been conducted assessing praying and hoping's use as a coping strategy as measured by the CSQ. However, the literature available is in agreement with the findings from the knee study.

Rapp et al. (2000) reported that in knee pain patients, less use of praying and hoping was associated with less disability and better physical functioning. Similarly, Hill et al. (1995) reported that, in patients with phantom limb pain following amputation, greater use of praying and hoping as a coping strategy was associated with greater levels of pain and physical dysfunction.

Rosentiel and Keefe (1983) assessed the impact of coping strategy use in chronic back pain patients. Principal components analysis was carried out on the completed CSQ and revealed three components including the 'diverting attention and praying hoping factor' which was characterised by high scores on both these coping strategies. Patients scoring highly on this

factor reported greater pain and functional impairment than patients scoring low on this factor. Related to this, McCracken et al. (1998) investigated the impact of coping strategy use in chronic low back pain patients asked to complete an specific task. Praying and hoping was found to be associated with greater anxiety both before and during completion of the task, with higher ratings of pain, more restricted range of motion and fewer repetitions. The report of fewer repetitions is interesting as it may explain why individuals who use praying and hoping as a coping mechanism took a longer time to achieve independence in chair transfer.

Ashby and Lenhart (1994) reported that, in chronic pain patients, praying and hoping was associated with greater self-reported disability whilst Snow-Turek et al. (1996) reported that its usage, alongside catastrophizing, was associated with greater psychological distress and depression.

Mechanisms of Action of Praying/Hoping

Little research has been conducted to assess the mechanism by which praying and hoping exerts its action on function and pain. However, previous studies suggest that praying and hoping may be related to a chance locus of control or a lower self-efficacy.

Chance

Crisson and Keefe (1998) reported that praying and hoping was associated with a chance locus of control orientation. Chronic pain patients employing praying and hoping, and having a chance LOC rated their ability to control and decrease pain as poor. As is demonstrated below, pain control efficacy is an important factor in both pain intensity and disability.

Self-efficacy

Self-efficacy may mediate the relationship between psychological factors such as praying and hoping and chance, and function and pain. Self-efficacy may mediate the relationship between use of praying and hoping as a coping strategy and function and pain. Keefe et al. (1997b) reported that praying and hoping was found to be a significant predictor of self-efficacy for function measured using the Arthritis Self-Efficacy Scale: higher scores on praying and hoping

were associated with lower self-efficacy. Self-efficacy is known to affect both pain and function of patients with arthritis. Lefebreve et al. (1999) reported that self-efficacy was significantly related to ratings of pain in patients with rheumatoid arthritis. Rejeski et al. (2001) reported that low-self efficacy at baseline was associated with worse functional outcomes 30-months into their longitudinal study involving adults with knee pain. Similarly, Gaines et al. (2002) reported that self-efficacy is related to functional performance in woman with osteoarthritis of the knee, however, they were unable to replicate the findings for the men participating in the study. As well as affecting the symptoms of osteoarthritis progression, self-efficacy may also affect outcome of arthroplasty surgery. Moon and Backer (2000) reported that self-efficacy was associated with a greater number of repetitions of exercises required in the early post-operative phase following total joint arthroplasty. Kurlowicz (1998) reported that self-efficacy in the immediate post-operative period following total hip replacement was positively associated with functional ability six-weeks later.

Summary of Praying/Hoping

A higher score on praying and hoping was associated greater pain and disability pre-operatively and with a longer time to achieve independence in chair transfer in the immediate post-operative period. Praying and hoping has been consistently linked with worse function and greater pain in the literature although little research has been conducted into the way in which this coping mechanism exerts its action.

Catastrophizing

Introduction to Catastrophizing

Catastrophizing is defined as:

> *"A method of cognitively coping with pain characterized by negative self-statements and overly negative thoughts about the future"* (Keefe et al. 1989:53).

In my knee study, catastrophizing was found to be a predictor of pre-operative levels of pain.

This finding is in agreement with the extensive literature available on catastrophizing.

Catastrophizing, Pain and Function

The relationship between catastrophizing and pain has previously been reported in rheumatological conditions (Edwards et al. 2006), in rheumatoid arthritis (Keefe et al. 1989), in chronic back pain (Rosenstiel and Keefe 1983;Main and Waddell 1991;Buer and Linton 2002;Peters et al. 2005a), in soft tissue pain (Sullivan et al. 1998), in chronic pain conditions (Keefe and Williams 1990;Sullivan et al. 2005;Vervoot et al. 2006), temporomandibular disorder (Turner et al. 2004), gastrointestinal disorders (Drossman et al. 2000), in chronic prostatitis (Tripp et al. 2006), in multiple sclerosis (Osborne et al. 2006), in spinal cord injury (Turner et al. 2002), and in phantom limb pain following amputation (Whyte and Carroll 2004). A more in depth of this literature can be found in Chapter 8 (Hip Discussion).

Mechanisms of Action of Catastrophizing

The possible mechanisms by which catastrophizing exerts its action on pain and the therapies available to target catastrophizing have been discussed in Chapter 8 and will not be discussed further here.

Summary of Catastrophizing

In my knee study, catastrophizing was found to be a predictor of levels of pain pre-operatively. A greater score on catastrophizing was associated with more pain. These findings are in line with the literature from many chronic conditions and diseases. The possible mechanisms of action of catastrophizing and the interventions designed to moderate the level of catastrophizing are discussed in Chapter 8.

Pain Control Efficacy

Introduction to Pain Control Efficacy

One item on the CSQ assesses the perceived effectiveness of controlling pain. The item for controlling pain is: *"Based on all the things you do to cope, or deal with your pain, on an average day, how much control do you feel you have over it?"* Respondents are asked to reply using a 7-point scale with 0 representing "no control", 3 representing "some control" and 6 representing "control".

In the knee study, controlling pain was found to be a predictor of both pain and function pre-operatively with a greater perceived control predicting less pain and greater function. However, the relationship was not replicated post-operatively. This relationship has previously been demonstrated in patients with osteoarthritis of the knee and in patients following TKR.

Pain Control Efficacy, Pain and Function

Keefe et al. (1987a) examined the effect of coping strategies on functional ability in completing a task. Factor analysis of the completed CSQ identified two factors. Perceived efficacy of controlling pain is contained in the 'pain control and rational thinking factor' alongside efficacy in decreasing pain and low levels of catastrophizing. They reported that patients scoring high on this factor were much less functionally impaired being able to complete a timed walk more rapidly and move from a standing to sitting position more quickly in the observed task. Related to this, Keefe et al. (1987b) reported that patients scoring highly on the 'pain control and rational thinking factor' reported lower levels of pain and psychological distress and a better health status. Keefe et al. (1991) reported that, in patients with rheumatoid following TKR, a higher score on the pain control and rational thinking factor of the CSQ was associated with lower levels of pain and less psychological disability.

In addition, the relationship has also been demonstrated in rheumatoid arthritis (Keefe et al. 1997a;Lefebvre et al. 1999), and in chronic pain (Keefe and Williams 1990;Toomey et al. 1991;Tan et al. 2002). A fuller discussion of these studies can be found in Chapter 8 (Hip Discussion chapter).

Summary of Pain Control Efficacy

In my knee study, efficacy in controlling pain was found to be related to pain and function pre-operatively. This is in line with previous research in osteoarthritis of the knee as well as other areas of health research.

Chance

Introduction to Chance

In the knee study a greater chance locus of control orientation was associated with worse functioning pre-operatively and greater pain post-operatively.

Chance locus of control was measured using the Multidimensional Health Locus of Control Scale Form C (Wallston et al. 1994) which assesses three components of LOC: internality, chance, and others (split into powerful others and doctors). Examples of items relating to chance are *'what will be will'* and *'luck will play a big part in how my knee improves'*. A higher score on the chance scale of MHLC indicates that the individual believes that fate or luck are responsible for the control of their OA.

The assessment assumes the LOC is multidimensional i.e. the score on one component is independent of another. Wallston et al. first proposed that LOC should be considered as multidimensional in 1978 (Wallston et al. 1978) and that this scale should replace the health locus of control scale (HLC) previously produced (Wallston et al. 1976). The HLC is uni-dimensional in nature and assumes internality and externality are polar opposites. However, several studies still incorporate the HLC as a measure of LOC which makes interpretation of results difficult. However, at a very basic level, chance and powerful other can be viewed as the external components. The findings of the knee study shall now be related to the literature, first focusing on studies which have (correctly) used the MHLC as a measurement of LOC.

Chance, Pain and Function

In a study assessing the effects of LOC in patients with OA, Cross et al. (2006) reported that a high score on the chance scale of MHLC correlated with pain, function, disability, health status and number of visits to GP. Martin et al. (1990) reported that, in patients with chronic headache, a higher score on chance was associated with greater depression, more physical complaints, more headache-related disability and greater use of maladaptive coping strategies. It is likely that chance locus of control may exert its effects on pain and function through use of maladaptive coping strategies or lower self-efficacy. Crisson and Keefe (1998) reported that, in

chronic pain patients, a chance LOC orientation was associated with greater use of catastrophizing, praying/hoping and diverting attention and less efficacy in controlling pain. In addition, a greater score on chance was found to be associated with greater levels of psychological distress. Similar findings have been replicated by Skevington (1983) and Martin et al. (1990). Härkäpää et al. (1996) assessed the relationship between LOC and pain coping strategy usage in back pain patients and reported that chance on MHLC was predictive of the helplessness factor on the pain-related control scale and catastrophizing. Patients scoring highly in chance may have a lower self-efficacy (Cross et al. 2006) thus inhibiting their activity resulting in more disability and pain (Nyland et al. 2002)

External Locus of Control, Pain and Function

There is greater scope of literature available using LOC measures which consider the construct to be unidimensional. Nyland et al. (2002) reported that, in patients awaiting anterior cruciate ligament reconstruction, that greater beliefs in external control was associated with greater perceived functional limitations. Härkäpää et al. (1991) reported that externality was associated with less exercise in the follow-up period after an physiotherapy intervention aimed at treating their back pain. Partridge and Johnston (1989) developed an uni-dimensional measure designed to assess LOC in recovery/rehabilitation. They reported, in their preliminary study involving wrist fracture patients and stroke patients, that patients with an internal orientation showed more progression during rehabilitation than patients with an external orientation. This measure has also been used in studies assessing recovery following TKR (Kendell et al. 2001) and following surgery for fractured neck of femur (Shaw et al. 2003). Kendell et al. (2001) reported that a greater degree of internality (considered polar opposite of externality) was associated with an earlier achievement of straight leg raise following TKR. However, LOC did not correlate with any of the other key physiotherapy outcome measures in this study and therefore it is possible that this finding arose as a result of type 1 error. Shaw et al. (2003) reported that, in women undergoing surgery for fractured neck of femur, greater internality was associated with less disability 30-days post-surgery.

Summary of Chance

Chance locus of control was found to be related to function pre-operatively and to level of pain post-operatively. A greater score on chance predicted worse function and greater pain levels. There is only limited previous research available in this area which has used the MHLC as the measure of LOC but the research available is in agreement with the findings of the study. There is more research available where LOC is measured using a uni-dimensional scale; if chance is considered as an external factor, then these results are also in agreement with the findings of the study. Chance locus of control may exert its actions of function and pain through use of maladaptive coping strategies such as catastrophizing and praying/hoping and through low control efficacy of pain.

Demographic Factors

Gender, age left school and hospital were found to be important predictors of outcome. Gender was found to be a predictor of pre-operative function and pain and time taken to independently use Zimmer frame as an inpatient. Age left school was found to be a predictor of several of the key physiotherapy milestones. Hospital was found to predict time taken to achieve independence with crutches, post-surgical length of stay (LOS), and function at 3-months post-operatively.

Gender

Being female was associated with a greater pain and disability pre-operatively and longer time to achieve independence in use of Zimmer frame as an inpatient in the early post-operative period. This finding is in agreement with previously published literature, which shall now be discussed.

Hawker et al. (2000) conducted a large scale study in Ontario, Canada to assess the unmet need for arthroplasty surgery as a result of hip or knee OA. Women were reported to have worse scores on WOMAC and SF-36 Physical Functioning and required more daily assistance as a result of their OA. However, the women in this study were older and more likely to live alone; both of these factors have an impact on the symptoms of OA.

In agreement with Hawker et al.'s (2000) findings, Paradowski et al. (2006) reported that, again in a study assessing knee complaints in a community sample, severity was worse in women. However, a previous two-year long study conducted by Paradowski et al. (2005) failed to detect any difference in function or pain as a result of gender in patients with early osteoarthritis of the knee. The observed difference may relate to the stage of OA that the patients in the studies were at.

Peters et al. (2005b) reported their findings of a study which assessed the progression of pain and disability (measured with the New Zealand Score)as a result of hip or knee osteoarthritis. They reported that, over the seven-year study period, women showed greater deterioration than men. Therefore, if severity is generally worse in the population is worse in women than men, then it would be expected that this gender difference would persist into the hospital sample. Kennedy et al. (2002) reported that in patients awaiting THR or TKR, women showed greater disability than men both in the self-report measure and also in the physical performance task indicating that the gender difference in functioning was real rather than as a result of reporter bias.

Why might gender impact on the symptoms of osteoarthritis of the knee? Possible explanations may be social factors, coping strategies or biochemical factors.

As already stated, the women in Hawker et al.'s (2000) study were more likely to live alone. Koukouli et al. (2002) reported that in the general population (in Crete) living arrangements had an impact on self-reported functional status with living alone being associated with greater problems with mobility, self-care and completion of activities of daily living. Similarly, Weinberger et al. (1990) reported that social support impacted on functional status of patients with osteoarthritis. Evers et al. (2003) demonstrated that low levels of social support at the time of diagnosis of rheumatoid arthritis were predictive of pain and disability at follow-up three and five years later.

Keefe et al. (2000) proposed that catastrophizing mediates the relationship between gender and pain and physical disability. However, this cannot be the case for the results of this study as gender was significant predictor of all of the outcome variables even when catastrophizing was included in the regression models.

The gender difference could be a result of the pathogenesis of the joint. Pagura et al. (2003) identified that insulin-like growth factor-I were markedly reduced in women (in 21% of cases to a level of clinical hormone deficiency) compared to men with end-stage osteoarthritis of the knee. It has been shown that insulin-like growth factor-I plays a role in the synthesis of articular cartilage and reduced levels may contribute to the disease process in osteoarthritis (Trippel 2004).

Age Left School

Leaving school at a younger age was found to be a predictor of a greater number of days taken to achieve unassisted straight leg raise, a greater number of days to independently bed transfer, less degrees flexion of knee at discharge, and longer post-operative LOS.

In designing this study age left school was included in the demographics questionnaire as an alternative measure of education level. Pearson correlations reveal that it moderately correlated with the other measure of education in the study; highest education level achieved ($r = .41$, $p = .001$). However, it was also found to significantly correlate with age ($r = -.38$, $p = .002$), suggesting that older generations were more likely to leave school at a younger age. Therefore, we cannot be sure whether the demographic variable of age left school is measuring advancement in age, a lower level of education or a combination of the two.

Both age and education have previously been shown to impact on outcome of knee replacement (Forrest et al. 1998;Mahomed et al. 2002;Vincent et al. 2006). Mahomed et al. (2002) proposed that a better education was associated with higher expectations of the

outcome of the surgery. Expectations were found to be a predictor of functional outcome following total joint arthroplasty.

In the general population advancing age is associated with worse functioning of the knee irrespective of injury or disease of the knee, hip, spine or lower extremities. This has been demonstrated by Bremner-Smith et al. (2004) who commented that in the OKS and KSKS the impact was more apparent for the questions relating to function; and also by Brinker et al. (1997) who reported that age effect was especially apparent for individuals 85 or older.

Slower recovery following TJA has also been noted. Peerbhoy et al. (1999) reported that advancing age was associated with a longer time to achieve independence with climbing/descending stairs. Several researchers have reported the relationship between older age and longer post-operative LOS (Forrest et al. 1998;Peerbhoy et al. 1999;Weaver et al. 2003;Vincent et al. 2006) and related to this, in America, advancing age was related to being discharged to another facility (such as rehabilitation ward) rather than directly to their home (Epps 2004).

Physiotherapy Intensity

Physiotherapy intensity was shown to be a predictor of time taken to achieve straight leg raise and 90° bend following surgery. Time taken to achieve 90° bend was only recorded in a few patients (21) and therefore caution must be taken in interpreting this result. Jette et al. (2005) reported that physiotherapy intensity was related to functional status in their study examining rehabilitation in stroke, orthopaedic, cardiovascular and respiratory patients.

Hospital

Receiving care at one of the private hospitals was associated with a shorter time taken to achieve independence in crutches, a shorter post-operative LOS, and better function at 3-months post-operatively. As discussed in Chapter 8, patients receiving their care at one of the private hospitals were more likely to be younger, in employment and had fewer co-morbidities. Seventy-two percent of the TKR patients enrolled in the study attending the private hospitals

were free of significant co-morbidity compared to 46% of the patients at the Northern General Hospital (NGH). In addition, no patients receiving their surgery at the private hospitals suffered from both cardiovascular and respiratory conditions. Comparatively, 21% of patients at NGH had both groups of co-morbidity.

Age (Forrest et al. 1998;Vincent et al. 2006) and co-morbidity (Wasielewski et al. 1998;Weaver et al. 2003;Lingard et al. 2004) are known to affect outcome from TJA. In addition, the intensity of physiotherapy was greater at Thornbury then Claremont compared with NGH. Physiotherapy intensity has previously been related to functional status in rehabilitation of stroke, orthopaedic, cardiovascular and respiratory patients (Jette et al. 2005).

Summary of Demographic Factors

Gender was found to be a predictor of pre-operative function and pain. Gender, age left school (a measurement combining age and education), physiotherapy intensity and hospital were predictors of key physiotherapy milestones. Hospital was also a predictor of three-month post-operative surgery. The relationship between gender and age and outcome of TJA has been well reported in the literature. Patients receiving their care at one of the private hospitals tended to be younger, have fewer co-morbidities, and receive more intense physiotherapy as an inpatient. Age, co-morbidity, and physiotherapy intensity are known to affect outcome.

The Relationship between Pre-operative Status and Post-operative Status

In a second level of analyses, pre-operative status was included as a variable predicting function and pain in the three-month post-operative analyses. Pre-operative function was a predictor of all post-operative function components excluding OKS functional component type 2. Pre-operative pain was only found to be predictive of post-operative pain levels measured using OKS pain component type 2 (see Table 11.19 for further details).

The relationship between pre-operative function and post-operative function in TKR has been well-documented. The relationship has been explored using the WOMAC (Fortin et al. 1999;Lingard et al. 2004), SF-36 (Fortin et al. 1999), and OKS (Lim et al. 2006) as outcome measures. The same relationship has also been found in hip replacement using the WOMAC (Fortin et al. 1999;Caracciolo and Giaquinto 2005) and a questionnaire concerning activities of daily living (Holtzman et al. 2002) as outcome measures. Finally, Davis et al. (2006) demonstrated that the relationship between pre-operative function and post-operative function also exists in revision THR using the WOMAC as an outcome measure.

The relationship between pre- and post-operative pain has also been well-documented (Thomas et al. 1998;Holtzman et al. 2002;Lingard et al. 2004;Davis et al. 2006) and therefore the absence of this relationship in the knee study (except between OKS pain component type 2) was contrary to expectations. Chance was found to be the predictor of post-operative pain as measured by KSKS pain component and the OKS pain component type 1. Chance was not a predictor of these components pre-operatively. However, pre-operatively both KSKS pain and OKS pain component type 1 were, in part, predicted by catastrophizing. In addition, praying/hoping made a significant contribution to the regression model for OKS pain component type 2. As is discussed above, it is thought that chance locus of control may exert its influence on pain through maladaptive coping strategies such as catastrophizing and praying/hoping and therefore it may be that pre-operative pain was not found to be a significant predictor of post-operative pain in the knee study as the way that the individual interprets pain was already been accounted for in the psychological variables.

The Relationship between Pain and Function

Both pre- and post-operatively pain was an important predictor in the regression models for function. This is in line with the findings of Chui et al. (2005) who reported a correlation between neck disability and pain. Leveille et al. (2001) that in women with musculoskeletal

pain, individuals with severe pain were more likely to have disability measured by difficulty in completing activities of daily living and walking ability. This is discussed further in Chapter 4.

Inclusion of pain as a variable in the regression models predicting pre-operative pain did not affect the significance of praying/hoping in the regression model suggesting that this construct exerts an effect on pre-operative function above and beyond its effect via pain.

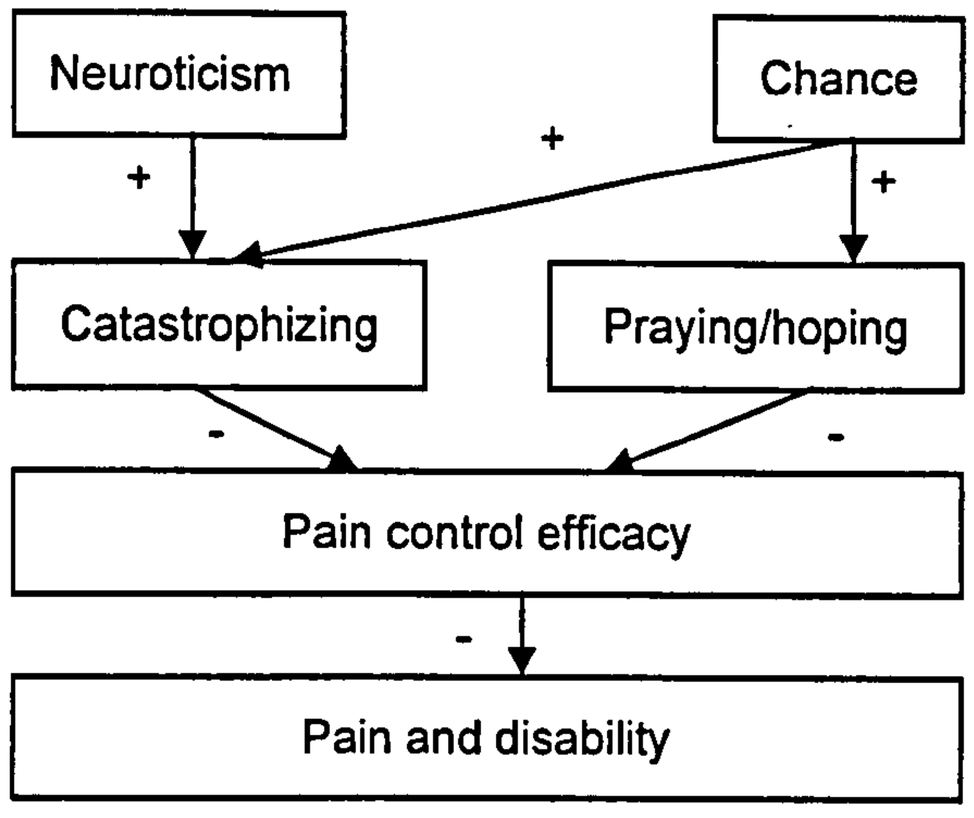
Post-operatively, the inclusion of pain as a variable in the regression models predicting pain caused most of the psychological variables to become non-significant. However, given that neuroticism was predictive of pre-operative pain and chance was predictive of post-operative pain, it is possible that psychological variables exert their action through perceptions of pain.

ROM was also included as a predictor of function at this point in the regression analyses. It was not found to be a significant predictor of either functional components either pre- or post-operatively. Post-operatively, strong correlations were recorded between ROM and function (see Chapter 4), but the regression analysis indicates that post-operative pain is a more important predictor of function.

Summary

A number of relationships were found between the psychological variables and outcomes of pain and function. Neuroticism was a predictor of greater pain and disability both pre- and post-operatively. Openness to experience was predictive of less pain and better function pre-operatively. A high score on praying/hoping was predictive greater pain and disability pre-operatively and of longer time to achieve independence in chair transfer as an inpatient. Efficacy in controlling pain was associated with less pain and better functioning pre-operatively whilst catastrophizing was associated with heightened perceptions of pain pre-operatively. Finally chance locus of control, was associated with greater disability pre-operatively and greater pain post-operatively. These findings are in line with the current literature available in the health psychology field. Several of psychological variables appear to be inter-related and may exert their actions in the model proposed in Fig 12.1.

Fig 12.1: Proposed model of action of negative psychological variables



Neuroticism and chance have been linked to heightened levels of catastrophizing. In addition, chance has been linked with greater usage of praying/hoping. Catastrophizing and praying/hoping are associated with a lower pain control efficacy which is predictive of greater pain and disability.

Gender was found to be an important predictor of pre-operative pain and function. This is in line with previous research. Gender, age left school, hospital and physiotherapy intensity were important predictors of physiotherapy outcomes.

Pre-operative function was found to be a predictor of post-operative function; this is line with previous research.

Finally, pain was found to be a strong predictor of function both pre- and post-operatively. Inclusion of pain in the regression analysis reduced the effects of many other predictors to non-significance. However, several of these variables were predictive of pain and therefore it is possible that psychological variables predict the level of pain (or interpretation of pain) which in turn influences function.

Chapter 13: Comparing and Contrasting the Findings from the Hip and Knee Studies

This chapter aims to compare and contrast the following findings from the hip and knee studies:

- Psychological variables predicting pain (impairment) and function (activities limitation and participation restriction).
- Demographic variables predicting pain and function (activities limitation and participation restriction).
- Demographic variables predicting achievement of key physiotherapy milestones.
- The effect of pre-operative status on the post-operative outcome.
- The relationship between pain and function.

Predictors of Pain and Function

For the ease of the reader, tables have been produced to compare the findings from the hip and knee studies at different time points. Tables 13.1 (pre-operative status – function and pain combined), 13.2 (pre-operative function), 13.3 (pre-operative pain), 13.4 (physiotherapy key milestones), 13.5 (post-operative status – function and pain combined), 13.6 (post-operative function), and 13.7 (post-operative pain) which compare the significant predictors in the hip and knee studies.

Table 13.1: Comparison of significant predictors of pre-operative status (function and pain combined) in hip and knee studies

		No. of regression models in which the variable is a significant predictor	
Questionnaire	**Variable**	**Hip Study**	**Knee Study**
NEO-FFI	Neuroticism	-	4
	Openness to Experience	-	5
	Conscientiousness	6	-
Coping Strategies Questionnaire	Reinterpreting Pain Sens.	-	1
	Coping Self Statements	-	1
	Praying/Hoping	-	5
	Catastrophizing	6	2
	Controlling Pain	4	4
	Decreasing Pain	2	-
MHLC	Chance	-	1
	Doctors	1	-
Demographics	Gender	3	7
	Social Class	4	-
	Employment Status	-	1
Medical Factors	Co-morbidity	1	1
	Body Mass Index	-	1

Note: In order to calculate the frequency a predictor featured in the regression models, the following components were used in the hip study: HHS, HHS function component, HHS pain component, OHS, OHS functional components type 1 and 2, OHS pain components type 1 and 2; and in the knee study: KSKS function component, KSKS pain component, OKS functional components type 1 and 2, and OKS pain components type 1 and 2. Body Mass Index was not recorded for patients in the hip study and therefore its effect on pre-operative status is unknown.

In both studies, catastrophizing, controlling pain, gender and co-morbidity were predictive of pre-operative status.

In the hip study, conscientiousness, social class, and decreasing pain were predictive of pre-operative status.

In the knee study, neuroticism, openness to experience, and praying/hoping were important predictors of pre-operative status.

Reinterpreting pain sensations, coping self statements, chance, doctors, employment status, and BMI were each only predictive of one outcome measure suggesting these associations may have arisen to conducting a study with multiple end-points.

Table 13.2: Comparison of significant predictors of pre-operative function in hip and knee studies

		No. of regression models in which the variable is a significant predictor	
Questionnaire	**Variable**	**Hip Study**	**Knee Study**
NEO-FFI	Neuroticism	-	1
	Openness to Experience	-	3
	Conscientiousness	1	-
Coping Strategies Questionnaire	Coping Self Statements	-	1
	Praying/Hoping	-	3
	Catastrophizing	2	-
	Controlling Pain	1	2
	Decreasing Pain	2	-
MHLC	Chance	-	1
	Doctors	1	-
Demographics	Gender	3	3
	Employment Status	-	1
Medical Factors	Co-morbidity	-	1
	Body Mass Index	-	1

Note: In order to calculate the frequency a predictor featured in the regression models, the following components were used in the hip study: HHS function component, OHS functional component type 1, OHS functional component type 2; and in the knee study: KSKS function component, OKS functional component type 1, and OKS functional component type 2. Body Mass Index was not recorded for patients in the hip study and therefore its effect on function is unknown.

Table 13.2 reveals that there are few variables which were responsible for predicting pre-operative function in both hip and knee studies. Only gender and controlling pain were predictive of pre-operative function in both hip and knee patients. The other measure of pain control efficacy, decreasing pain, was a predictor of pre-operative function in the hip study. Openness to experience and praying/hoping were important predictors of pre-operative function in the knee study.

Several of the psychological variables (neuroticism, conscientiousness, coping self statements, chance locus of control, and doctors locus of control) were only predictive of one pre-operative functional outcome measure indicating that these findings may be a result of type 1 error. However, these psychological variables all link into a proposed model of action (see Fig 13.1).

Employment status, co-morbidity, and body mass index each only predicted one pre-operative functional outcome measure; these findings may be a result of conducting a study with multiple end-points.

Table 13.3: Comparison of significant predictors of pre-operative pain in hip and knee studies

		No. of regression models in which the variable is a significant predictor	
Questionnaire	**Variable**	**Hip Study**	**Knee Study**
NEO-FFI	Neuroticism	-	2
	Openness to Experience	-	1
	Conscientiousness	3	-
Coping Strategies Questionnaire	Reinterpreting Pain Sens.	-	1
	Praying/Hoping	-	1
	Catastrophizing	2	2
	Controlling Pain	2	1
Demographics	Gender	-	3
	Social Class	3	-
Medical Factor	Co-morbidity	1	-

Note: In order to calculate the frequency a predictor featured in the regression models, the following components were used in the hip study: HHS pain component, OHS pain component type 1, OHS pain component type 2; and in the knee study: KSKS pain component, OKS pain component type 1, and OKS pain component type 2.

Catastrophizing and efficacy in controlling pain were significant predictors of pre-operative pain in both studies. Conscientiousness and social class were predictors of all three components in the hip study. Co-morbidity was predictive of only one pain outcome measure in the hip study; therefore the finding of a relationship between co-morbidity and pre-operative pain may be a type 1 error. Neuroticism and gender were predictive of pre-operative pain in the knee study. Openness to experience, praying/hoping and reinterpreting pain sensations each only predicted one pain outcome measure in the knee study.

Table 13.4: Comparison of significant predictors of achievement of key physiotherapy milestones in hip and knee studies

		No. of regression models in which the variable is a significant predictor	
Questionnaire	**Variable**	**Hip Study**	**Knee Study**
Coping Strategies Questionnaire	Diverting Attention	-	1
	Praying/Hoping	-	1
	Catastrophizing	1	-
Demographics	Gender	-	1
	Social Class	1	-
	Education	2	-
	Age Left School	1	4
Medical Factor	Hospital	3	2
	Physiotherapy Intensity	-	2

Note: All physiotherapy key milestone regression models from each study were used in calculating the number of regression models in which the variable is a significant predictor.

Few psychological variables were predictive of time taken to achieve key physiotherapy milestones. None of the psychological variables measured with the NEO-FFI or MHLC were predictors. From the CSQ, diverting attention, praying/hoping and catastrophizing were found to be predictors of time taken to achieve key milestones. However, each was only predictive of one outcome measure suggesting these findings may have arisen by chance.

Demographic variables and medical variables featured as predictors in many of the regression models for physiotherapy key milestones. Hospital, physiotherapy intensity, and age left school were predictors of physiotherapy outcomes in both studies. Education was a predictor of two of the physiotherapy outcome measures in the hip study. Social class and gender were predictive

of only one outcome measure each suggesting these findings may have arisen by conducting a study with multiple endpoints.

Table 13.5: Comparison of significant predictors of post-operative status (function and pain combined) in hip and knee studies

		No. of regression models in which the variable is a significant predictor	
Questionnaire	**Variable**	**Hip Study**	**Knee Study**
NEO-FFI	Neuroticism	-	5
Coping Strategies Questionnaire	Reinterpreting Pain Sens.	3	-
	Catastrophizing	6	-
	controlling pain	2	-
MHLC	Chance	-	2
Demographics	Age Left School	1	-
	Social Class	1	-
	Education	1	-
Medical Factors	Hospital	-	1
	Previous TJA	4	-

Note: In order to calculate the frequency a predictor featured in the regression models, the following components were used in the hip study: HHS, HHS function component, HHS pain component, OHS, OHS functional components type 1 and 2, OHS pain components type 1 and 2; and in the knee study: KSKS function component, KSKS pain component, OKS functional components type 1 and 2, and OKS pain components type 1 and 2.

No variables were predictive of post-operative status in both hip and knee studies. Catastrophizing, reinterpreting pain sensations, and number of previous total joint arthroplasties

were frequent predictors of post-operative status in the hip study. Neuroticism and chance locus of control were predictors of post-operative status in the knee study. Age left school, social class, education, and hospital were each only predictive of one outcome measure.

Table 13.6: Comparison of significant predictors of post-operative function in hip and knee studies

		No. of regression models in which the variable is a significant predictor	
Questionnaire	**Variable**	**Hip Study**	**Knee Study**
NEO-FFI	Neuroticism	-	3
CSQ	Reinterpreting Pain Sens.	2	-
	Catastrophizing	2	-
Medical Factors	Hospital	-	1
	Previous TJA	2	-

Note: In order to calculate the frequency a predictor featured in the regression models, the following components were used in the hip study: HHS function component, OHS functional component type 1, OHS functional component type 2; and in the knee study: KSKS function component, OKS functional component type 1, and OKS functional component type 2. Body Mass Index was not recorded for patients in the hip study and therefore its effect on function is unknown.

Reinterpreting pain sensations, catastrophizing, and number of previous total joint arthroplasties were predictive of post-operative function in the hip study. Neuroticism was predictive of all three outcome measures of post-operative function in the knee study. Hospital was a predictor of only one outcome measure suggesting this may be a chance finding as a result of conducting a study with multiple endpoints.

Table 13.7: Comparison of significant predictors of post-operative pain in hip and knee studies

		No. of regression models in which the variable is a significant predictor	
Questionnaire	**Variable**	**Hip Study**	**Knee Study**
NEO-FFI	Neuroticism	-	1
	Catastrophizing	1	-
	Controlling Pain	2	-
	Social Class	1	-
MHLC	Chance	-	2
Medical Factor	Previous TJA	1	-

Note: In order to calculate the frequency a predictor featured in the regression models, the following components were used in the hip study: HHS pain component, OHS pain component type 1, OHS pain component type 2; and in the knee study: KSKS pain component, OKS pain component type 1, and OKS pain component type 2.

Table 13.7 reveals that no variables were predictive of post-operative pain in both hip and knee patients. In the hip study, controlling pain predicted two pain outcome measures; social class, number of previous total joint arthroplasties, and catastrophizing were each only predictive of one outcome measure. In the knee study, chance locus of control was a significant predictor of post-operative pain; neuroticism was also predictive of pain.

A discussion of the psychological variables will take place first, followed by sections discussing the impact of demographic variables, the impact of pre-operative status on post-operative outcome and finally a discussion as to the relationship between pain and function.

Psychological Variables

This section discusses the similarities and differences in the hip and knee study in the psychological variables predicting pain and function. This comparison has been conducted where pain and pre-operative status were excluded as predictors in the regression analyses.

At first glance, there appears to be a limited number of similarities between the findings of the hip and knee study with regard to psychological predictors of function. When predicting pre-operative function, the only psychological variable which was found to be a predictor in both hip and knee studies was pain control efficacy (controlling pain and decreasing pain items from CSQ). Catastrophizing was found to be an important predictor in the hip study whereas, in the knee study, openness to experience, and praying/hoping were important predictors of function. Post-operative predictors of function in the hip study were catastrophizing and reinterpreting pain sensations whereas neuroticism was the only psychological predictor of function in the knee study.

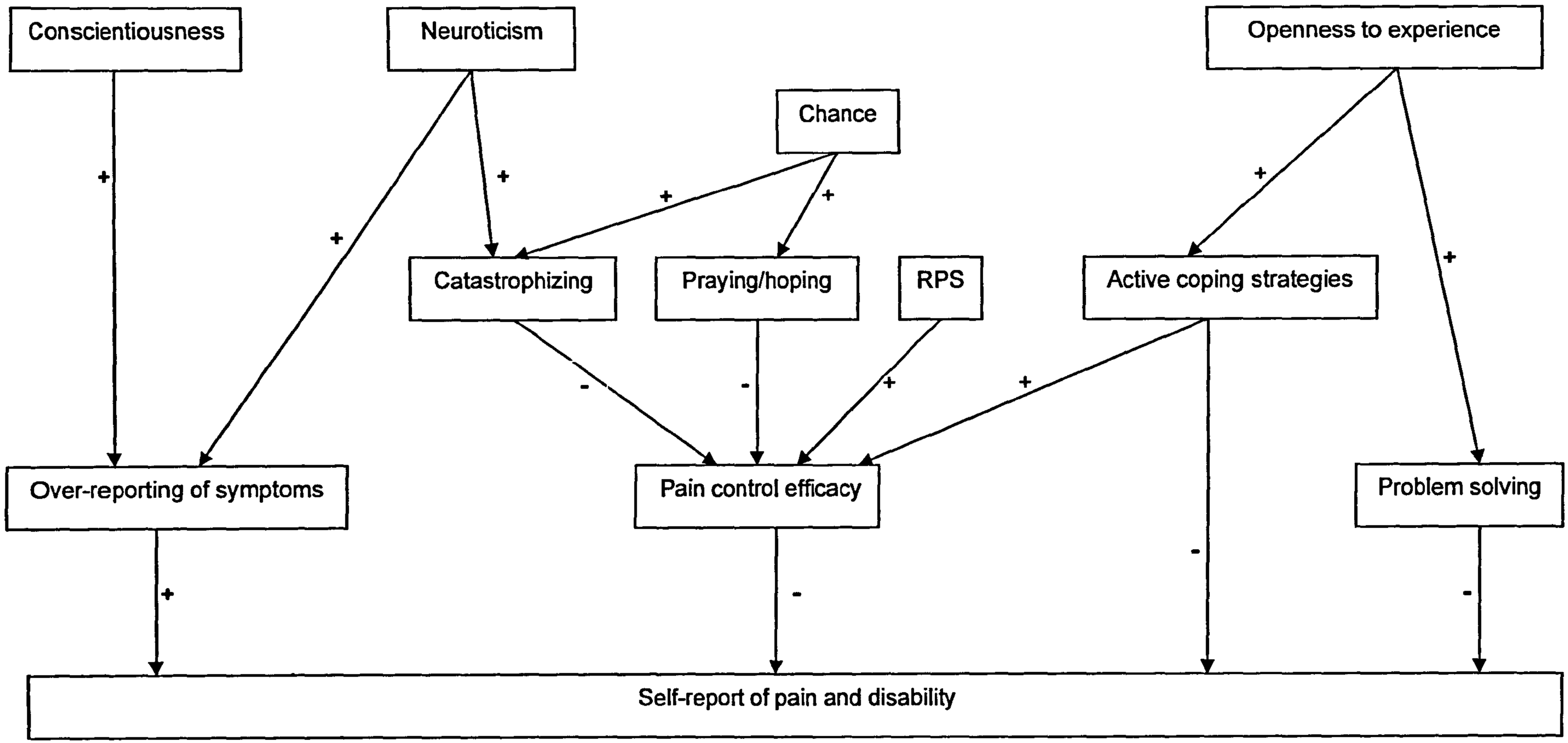
There was more agreement with respect to predictors of pain. In both studies catastrophizing and pain efficacy were predictors. In addition, conscientiousness was a predictor in the hip study, whilst neuroticism and chance were predictors in the knee study.

Overall, the main psychological factors which were predictors of pain and/or function in the hip study were conscientiousness (NEO-FFI), reinterpreting pain sensations (CSQ), catastrophizing (CSQ) and pain control efficacy (CSQ). Catastrophizing and pain control efficacy were also important predictors in the knee study alongside praying/hoping (CSQ), chance (MHLC), neuroticism (NEO-FFI) and openness to experience (NEO-FFI). Despite the differences in the precise psychological variables found to be predictors of pain and function in the hip and knee studies, it is likely that they exert their actions through similar mechanisms.

Both conscientiousness and neuroticism have been linked with over-reporting of symptoms (Jerram and Coleman 1999;Feldman et al. 1999) and this is one of the possible mechanisms by which these psychological variables are linked with self-reports of greater pain and disability. Both neuroticism and openness to experience have been linked to coping strategy usage. Neuroticism has been associated with the use of maladaptive coping strategies such as catastrophizing (Turner and Aaron 2001) whilst openness to experience has been linked to the use of active coping strategies (David and Suls 1999). Coping strategies impact on the pain control efficacy. Catastrophizing (Keefe et al. 1987a), praying/hoping (Crisson and Keefe 1998), and chance (Crisson and Keefe 1998) have been linked with lower perceived control over pain, whilst reinterpreting pain sensations has been associated with a better pain control efficacy (Haythornthwaite et al. 1998). Pain control efficacy has been shown to impact on pain and function in a variety of conditions including osteoarthritis (Keefe et al. 1987a;Keefe et al. 1987b), rheumatoid arthritis (Keefe et al. 1997a;Lefebvre et al. 1999), and chronic pain (Keefe and Williams 1990;Toomey et al. 1991;Tan et al. 2002).

Based on the above knowledge from the literature as to how the psychological variables interact in influencing pain and function, Figure 13.1 summarises the possible relationship by which the psychological variables exert their action on pain and disability in patients undergoing TJA as a result of osteoarthritis of the hip or knee.

Figure 13.1: The relationship between the psychological variables on pain and function in the hip and knee studies



Note: RPS = Reinterpreting Pain Sensations.

Returning to the comparison of the psychological factors predicting function in the hip and knee studies, the above figure helps integrate their findings. In both the hip and knee studies pain control efficacy was found to be a predictor of pre-operative function. Figure 13.1 indicates that pain control efficacy is a central psychological variable in predicting pain and function. Catastrophizing was found to be an important predictor of function in the hip study whilst, in the knee study, praying/hoping was an important predictor. Both psychological variables have previously been shown to have a negative impact on pain control efficacy (Keefe et al. 1987a;Crisson and Keefe 1998). In addition, openness to experience was found to be a predictor of pre-operative function in the knee study. Openness to experience is associated with the use of active coping strategies which have been shown to have a positive impact on pain control efficacy.

Post-operative predictors of function in the hip study were catastrophizing and reinterpreting pain sensations whilst neuroticism was the only psychological predictor of function in the knee study. Catastrophizing has a negative impact on pain control efficacy (Keefe et al. 1987a), whereas reinterpreting pain sensations (Haythornthwaite et al. 1998) has previously been linked to a better pain control efficacy. It has been hypothesised in previous studies that neuroticism exerts its influence through increasing levels of catastrophizing (Goubert et al. 2004).

Catastrophizing and pain control efficacy were found to be predictors of pain in both the hip and knee studies. In addition, conscientiousness was a predictor in the hip study, whilst neuroticism was a predictor in the knee study. As stated above, neuroticism has been linked to catastrophizing tendency. In addition, neurotic individuals have been shown to over-report symptoms (Jerram and Coleman 1999;Feldman et al. 1999) leading to a self-report of greater pain and disability. Over-reporting of symptoms has also been demonstrated in conscientious individuals (Feldman et al. 1999).

It therefore appears that the majority of the effects of the psychological variables recorded as predictors in the hip and knee studies can be explained through two different mechanisms. Self-reports of pain and disability may be more severe than if objectively measured as some

personality traits (neuroticism and conscientiousness) are associated with over-reporting of symptoms. Pain control efficacy is known to affect pain and disability in osteoarthritis (Keefe et al. 1987a;Keefe et al. 1987b) and a number of the coping strategies recorded in this study are known to have an effect on this. Efficacy in pain control can be moderated by cognitive behavioural therapy (Turner et al. 2006) and therapy can be used effectively to increase pain control (Kole-Snijders et al. 1999). Development of a pre-operative course of therapy may benefit patients undergoing TJA who are neurotic, use maladaptive coping strategies such as catastrophizing and praying/hoping, and have low pain control efficacy.

Demographic Variables Predicting Pain and Function

Gender

Gender was found to be a predictor of pre-operative function in both hip and knee patients; being female was associated with greater disability. In addition, being female was associated with greater pain in the knee study. These findings are in agreement with the literature. Keefe et al. (2000) reported that in patients with osteoarthritis, women had greater disability and pain compared to men. In addition, they exhibited more pain behaviours such as a guarding the joint, rubbing the joint and unloading the affected joint. Kennedy et al. (2002) reported that women showed greater disability in both self-report measures and physical performance tests assessing the function of patients awaiting unilateral total hip or knee arthroplasty.

As discussed in Chapter 12 there are social, biological and psychological mechanisms by which gender may exert its effects on pain and disability. Elderly women are more likely to be living alone than elderly gentlemen and therefore it is possible their OA is worse as a result of continuous use of the affected joint.

The gender difference could be a result of the pathogenesis of the joint. Pagura et al. (2003) identified that insulin-like growth factor-I were markedly reduced in women (in 21% of cases to a level of clinical hormone deficiency) compared to men with end-stage osteoarthritis of the knee. It has been shown that insulin-like growth factor-I plays a role in the synthesis of articular

cartilage and reduced levels may contribute to the disease process in osteoarthritis (Trippel 2004).

Alternatively, the worse pain and function experienced in women may be a result of coping strategy usage; Keefe et al. (2000) proposed that catastrophizing mediates the relationship between gender and pain and physical disability. However, if this was the case then it would be expected that the effects of gender would also apparent in the three-month results.

Gender was not found to be a predictor of post-operative pain or function in either study; the reason for this is unclear. Previous published research on the effect of gender on pain and disability in osteoarthritis has tended to focus on patients with chronic OA either where no surgery is planned, or prior to surgery. There is therefore little evidence as to whether the gender effect persists post-surgery. As gender was not found to be a predictor of post-operative function and pain, the most plausible theory of the mechanism by which gender exerts its actions is the biological mechanism whereby a greater reduction of insulin growth factor type I in women leads to more severe symptoms of OA compared to men. If the other two theories of the mechanism of action were true then it would be expected that the effects would persist post-operatively.

Social Class

Social class was found to be an important predictor of pre-operative function in THR patients. Peters et al. (2005b) reported that, in a longitudinal study assessing progression of hip and knee pain over a seven-year period, being of a lower social class was associated with a greater deterioration in symptoms. However, it has been reported that in healthy volunteers where there is no evidence of any condition affecting the hips, knees or spine, individuals with a lower social class had worse scores on outcome measures used to assess pain and function in hip and knees (Brinker et al. 1996;1997). Therefore, there is uncertainty as to whether social class is actually associated with worse pain and functioning or rather the reporting of worse functioning. The reason that this finding was not replicated in the knee study is unknown.

Previous Total Joint Arthroplasty

Post-operatively, a greater number of previous TJAs was a predictor of pain and disability in THR patients. This finding was not found pre-operatively or in the knee study. In Chapter 8, it was hypothesised that a greater number of previous TJAs may relate to a generalised osteoarthritis which was predictive of worse functioning and greater pain, or alternatively acts as a cumulative effect which leads to greater disability. The theory of generalised OA would not explain why this was not found pre-operatively in the hip study or at all in the knee study. A generalised OA would be thought to impair function greater irrespective of the joint being replaced. The second theory that previous TJA had a cumulative effect that contributed to pain disability as the prosthesis whilst better than an OA joint was not as good compared to a natural-disease free joint. It is possible that this effect was only seen post-operatively in the hip study as the cumulative effect slowed the recovery and therefore comparing individuals at three-months with and without previous TJA meant that individuals with multiple TJA had not yet reached their full potential with respect to recovery. It is possible (though unlikely given the range of scores in post-operative knee questionnaires) that this effect was not seen in knee replacement patients as recovery from TKR is more prolonged compared to THR and therefore none of the patients have reached their full potential at three-months post-surgery.

Demographic Factors Predicting Achievement of Physiotherapy Key Milestones

The hospital in which patient had their surgery and intensity of physiotherapy were predictors of achievement of key physiotherapy milestones in both hip and knee patients. In addition, education was predictive of time taken to achieve key milestones in THR patients whilst age left school (which is thought to measure a combination of age and education) was predictive of many key physiotherapy milestones in the knee study.

Hospital

Hospital was predictive of time taken to achieve physiotherapy key milestones; patients receiving their care in the private hospitals tended to achieve key milestones earlier and have a

shorter post-operative length of stay. Patients were 'cherry-picked' to receive treatment at one of the private hospitals. These patients tended to be younger, still in employment and have fewer co-morbidities than patients receiving their surgery at NGH. Age has been shown to be related to slower achievement of rehabilitation milestones post-TJA (Peerbhoy et al. 1999) and longer post-operative LOS (Forrest et al. 1998;Peerbhoy et al. 1999;Weaver et al. 2003;Vincent et al. 2006). Co-morbidities are also known to affect outcome morbidity of TJA (Wasielewski et al. 1998;Weaver et al. 2003;Lingard et al. 2004). It is therefore possible that these factors contributed to the earlier achievement of key milestones in the private hospitals. In addition, patients at the private hospitals received a greater intensity of physiotherapy which has been shown to be related to outcome in rehabilitation (see below).

Physiotherapy Intensity

Physiotherapy intensity was associated with time taken to achieve key physiotherapy milestones in knee replacement patients (and in hip replacement patients when hospital was excluded from the regression analysis). This is in line with Jette el al. (2005) who reported a relationship between therapy intensity and outcome in rehabilitation of stroke, orthopaedic, cardiovascular and respiratory patients.

Education

Education was found to be a predictor of achievement of key physiotherapy milestones in the hip study; similarly, age left school, which was designed to measure level of education at school, was predictive of several key physiotherapy outcomes in the knee study. This is in agreement with previous literature which states that education was a predictor of outcome from TJA (Mahomed et al. 2002).

The effect of Pre-operative Status on Post-operative Outcome

As shown in Tables 13.8 and 13.9, in the hip and knee studies, pre-operative function was predictive of function at three-month post-surgery.

Table 13.8: Comparison of significant predictors of post-operative function where pre-operative function is included as a predictor

		No. of regression models in which the variable is a significant predictor	
Questionnaire	**Variable**	**Hip Study**	**Knee Study**
NEO-FFI	Neuroticism	-	1
	Extraversion	-	1
CSQ	Reinterpreting Pain Sens.	1	-
	Catastrophizing	1	-
Medical Factors	Pre-operative Function	2	2
	Previous TJA	1	-

Note: Reinterpreting pain Sens. = reinterpreting pain sensations.

Table 13.9: Comparison of significant predictors of post-operative pain where pre-operative pain is included as a predictor

		No. of regression models in which the variable is a significant predictor	
Questionnaire	**Variable**	**Hip Study**	**Knee Study**
CSQ	Controlling Pain	1	-
MHLC	Chance	-	2
Demographics	Social Class	1	-
Medical Factors	Pre-operative Pain	2	1
	Previous TJA	1	-

Note: regression analyses were not repeated for KSKS pain or OKS pain component type 1 as no significant correlations were found between pre- and post-operative scores for these pain components. Therefore, the variables identified in the original regression are included here.

In both studies, pre-operative function was predictive of post-operative function. This finding was in line with the existing literature relating to TJA. This relationship has been explored in TKR using the WOMAC (Fortin et al. 1999;Lingard et al. 2004), SF-36 (Fortin et al. 1999), and OKS (Lim et al. 2006) as outcome measures. The relationship between pre-operative function and post-operative function has been demonstrated with the WOMAC as an outcome measure in THR (Fortin et al. 1999;Caracciolo and Giaquinto 2005) and in revision THR (Davis et al. 2006).

In the hip study, pre-operative pain levels were found to be a predictor of post-operative pain. This is in agreement with the existing literature on TJA (Thomas et al. 1998;Holtzman et al. 2002;Lingard et al. 2004;Davis et al. 2006). Contrary to expectations, and to the previously published literature, this finding was not replicated in the knee study. Pre-operative OKS pain component type 2 was predictive of post-operative pain measured using this component,

however, pre-operative OKS pain component type 1 was not predictive of the post-operative component neither was the pre-operative pain component predictive of its post-operative counterpart. It was hypothesised in Chapter 12, that the psychological variables which were predictive of post-operative pain may have explained the influence of pre-operative pain on this and therefore it was not found to be a significant predictor.

The Relationship between Pain and Function

Both pre- and post-operatively strong correlations were recorded between pain and activities limitation and participations restriction. In the final regression analyses (both pre- and post-operatively) in the hip and knee studies, pain was found to be a significant predictor of function. This is in line with the findings of Creamer et al. (2000) who reported that pain severity was found to strongly predictive of activity limitation and participation restriction (as measured with WOMAC) in patients with knee OA. Chui et al. (2005) who reported a correlation between neck disability and pain. Leveille et al. (2001) reported that, in women with musculoskeletal pain, individuals with severe pain were more likely to have disability measured by difficulty in completing activities of daily living and walking ability. This is discussed further in Chapter 4.

In each instance, including pain as a predictor in the regression analyses caused many of the psychological variables to become non-significant. However, the psychological variables were able to predict level of pain (mediated by pain control efficacy) and therefore psychological factors may still have an impact on function (via pain). Given that pain was found to have a strong impact of function in hip and knee patients both pre- and post-operatively, there is scope to develop a therapy technique for TJA patients to improve pain control and perceptions of pain.

Summary

This chapter has compared and contrasted the findings of the hip and knee studies. On the whole, the findings between the two studies were similar.

Only a weak relationship was reported between range of motion and self-reported function both pre-and post-operatively; this is in agreement with the existing literature (see Chapter 4).

Although the precise psychological variables which were predictive of pain and function differed from pre- to post-operatively and between hip and knee studies, it seems likely that the psychological variables exert their actions through one of two common mechanisms. First, psychological characteristics may predispose to over-reporting symptoms and therefore lead to reports of greater pain and disability (greater disability may not be found if objectively measured). Second, many of the psychological variables may exert their impact through pain control efficacy. A lower pain control efficacy has previously been shown to affect pain and disability in arthritis.

Gender was found to be a predictor of pre-operative function in both the hip and knee studies. This is in line with the existing literature although the mechanism by which it exerts its influence remains unknown. In addition, social class was found to be a predictor of pre-operative pain and function and previous TJA of post-operative pain and function in the hip study; these findings were not replicated in the knee patients.

Few psychological variables were found to be predictive of achievement of key physiotherapy outcomes. Instead demographic variables were found to be predictors. Hospital in which patient received their surgery, physiotherapy intensity and education level were found to be predictors of achievement of key physiotherapy milestones in both hip and knee patients.

In both studies, pre-operative function was found to be predictive of post-operative function. This finding is in agreement with previous research. In addition, pre-operative pain was found to be predictive of post-operative pain in the hip study (again in line with previous research). This

finding was not replicated in the knee study possibly as the psychological factors predicting post-operative pain had already accounted for pre-operative pain levels.

Finally, in both studies pre- and post-operatively pain was found to be predictive of function. Including pain in the regression analyses led to most of psychological variables becoming non-significant. However, the psychological variables were predictive of pain and therefore still may exert an indirect effect on function.

These findings have implications for clinical practice and future research which will be discussed in the next chapter.

Chapter 14: Future Directions and Clinical Implications

This chapter will discuss the clinical implications and recommendations for change in clinical practice relating to:

- The relationship between ROM, pain and function.
- Development of interventions.
- Physiotherapy intensity.

In addition, it will discuss the future directions for further research relating to:

- Research into the disparity in treatment of ethnic minorities.
- Development of outcome measures.

Change in Clinical Practice Relating to Recording of Range of Motion

Currently in clinical practice, passive range of motion (ROM) (alongside radiographical evidence) is routinely used to objectively assess level of impairment in determining need for TJA. Similarly, post-operatively ROM is used as an assessment of level of success of TJA. There is limited evidence in the literature that these variables are related. Johnston and Smidt (1970) reported that where there is impairment in movement of the hip, there is also limitation in function in completing a variety of activities of daily living. However, Johnston and Smidt's (1970) study was fundamentally flawed as the same individual was responsible for recording ROM (assessed using an electrogoniometer) and assessing level of difficulty in completing activities. This introduces observer bias. More recently McGrory et al. (1996) reported that certain activities such as donning shoe and socks, and picking an object up from the floor were strongly correlated with ROM 1-year post-THR. However, ROM was not found to be correlated with overall scores on self-report instruments measuring activities limitation and participation restriction.

As there was limited literature available supporting this clinical practice, my study sought to further assess the relationship between ROM and function. In hip and knee patients, both pre- and post-operatively, only a weak correlation was recorded between range of motion (ROM) and function as measured with the self-report joint-specific questionnaires. ROM was not a predictor of function in the regression analyses. ROM was found to be a predictor of ability to don shoes and socks pre-operatively in hip patients (as measured with OHS and HHS) but not post-operatively. The findings of the weak relationship between ROM and activities limitation and participation restriction is in agreement with previous findings in TKR patients (Kantz et al. 1992;Witvrouw et al. 2002;Miner et al. 2003) and in the wider healthcare setting when assessing whether impairment is related to or can predict limitation of activities and participation restriction (Grigioni et al. 2003;Kocher et al. 2004;Rosenzweig et al. 2004;Goverover et al. 2006;Thorsen et al. 2006).

Much stronger correlations were recorded between pain (measured using the joint-specific questionnaires) and activities limitation and participation restriction both pre- and post-operatively in hip and knee patients. Pain was found to be a significant predictor in the regression analyses of function both pre- and post-operatively in hip and knee patients.

In his paper which introduces the Harris Hip Score, Harris (1969) states that *"motion is only important as it affects function"*. If, as the mounting evidence suggests, that motion is not in fact strongly related to function then what is the benefit in measuring it? Instead, given the fact that pain strongly predicted function pre- and post-operatively in hip and knee patients, I would suggest that it would be far better to assess degree of pain. My study indicates the need to consider a change in clinical practice to place more emphasis on accurately assessing pain (and less emphasis on ROM) providing a far more accurate assessment of activities limitation and participation restriction than movement in the joint.

Development of Psychological Interventions to Alter Levels of Pain, Activities Limitation, and Participation Restriction

As has been reported in the above section, pain is strongly correlated with activities limitation and participation restriction. My study contributes to the literature that indicates that this relationship is mediated through a variety of psychological factors. Central to these is pain control efficacy. Individuals who feel they have better control over their pain tend to experience less pain and better functioning. Contrastingly, those who have low pain control efficacy, tend to use maladaptive coping strategies such as catastrophizing and report greater pain and disability. Cognitive behavioural therapy (CBT) has been shown to be an effective treatment in increasing pain control efficacy, reducing maladaptive coping strategies, reducing pain and increasing function in back pain and chronic pain patients (Kole-Snijders et al. 1999;Turner et al. 2006). A similar intervention may be of great benefit to patients undergoing TJA. Psychological profiling completed at the time that the patient is added to the waiting list could identify patients with psychological factors (neuroticism, catastrophizing, praying/hoping, and low pain control efficacy) which are associated with worse outcome. My study leads us to the speculation that these patients could receive CBT prior to their surgery to improve overall outcome.

From the research conducted in my hip and knee studies, an estimate can be made as to the number of patients who may benefit from this intervention. In the hip study, both pre- and post-operatively, catastrophizing was found to be predictive of pain and activities limitation/participation restriction. As stated on page 114 of Chapter 5, there is no normative data available for coping strategies assessed with the CSQ (Lawson et al. 1990). Therefore it is not possible to state how many people are "high catastrophizers". However, on examining the histogram on page 118, it can be seen that scores for catastrophizing are significantly skewed with several patients scoring zero (19 participants). After this, there is no obvious cut-off point between high and low catastrophizers. The total possible score for catastrophizing is 36. The scale could be dichotomized with 0-17 being classed as "low catastrophizers" and 18-36 being classed as "high catastrophizers". 15 THR patients (11.5%) of the patient sample would be

defined as "high catastrophizers" and it could be postulated that the CBT intervention might be beneficial to them. Also in the hip study, perceived ability in controlling pain was found to be a predictor of pain both pre- and post-operatively (and of function pre-operatively). Again, this is measured using the CSQ for which there is no normative data. Perceived ability in controlling pain is assessed with a single item. Patients were asked to rate their ability in controlling their pain with 0 indicating "no control", 3 representing "some control" and 6 indicating "complete control". The scores for controlling pain approximated a normal distribution (see page 114). Therefore, if we consider patients scoring between 0-2 have a poor ability to control pain then it could be postulated that in this sample, 19 patients (18.3%) may have benefited from CBT targeted at improving perceived control of pain.

In the knee study, pre-operatively, controlling pain was found to be predictive of pain and activities limitation/participation restriction as measured with the joint-specific questionnaires. Fourteen patients (20%) scored between 0-2 (indicating they perceive themselves to have a poor ability to control pain); these patients may benefit from a CBT intervention to improve their pain and functioning pre-operatively.

Post-operatively in the knee study, neuroticism was found to relate to worse pain and functioning. Whilst neuroticism has been shown to be stable over long periods of time (Soldz and Vaillant 1999) it is thought that it may exert it's actions through maladaptive coping strategies such as catastrophizing (Goubert et al. 2004) and therefore there is scope to improve outcome. On page 215 it is stated that the scores for neuroticism approximated normal distributions and that the scores were similar to the US norms reported by Costa and McCrae (1992). When scoring the NEO-FFI it is possible to categorise respondents as very low, low, normal, high or very high. The findings of the knee study suggested that patients scoring highly on neuroticism had a worse outcome. Fourteen patients (20%) were categorised as either high or very high for their scores on neuroticism (see page 216); it is possible that these patients may benefit from a CBT intervention.

It is difficult from the work conducted in the hip or knee studies to assess the size of the impact (i.e. how greater improvement) a CBT intervention may have on outcome. Therefore, further work is needed to ascertain this. After initial studies assessing this, a randomised controlled trial should be conducted to compare the efficacy of CBT with waiting list controls. Assuming these results are positive, then CBT could be adopted into clinical practice to benefit patients who still experience great pain and disability post-TJA.

Change in Physiotherapy Practice

In both studies it was found that physiotherapy intensity had an impact on time taken to achieve key physiotherapy milestones. This finding was in agreement with Jette et al. (2005) who reported that therapy intensity affected outcome of rehabilitation after stroke, and with, orthopaedic, cardiovascular and respiratory patients. This of interest for two reasons: first, early rehabilitation may be predictive of long term outcome (Kendell et al. 2001), and second, a shorter LOS would have an impact on waiting list length and on cost. As physiotherapy intensity was not the main focus of this study, further research is required which focuses specifically on its impact. However, should the findings be replicated, a change in practice to increase the physiotherapy intensity (i.e. number of physiotherapy sessions that a patients receives each day) in the inpatient post-operative period may be of benefit to the patient in terms of long-term outcome, and in shortening waiting lists; and of benefit to the hospital in reducing the cost per stay for each patient.

Research into Individuals with Osteoarthritis from an Ethnic Minority

In both studies there was a very low number of ethnic minority patients. In each study, there was one black patient recruited and no other ethnic minorities represented. In the knee study, this patient failed to return their pre-operative questionnaires and therefore was excluded from the study leaving an entirely white study sample. The low number of non-White participants was reflective of low numbers of ethnic minorities being referred to the orthopaedic department for consideration for TJA. The possible reasons for this have been discussed in Chapters 4 and

7. The majority of the research conducted into assessing this phenomenon has taken place in USA and has focused on Black or Hispanic groups. In Sheffield, there is a sizeable Asian community. Little research has focused on the need for TJA, difficulty in accessing services (e.g. not reporting problem to GP or GP not referring patient to hospital), or reasons why Asian individuals with OA of the hip or knee do not want to undergo TJA. Further research is required to assess this to determine whether there are cultural barriers in receiving TJA or whether this can be improved to reduce pain and disability as a result of OA in the elderly Asian population.

Development of More Appropriate Outcome Measures

Pages 577-626 in the Appendix have demonstrated that from the patient perspective, the joint-specific questionnaires contain questions which are not applicable to the patient (e.g. asking about ability to climb stairs when the live in a bungalow), lack clarity (e.g. the question for donning shoes and socks does not state whether this activity should be completed with or without aid) and in some instances refer to two different activities in one question (e.g. using transport refers to bus or car). These findings are in agreement with previously published research (McMurray et al. 1999;Wylde et al. 2005;Whitehouse et al. 2005) which question the appropriacy of some measures. In addition, outcome is influenced by various factors including age (Brinker et al. 1996;Brinker et al. 1997;Bremmer-Smith et al. 2004), social class (Brinker et al. 1996;Brinker et al. 1997), generalised co-morbidity (Brinker et al. 1996;Brinker et al. 1997;Bremmer-Smith et al. 2004), disease of another joint (Harcourt et al. 2001). This suggests that the current instruments available as joint-specific outcome measures are outdated and lack the sophistication to adequately measure what they are designed to. This casts a shadow of doubt on the results of many orthopaedic trials running (e.g. in the comparison of two different types of prosthesis) as the trials rely on these instruments as outcome measures. In order to rectify this, a new more sophisticated measure needs to be developed. Research needs to be conducted to develop a psychometrically robust outcome measure which contains specific questions relating to only activity/concept, and is weighted to allow non-applicability of answers, to allow for advancing age and co-morbidity.

Summary

Based on the findings of the hip and knee studies, there are three main recommendations for change in clinical practice. First, the routine practice of assessing ROM pre- and post-TJA is outdated and serves little purpose. A measure assessing patients' pain levels would more accurately assess function. Second, the studies have identified psychological factors which are associated with worse outcome. Many of these psychological factors exert their effects through pain control efficacy. Cognitive Behavioural Therapy can be used to effectively increase an individual's perception of pain control. Further research is required to develop and evaluate effective management to provide therapy for those predicted to have a poor outcome following TJA. Third, physiotherapy intensity has been shown to affect achievement key physiotherapy milestones. Increasing the number of physiotherapy sessions that patient receives during a day whilst an inpatient may facilitate earlier achievement of key milestones which may impact on long term outcome. In addition, a shorter LOS would free-up hospital beds reducing the length of the waiting list and reduce the cost per patients for TJA. Based on the findings of the hip and knee studies, there are also recommendations for further research. In addition, to the development of appropriate cognitive behavioural therapy described above, the findings point to a need for further research into TJA in ethnic minorities and also the development of new outcome measures.

Chapter 15: Limitations of Study

This chapter will discuss the following limitations:

- Study design.
- Sample size.
- Sample not representative of population.
- Method of recording co-morbidity.
- None return of questionnaires.
- Timing of pre-operative questionnaires:
    - Pre-operative questionnaires
    - The Coping Strategies Questionnaire
    - Follow-up questionnaires
- Problems with joint specific-questionnaires.
- Recording of range of motion (ROM) pre-operatively.
- Hospital in which patient had surgery.
- Problems with physiotherapy notes.

Study design

The study was designed to be exploratory in nature investigating which psychological factors might affect outcome of joint replacement. There is some previous research available (see Chapter 2) on many of the psychological variables studied. However, the previous research was limited both in number of studies and in quality of the studies that had been conducted. Therefore, there were no clear hypotheses set of which factors might affect outcome. This itself is problematic as it may lead to type 1 error; observing a difference when really there is none. The likelihood of finding a false positive increases with the number of factors studied. It is possible that this is the case with the results of the analyses in this thesis. However, as I was aware of this possibility, I exerted caution when interpreting results. I would expect that a psychological variable predicting one outcome, would also be predictive of another. For example, catastrophizing was ubiquitous in predicting pre-operative status in hip replacement

patients. As such, I feel confident that this is a true positive finding. Where a certain psychological trait has only been implicated once, it is more possible that this is a chance finding (or a false positive). Further work, with strict hypotheses would be necessary to confirm the relationship.

Factors Included in Study

The aim of the study was to asses the impact of personality and other psychological factors on outcome of total joint replacement. Therefore, these were the focus of the variables for inclusion in the regression analysis. It was necessary to limit the number of factors included in the analyses otherwise the analysis would be underpowered and there would be a greater risk of type 1 error. However, some demographic variables which were known to affect outcome were recorded including age, gender, education, social class, co-morbidity etc. However, there is a multitude of other factors which may affect outcome either in the immediate post-operative period or during a long time frame. These include a variety of clinical factors such as amount and type of anaesthetic, prosthesis type, incision etc. The reasons for choosing not to include these clinical factors has been discussed in Chapter 3. However, there are other psychosocial/demographic factors which may affect outcome such as patient education and expectations see Chapter 1) which, with retrospect, perhaps should have been included in the study. A section in the literature at the beginning of the thesis discusses the impact of these. It is possible that these are related to psychological factors and further work needs to be conducted to asses this.

Sample Size

The sample size required for the study was estimated on power (although difficult as there have been previous studies in this area) and time constraints relating to the length of the recruitment period. Due to loss of patients from the study and lack of notes available (see sections below) the physiotherapy and three-month analyses are underpowered. However, as an exploratory study this data provides a guide as to where further research should be conducted.

Sample

As discussed in Chapters 5, 9, and 14, there was a very low number of patients of an ethnic minority within the studies. This was representative of the numbers of individuals being referred to orthopaedic clinic for TJA within the Sheffield area. However, this may not be representative of the wider UK TJA population and therefore some caution should be exercised in extending the results to individuals of an ethnic minority especially as some coping strategies are known to differ with culture.

Method of Recording Co-morbidity

Co-morbidity was recorded categorising broadly into: cardiovascular, respiratory or cardiovascular and respiratory. Patients with neurological co-morbidities were excluded from the study. Patients with conditions such as rheumatoid arthritis which affected multiple joints were also excluded. In addition, the number of co-morbidities was recorded. Co-morbidity was categorised in this way after taking advice from physiotherapists as which conditions had an impact on the rehabilitation process following TJA. However, this method may not have been sensitive enough to pick up the effects of co-morbidity in pre-operative and three-month post-operative pain and function. If the study were to be repeated a more sophisticated method of recording co-morbid conditions should be employed. A discussion of why this method was chosen is included in the footnote on page 45.

Non-return of Questionnaires

As with all survey-based studies there were participants who failed to return their questionnaires despite receiving telephone calls to remind them to do so. This had an impact on sample size and could have been combated by recruiting a larger number of individuals. In addition, loss of participants may have introduced a bias into the study as a certain type of individual may have been more likely to return their questionnaires. However, as there was a widespread of scores for the personality domain, coping strategies and orientation of locus of control; this does not appear to be a problem

Timing of the Questionnaires

Pre-operative Questionnaires

In order to ensure that the questionnaire pack had been completed before surgery (and to allow time to check for missing answers), patients were asked to send and return the main questionnaire pack as soon as possible after their attendance to pre-admission assessment clinic. It was known when planning the study that the length time between attending pre-admission assessment clinic and the patient receiving their surgery should not normally be more than 12 weeks. It was deemed acceptable to record all the questionnaires at this point and repeat the CSQ, which had been shown to have a low test-re-test reliability, closer to the time of surgery.

However, upon review of the data, it was found that the number of days between the two points ranged from 11 to 307 days (mode = 14, 31, median = 47) in the hip study and 15 to 210 (mode = 16, 33, 41, 43, 50, 73, median = 50) in the knee study. The extended length of time between recruitment of patients to the study and them receiving their surgery was usually due to the discovery of another pre-existing medical condition at pre-admission assessment clinic which required treatment before the surgery could proceed.

During this extended period of time (for some of the patients) it is possible that further deterioration in patient's condition with respect to their hip or knee occurred (Kiļi et al. 2003). This would therefore have an impact on the reliability of the finding that pre-operative status was strongly predictive of post-operative outcome. However, as several other researchers (Fortin et al. 1999;Davies 2002;Lingard et al. 2004;Caracciolo and Giaquinto 2005;Lim et al. 2006)have also concluded the importance of pre-operative status in predicting outcome, this is unlikely.

There may have also been a change in the patient's locus of control orientation over this time period. No repeat measure of locus of control was taken for patients who had their surgery delayed and therefore it is not possible to test this hypothesis. It is unlikely that the further wait for surgery would have any impact on the patient's global personality (as measured with the NEO-FFI) as global personality has been shown to be stable over long period of time (Soldz and

Vaillant 1999) and therefore any delay in time between completion of the pre-operative questionnaire and surgery should not have an impact on the results relating to any of the five personality traits.

The Coping Strategies Questionnaire

A second measure of the CSQ was taken a couple days prior to the patient receiving their surgery. The reasoning for this was twofold. First, it would allow analysis to assess the variability of coping strategies over time (see Appendix page 565). Second, as coping strategies have previously been shown to be variable over time (Keefe et al. 1990a;Keefe et al. 1990b;Main and Waddell 1991), it would allow the measure of the patient's level of each coping strategy to be taken close to the time of surgery and therefore providing a more accurate reading. However, these readings might not reflect the inpatient post-operative period when the patient is coping with acute pain of the operation. Therefore, it may have been wise to ask the patients to repeat the measure at this point.

Follow-up Questionnaires

In both the hip and knee studies, outcome was assessed at three-months post-surgery. With retrospect, this time point may have been too early and 6-months to a year may have been more appropriate. Several other studies have assessed outcome at 6-months or beyond (Fortin et al. 1999;Lingard et al. 2004;Caracciolo and Giaquinto 2005). This was noted during the hip study and therefore the protocol was changed in the knee study to include a one-year post-surgery follow-up (beyond the scope of the thesis). However, unfortunately, it was too late to rectify this for the hip study.

Problems with Joint-specific Questionnaires

As in discussed in pages 577-626 of the Appendix the patients experienced some difficulty in completing some questions on the joint-specific questionnaires as they were not applicable to them or lack clarity. The questionnaires used are currently the best available for their purpose, however, this finding indicates the need for the development of new questionnaires.

Measurement of Pain

Pain was assessed using the relevant questions from the joint-specific questionnaires. The rationale for using this method is assessed on pages 74-75. However, with retrospect, it may have been advisable to use a dedicated measure of pain which has greater validity for that purpose.

Recording of Pre-operative Range of Motion

Pre-operatively, there were several individuals recording range of motion (ROM) of the joint. Inter-rater reliability was not checked. If there was low agreement this could partially explain the findings of a weak relationship between ROM and function pre-operatively. However, post-operatively, ROM was measured by one individual only and the same weak relationship was found between ROM and function.

Hospital

The original protocol for the study was to only include patients having their surgery at NGH. However, shortly after the study commenced a waiting list initiative meant that some patients began receiving their surgery at one of the private hospitals. These patients tended to be younger and fitter. An ethical amendment was sought to include these patients as excluding them from the study would have skewed the data. In addition, at the time of pre-assessment it was unknown where patients would be receiving their surgery and therefore if the amendment had not been made then individuals would have to be excluded from the study after consenting. However, including patients attending one of the private hospitals also posed problems as the hospitals have slightly different protocols with respect to intensity of therapy and discharge.

Physiotherapy

Three main problems related to the physiotherapy notes: The degree of accuracy in recording of achievement of key milestones, recording of degrees flexion of knee, and missing notes. Each of these shall now be discussed.

Accurate Recording of Achievement of Key Milestones

Physiotherapists were blinded to the purpose of the study and continued to record the achievement of key milestones in their routine way. They were alerted to the importance of recording achievement in independence of physiotherapy milestones by their clinical lead. However, despite this, there are several instances where information regarding the day of achieved independence in one or more key milestones was missing. It often occurred that it would be recorded when a patient required assistance in completing an activity but not when the patient achieved the activity independently. In these instances it was inferred when independence was achieved (see methodology chapter for further details). However, this may have been inaccurate. As a result, these inaccuracies may be partially responsible for the lack of findings of a relationship between physiotherapy key milestones and psychological factors.

Recording of Flexion of the Knee (Knee Study Only)

Time taken to achieve 90° flexion of knee was included as key milestone as according to the hospital care pathway this should be achieved prior to discharge. However, on collecting the data it became apparent that many patients were discharged prior to achievement of this milestone. In fact this milestone was only recorded for 21 out of the 64 patients completing their surgery post-operative complication free. With such a small number, the regression analyses relating to this variable are pointless. As an alternative, number of degrees flexion that the patient had achieved by discharge from physiotherapy (which ranged from 50-90° degrees) was recorded and also included as a dependent variable in the regression analysis.

Missing Notes

The physiotherapy key milestone data was collected retrospectively from the patients' physiotherapy notes. However, many of these set of notes were missing (11 in the knee study) further reducing the number of participants in the physiotherapy regression analyses.

Summary

An inadequate sample size and problems with the physiotherapy notes have the effect of making the study underpowered. An underpowered study may cause of type II error, however, despite this, many interesting results have been found. Additionally, the choices of outcome measures used in this study may have lead to some problems of reliability. If the study were to be repeated, then a different method of recording co-morbidity would be employed, and a greater effort would be made to ensure that ROM is recorded by one individual.

Chapter 15: Summary

The two studies reported in this thesis aimed to assess which psychological factors might impact on outcome of total hip and knee replacement in terms of pain, activities limitation and participation restriction. The psychological factors studied were global personality measured using the NEO-Five Factor Inventory, health locus of control, and coping strategies. In addition, demographic and medical factors known to assess outcome were recorded. A regression analysis design was used for this; this method was deemed fit for purpose as several other studies have successfully used this method in assessing determinants of outcome (see Appendix page 412).

No specific hypotheses were set as there was a lack of appropriate research in the area to base hypotheses on. As such, there are risks when conducting research which is not hypothesis driven, that false positives would be found. In order to minimise this risk, caution has been exerted when interpreting the findings. The assumption has been made (that as the outcome measures are strongly correlated) then if a psychological variable is predictive of only one outcome measure then it is likely to be a chance finding (type I error).

In the hip study, a high score on catastrophizing was found to be a predictor of worse pain and self-reported function both pre- and post-operatively. This finding is in line with other research assessing the impact of coping strategies in osteoarthritis and other chronic conditions. A greater pain control efficacy (assessed with items on the CSQ) was found to be associated with less pain and better functioning both pre- and post-operatively. Additionally, conscientiousness, measured with the NEO-FFI was found to be predictive of greater pain and activities limitation/participation restriction pre-operatively. It was hypothesised that this was as a result of over-reporting of symptoms rather than of more severe symptoms.

In the knee study, both pre- and post-operatively, neuroticism was found to be predictive of worse pain and greater activities limitation and participation restriction. Neuroticism may exert its effects either through over-reporting of symptoms (therefore symptoms not actually more severe) or through the use of maladaptive coping strategies such as catastrophizing.

Praying/hoping, openness to experience and pain control efficacy were also predictors of pre-operative pain and function. Post-operatively, (in addition to neuroticism), a chance locus of control orientation was predictive of worse functioning.

Based on the findings of the study, it has been suggested that further work be conducted to develop a cognitive behavioural therapy intervention for total joint replacement patients with personality traits which are likely to result in sub-optimal outcome. Cognitive Behavioural Therapy has been shown to be successful in other areas such as in treating chronic back pain (and the associated disability).

One of the aims of the study was to assess the relationship between psychological variables and early outcome of surgery assessed with time taken to achieve key physiotherapy milestones in the immediate post-operative period. In both studies, few psychological variables were related to outcome (those that were, were considered to be chance findings as a result of conducting a study with multiple endpoints.) The lack of findings at this time point may be a reflection of inaccuracies in recording the outcome measures. However, in both studies, several demographic variables were found to predict outcome.

It was also intended to asses the relationship between impairment (measured with range of motion and pain) and activities limitation and participation restriction (as measured with the joint-specific questionnaires) both pre- and post-operatively. In line with previous research (see Chapter 4) only a weak relationship was reported between objectively assessed impairment (ROM) and activities limitation and participation restriction pre- and post-operatively in the hip study. In the knee study, in agreement with this, only a weak relationship was found pre-operatively but a stronger relationship was found post-operatively. However, it was postulated that this was a reflection of loss of range of motion from pre- to post-operatively rather than absolute ROM as when patients who had experienced a deterioration in ROM from pre- to post-operatively were excluded from the analysis a much weaker relationship was found. In the hip and knee studies, both pre- and post-operatively, a much stronger relationship was found

between pain and activities limitation/participation restriction. This is in line with previous findings (see Chapter 4).

Whilst the findings of the study are undoubtedly interesting, there are several limitations of the study including the choice of outcome measures and sample size (see Chapter 14). A study conducted in the future should take these factors into consideration, however, this novel research is a good starting point for further research to be conducted in this area.

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