UNIVERSITY OF SOUTHAMPTON

A SURVEY OF CHIROPRACTIC PRACTICE IN EUROPE

How important are demographic factors in explaining differences in chiropractors' estimated use of x-ray, examination and practice management procedures, and treatment techniques?

BY

Palle Lauridsen Pedersen, D.C.

A thesis submitted to the University of Southampton for the degree of Master of Philosophy (M.PHIL)

Department of Medical Statistics and Computing

Faculty of Medicine

October 1994

UNIVERSITY OF SOUTHAMPTON

ABSTRACT

FACULTY OF MEDICINE

DEPARTMENT OF MEDICAL STATISTICS AND COMPUTING

Master of Philosophy

A SURVEY OF CHIROPRACTIC PRACTICE IN EUROPE

How important are demographic factors in explaining differences in chiropractors' estimated use of x-ray, examination and practice management procedures, and treatment techniques?

by Palle Lauridsen Pedersen

The objective of this study was to investigate chiropractors' estimated usage of x-ray, examination and practice management procedures, and treatment techniques, as well as the importance of demographic variables in explaining differences in use of such procedures. Multiple regression and cluster analysis techniques were used to analyse the data. This study is the first and most comprehensive survey of members of the European Chiropractors' Union (ECU).

A postal questionnaire of all privately practising ECU members (1990 directory) produced demographic information and practice characteristics. Documents collected from 13 out of 15 countries were returned during the first half of 1991 for analysis. Patient case forms, completed by randomly selected practitioners, showed the demographic features, presenting complaints, diagnoses and management procedures used. Seven hundred and fifteen practitioner questionnaires (55% response) and 1014 patient case forms were returned.

Demographic features of chiropractors and patients are similar to those from previous studies. Most chiropractors, one quarter of whom are now females, were European trained. The majority are independent practitioners although, many practise in groups and in co-operation with other health professions, especially in relation to the provision of x-ray services. Regression analyses showed that country, sex, college of graduation, age, duration of practice and year of graduation were the most useful demographic features in describing the chiropractors' estimated use of procedures and treatment techniques. The country variable reflected legal and political cultural influences on practice. Differences between males and females in their use of procedures and treatment techniques were shown. College of graduation also affected their use of treatment techniques, management and examination procedures. Younger, recent graduates tended to

examine more thoroughly and, together with female chiropractors, spent more time with the patient. Those with an academic degree reported performing non-musculoskeletal examinations more frequently. Cluster analyses were applied for data exploration purposes and largely confirmed the regression results.

The results reflect a considerable change of profile and maturation of the profession over the past two decades. The study has established a body of knowledge of European chiropractic practice.

DEDICATION

This work is dedicated to the memory of my late grandmother Henriette Hansine Lauridsen (22/5-1909 - 30/12-1991) whose generosity and good nature will always be remembered.

ACKNOWLEDGEMENTS

This study was mainly funded by the European Chiropractors' Union. Additional funds were provided during the data analysis phase by The Danish Pro-Chiropractic Association's "Wilhelm Krause's Research Fund". The executives from these organisations are gratefully acknowledged for their financial support and encouragement throughout the survey.

Many thanks to all the chiropractors in the survey for supplying details of their practices, and special thanks to the National Officers from each country for their invaluable help in collecting the data.

I would like to express my gratitude to my supervisor Ruth Pickering, PhD, for her generosity, guidance and many useful suggestions. Many thanks to all staff members at the Department of Medical Statistics and Computing, Southampton University, for putting up with my many questions.

TABLE OF CONTENTS

Page

CONTENTS OF FIGURES

All figures are numbered according to the sections in which they occur.

CONTENTS OF TABLES

All tables are numbered according to the sections in which they occur.

Page

CHAPTER 1

INTRODUCTION

Chiropractors are educated in a limited number of colleges worldwide. Although there are some differences in the curriculum from one college to another the aim is to train them to be primary contact practitioners with specialist skills in spinal manipulative therapy. One would therefore expect few differences in terms of how they practice. However, despite common features in training it is not known in the European context how demographic factors may affect chiropractors' way of practising.

Many people have successfully been treated by chiropractors for back pain and other musculoskeletal complaints but no studies have shown which components of the management are responsible for the beneficial effects (1,2,3). Several studies highlight the problems and the associated costs to society are enormous (4,5).

1.1 AIMS AND OBJECTIVES

The purpose of this study was, by means of a postal questionnaire, to get an overview of chiropractic practice in Europe. The main aim was to assess which demographic factors affect chiropractors' estimated use of treatment techniques, x-ray, examination and management procedures. No previous study has attempted to elicit this information (6).

No attempt was made to quantify the success of chiropractic management, assess the efficacy of the treatment or to compare it with any other form of treatment for musculoskeletal disorders.

1.2 WHAT IS CHIROPRACTIC AND WHY DO PEOPLE CONSULT A CHIROPRACTOR?

In 1895 a Canadian merchant with an interest in healing, David Daniel Palmer, treated a man by manipulating the vertebrae of the spine. The deafness, from which this person had been suffering since a lifting accident 17 years previously, was permanently cured (7). Thence, Palmer founded chiropractic (Greek "cheir" which means "hand" and "praktos" meaning "done") based on the theory that misalignment of vertebrae might cause nerve interference and hence, malfunction of the organ(s) supplied by the nerve. This malfunction of an organ distant from the source of the problem, was contrary to the medical belief, that disease comes from the organ itself. Although anatomists and neurologists have questioned whether Palmer's treatment possibly could have cured deafness, a number of similar cases have been reported in the medical literature (7). As with other systems of health care emerging at the time Palmer's theory was very simplistic. Chiropractors now emphasize the use of manipulation to ensure normal joint function, particularly of the spine and pelvis, in the treatment and preventative care of musculoskeletal pain syndromes (8).

In 19th century America, medicine was, at best practised in a way that in Europe would have been considered more typical of the 18th century (9). Many systems of treatment emerged during the last century including homeopathy and osteopathy. The latter has common historical roots with chiropractic but was later integrated into orthodox medicine. Few American osteopathic physicians now practise spinal manipulation.

In Great Britain osteopathy maintains its independent primary health care status together with chiropractic. This means that patients can go directly to these practitioners without prior medical consultation. The clinics thus form one port of entry into the health care system, which allows easy access to physical examination, diagnosis and treatment. Patients usually remain in work during the course of their treatment. The current differences between the two professions are mainly in terms of the treatment techniques used and chiropractors' more frequent use of x-rays (10,11,12,13).

When indicated chiropractors may use x-rays to exclude pathology, such as cancer, bone infections and inflammatory conditions. Additionally, they also use the skeletal films to assess aspects of the mechanics of the spine, both in the region of symptoms and as an overall impression of the region of the spine x-rayed. This is used together with the clinical examination and palpation to determine the most appropriate manipulative procedure (14) (Figures 1a & 1b). Conditions not suitable for chiropractic care are normally referred to the patient's general medical practitioner. Chiropractors are not allowed to prescribe drugs in the UK (or elsewhere) and only rarely recommend the use of over-the-counter medication. Chiropractors do not perform surgery.

1.3 WHY IS THE RESEARCH NECESSARY?

The chiropractic profession has grown to become the largest independent primary contact health profession in the world after medicine and dentistry (15) and many countries have taken steps to

Figure 1a This figure shows an example of how neck manipulation may be performed (Diversified technique).

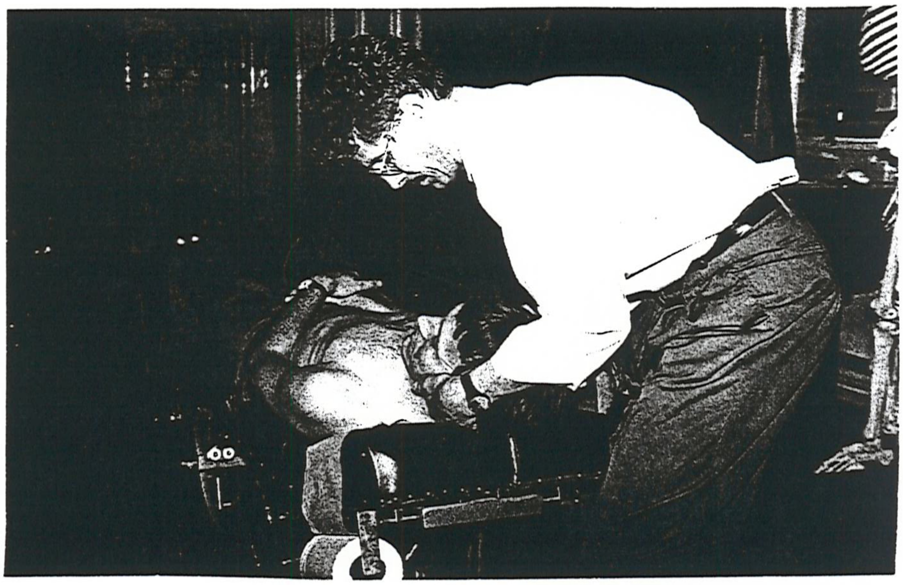


Figure 1b This figure shows an example of how lumbar manipulation may be performed (Diversified technique).

pass legislation to protect the title "chiropractor" (6). In most European countries, the right to practise a profession is granted under one of two legal environments. Those countries governed by Common Law, such as the UK, allow the practice of a profession as long as there is no law against it, while countries governed by Napoleonic Law (or Dutch Roman Law), for example France, deem that any professional practice not legislated is, in fact, illegal (16).

Although there has been good progress for the profession, complacency could easily lose the chiropractors their hard won privileges. Political and economic changes in society affect conditions under which practice is carried out and, as a minority profession in most countries, little evidence is available to reveal the demographic profile of the profession, or support claims of cost-effectiveness in the management of musculoskeletal conditions (6). It has been said that, the price for clinical freedom is eternal professional vigilance. Without definitive data it is not possible to evaluate the chiropractic approach to the management of patients.

1.4 THE DEMOGRAPHIC FEATURES TO BE CONSIDERED

The demographic features of chiropractors are well documented in some parts of the world (17,18,19,20,21,22). In Europe few studies have investigated this, but what data there is from a study in the United Kingdom in 1977 are comparable to international studies (23).

1.4.1 WHY IS SEX IMPORTANT?

Studies in the 1970s showed that approximately 90% of chiropractors are males (21,23). Huisman (1989, ref. 24), in her follow up to Breen's work (23), noticed a decrease (from 92% to 78%) in the proportion of males over the interval from 1973 to 1988. An estimated 50% of the profession graduated since 1980 (25), and it might be supposed that more women could have entered the profession in recent times. However, recent figures for Europe are hard to come by because, few studies are done and there is no consensus on standardised data collection.

Although the nature of chiropractors' work is physically demanding it is more often a question of using appropriate manipulative techniques. This can be done with the help of specially built treatment couches (Fig. 1). Because many of these have adjustable sections, it is possible to reduce the physical strain on the clinician and improve patient comfort. Although tendencies for chiropractors to chose treatment techniques on the basis of size and gender have been reported (26), it has not been established which factors are associated with female chiropractors' choice of treatment techniques.

An increase in the number of female graduates could influence the way patients are managed in practice. No published information was available regarding female chiropractors' decisions pertaining to the use of x-rays. They are likely to have a different psychosocial approach to patients, especially with strictly female conditions such as back pain associated with dysmenorrhoea. Some examination procedures are perhaps more likely to be performed by a female chiropractor. In medical practice it is suggested that factors other than clinical judgement influence the frequency of some procedures, such as rectal examination (27). Similar circumstances may be true for chiropractic practice and attempts will be made to assess if gender affects the chiropractors' estimated use of treatment techniques and other procedures.

1.4.2 DOES IT MATTER IN WHICH COUNTRY YOU PRACTISE?

There are various legal implications of practising in some states in North America (28). Similar limitations can be found in Europe (16). Here one would expect legislation in different countries to affect practice, especially with respect to taking x-rays. It is possible that the differences in legislation across Europe will affect the chiropractors' means of obtaining x-rays of their patients. Thus, in countries where such procedures are permitted, more frequent use might be expected, and in prohibited areas an increase in the use of other facilities, such as hospitals and private radiological clinics, is anticipated.

It has been demonstrated that, despite ideological differences chiropractors display very similar practice patterns (29). Practitioners in countries with strong traditions for the use of additional therapies, such as homeopathy and acupuncture, may indicate using some of the manipulative treatment techniques less frequently. In some regions certain treatment techniques appear to be promoted much more than in others. It has been suggested that exposure to prevailing therapeutic trends in the chiropractic community affects the attitude of recently graduated chiropractors as much as, if not more than, their undergraduate training (26). Therefore, the country variable (and college of graduation, see section 1.4.3) is expected to be particularly important when attempting to assess its influence on the use of treatment techniques.

1.4.3 DO THE COLLEGES PRODUCE DISSIMILAR PRACTITIONERS?

In the past there have been considerable differences in the ideology of graduates from various colleges. Much debate was concerned with the use of examination procedures and treatment techniques, such as heart examination and massage, which are not strictly related to the spine (29). This was mainly reflected in the curriculum of individual colleges, but also led to heated discussions amongst private practitioners. In the early days of North American chiropractic some practitioners made claims that they could cure just about every illness by manipulation of the spine. Such claims were a major cause of opposition from mainstream medicine.

Because European chiropractors were few and widely spread their claims of therapeutic efficacy generated less debate than their flamboyant North American colleagues hence, much of the medical opposition seen in the States was avoided (30). The longest established (1965), and until recently the only, training college in Europe is the Anglo-European College of Chiropractic, Bournemouth. Here basic science and some of the clinical subjects of the Bachelor of Science course are very similar to those taught in medical school, although emphasis is on biomechanics and neurology. During recent years national and international governing bodies have been set up to generate guidelines for the course contents and mutual recognition of colleges throughout the world.

In the past very few chiropractors had other qualifications. With the development of the profession during the past decade more uniform training has emerged and a number of colleges now award degree status qualifications. One might imagine that practitioners graduating from the limited number of colleges worldwide would, perhaps with the exception of the use of x-rays, deliver fairly similar care. Some techniques appear to be preferred regardless of educational background (31). However, detailed information regarding these issues are not available for Europe. The possession of other than chiropractic qualifications may, through knowledge and experience, influence the delivery of care. However, this also needs to be investigated further.

1.4.4 SHOULD I MOVE TO A MORE ELEGANT STREET OR A LARGER PRACTICE?

Chiropractors no doubt like to be seen as successful professionals. Patients' lasting impression of the clinic and practitioner they consult has been said to be formed within the first 5 minutes. Good public relations is invaluable to the chiropractor because, most patients are referred by family, friends or other patients (32,33). Therefore, it is possible that chiropractors setting up in different locations deliver different services. It has not been established to what extent, if any, the location influences for example the time spent with patients, thoroughness of examination, treatment techniques used or x-ray procedures performed.

Many city practices see a large number of patients, who often have to fit their consultation to a busy work schedule, public transport and other stressful factors in a modern society. In rural practices one might imagine that the pace is a bit slower. Some services, such as x-rays, have to be performed through referral to other clinicians, as the maintenance costs may not be sustained due to a lower number of patients seen. The scarcity or long waiting times pertaining to other community health services may also affect the way clinicians decide to manage their patients.

The employment status of the chiropractor, for example solo or group practitioner, is likely to set physical and financial limits on the size of the practice. A shared load amongst clinicians may allow more comprehensive care and have an internal self-regulatory function in terms of quality assurance. Thus, the practice address and type of practice are anticipated to affect various procedures which will be explored further in this study.

1.4.5 IS EXPERIENCE MORE IMPORTANT THAN A YOUNGISH APPEARANCE?

Is the pratice of chiropractic influenced by the age (maturity), year of graduation (quality of training) and duration of practice (experience)? The patients' choice of practitioner is not unlikely to be affected by the gender of the clinician. Is it possible that patients also consider the maturity, experience, or more likely, the reputation of the chiropractor when referred by family, friends and other patients? Over a few consultations they might evaluate the thoroughness of examination, attention to comfort when treated, and the time and care given to their individual problems.

These matters are very subjective and may be judged erroneously by the patient. However, it is conceivable that, despite the initial level of training, additional courses and the experience achieved over a number of years compensate for early deficiences. As previously mentioned the exposure to popular therapeutic trends in the chiropractic community affects the attitude of recently graduated chiropractors. The techniques taught decades ago may still be the ones favoured by older clinicians, when perhaps less emphasis was put on examination procedures. Some of these techniques (notably Gonstead technique, see section 2.4.4) incorporated the use of x-rays and drawing lines on the films in order to assess which manipulative technique to use. Because, drawing permanent lines on the x-rays may obscure subtle radiological signs, for example a small change in the bone structure due to cancerous metastases, this procedure is generally not acceptable any more. However, it is possible to use this type of spinal manipulation without having to rely on x-rays and the techniques are still widely used.

Recent graduates are generally younger (mean age range from 35 to 40 years; 17,21,23) and have a larger body of knowledge when leaving college. They are also likely to have different beliefs and values from those clinicians who graduated at times when medical opposition was more common than trends towards collaboration. A practitioner's age, year of graduation and duration of practice are highly correlated and it is difficult to say which may be the most important.

1.4.6 IN SUMMARY - THE WHOLE IS MORE THAN THE SUM OF THE PARTS

Previous studies have mainly reported frequencies of occurrence for various services delivered in chiropractic clinics. Few studies have given detailed analyses of chiropractic practice and these mainly in relation to clinical trials of the efficacy of managing patients with low back pain (1,2). No previous surveys are available which attempt an analysis of practice patterns across Europe (6).

This thesis is limited to obtaining an overview of those factors which, are thought most likely to affect chiropractors' estimated use of x-ray, examination and management procedures and treatment techniques. It has been done using a postal questionnaire of all members of the European Chiropractors' Union. Studies of similar magnitude may only be carried out once every 10 to 20 years hence, other subordinate data were collected for later analysis.

CHAPTER 2

THE DATA DESCRIPTION

2.1 INTRODUCTION

In this chapter the sampling procedures, variables, questionnaire design and a descriptive profile of the chiropractors in the study are presented.

Because no previous studies of chiropractic practice in Europe have been done the number of variables considered is large. They were chosen to give a comprehensive description of chiropractors. The features to be analysed are the demographic profile, x-ray and examination procedures, treatment technique and miscellaneous practice management procedures, and in particular how demographic factors influence chiropractors' estimated use of these treatments and procedures (Appendix 1).

A separate questionnaire completed by 71 randomly selected chiropractors related to the treatment of 1014 patients. Some of the patient information will be used here to provide a check for chiropractors' estimated application of certain procedures and their actual usage. All data were entered in the Statistical Package for the Social Sciences (SPSS) Data Entry programme and descriptive statistics performed in SPSS/PC+ on an IBM PS/2 (34).

2.2 COLLECTION OF THE DATA

The data were obtained from questionnaires (Appendix 1) sent to all 1290 members of the European Chiropractors' Union (ECU 1990 register). The ECU, founded in 1932 is the parent organization for

European based practitioners who graduated from accredited chiropractic colleges around the world. It acts as an international union representing its members through various boards facilitating inter-professional co-operation, setting standards of practice and education, and providing information on professional and social matters relevant to the practice of chiropractic in Europe.

In 1990 the ECU consisted of 15 member countries each of which had between a handful and a few hundred practitioners. Because of legal limitations, described in the introduction (section 1.3), as well as the number of practitioners and their organization, an efficient establishment of national chiropractic associations is only recognized in a few countries. The ECU keeps names and addresses only and encourages national organisations to keep more detailed registers.

The data collection took place during the first half of 1991. Representatives of the national chiropractic associations were approached and those countries agreeing to participate in the study (Germany refused) selected a contact person who would distribute and later collect the completed questionnaires. Furthermore, this person would also supply demographic information about the non-responding chiropractors. This was collected from the archives of each national association. It later became apparant that, despite the stated intention of the ECU to keep national registers, some associations did not do so. This had consequences for obtaining information about the non-responders (described in section 2.3). The documents from 13 European countries were returned for analysis. Despite agreement to participate no forms were returned from Spain. Table 2.3.1 shows the proportions of responders and non-responders. There is considerable disparity in numbers across countries. In the United Kingdom and Scandinavia chiropractic is much more popular and there are fewer legal restrictions on practice. In some continental countries, for example Germany and France, all non-medical practitioners are registered by the respective authorities, but in France the practice of spinal manipulation by non-medical persons may have serious legal consequences. They risk being prosecuted for practising medicine despite the free movement of labour forces within the European Economic Community and the acceptance of chiropractic as part of other European countries' health care systems.

2.3 RESPONSE RATES AND FEATURES OF THE NON-RESPONDERS

The total sample of chiropractors registered with the ECU (1290) consisted of 715 responding chiropractors (55.4%) and 575 non-responders (44.6%) (Table 2.3.1). Most non-responders came from the Continent and to some extent Scandinavia. Demographic information relating to the total sample (where available from the National Registers, for non-responders) is shown in tables 2.3.2 and 2.3.3. The non-responders were on average 3 years older, have practised for an average of 14.2 years, as compared to 9.8 years for the responders, and are more likely to have graduated from American colleges than the responders. However, the figures for non-responders must be treated with caution.

The large amount of missing information about the non-responders

Table 2.3.1 Chiropractors' Response Rates per Country and Region.

N = 1290*

VARIABLE	RESPONDERS BY COUNTRY N/TOTAL (%)	RESPONDERS BY REGION N/TOTAL (%)	NON-RESPONDERS BY COUNTRY N/TOTAL (%)	NON-RESPONDERS BY REGION N/TOTAL (%)
DENMARK	154/232 (66.4)	SCANDINAVIA 234/453 (51.7)	78/232 (33.6)	SCANDINAVIA 219/453 (48.3)
FINLAND	1/17 (5.9)		16/17 (94.1)	
ICELAND	3/3 (100.0)		0	
NORWAY	47/111 (42.3)		64/111 (57.7)	
SWEDEN	29/90 (32.2)		61/90 (67.8)	
BELGIUM	11/58 (19.0)	CONTINENT 158/479 (33.0)	47/58 (81.0)	CONTINENT 321/479 (67.0)
FRANCE	27/126 (21.4)		99/126 (78.6)	
GREECE	5/6 (83.3)		1/6 (16.7)	
ITALY	23/57 (40.4)		34/57 (59.6)	
NETHERLANDS	9/51 (17.6)		42/51 (82.4)	
SWITZERLAND	83/147 (56.5)		64/147 (43.5)	
GERMANY	0/13 (0.0)		13/13 (100.0)	
SPAIN	0/21 (0.0)		21/21 (100.0)	
IRELAND	15/18 (83.3)	BRITISH ISLES 323/392 (82.4)	3/18 (16.7)	BRITISH ISLES 69/392 (17.6)
UNITED KINGDOM	308/374 (82.4)		66/374 (17.6)	

* This constitutes the number of chiropractors where information was available on both responders and non-responders. The numbers from Germany (13) and Spain (21), where no information on either responders or non-responders was submitted, must be added thus giving a total of 1324 members of the European Chiropractors' Union in 1990.

Table 2.3.2 Categorical Demographic Variables - number of cases and percentages for responders and non-responders.

VARIABLE	CATEGORY	RESPONDERS (N=715)		NON-RESPONDERS (N=575)	
		N (%)	MISSING N (%)	N (%)	MISSING N (%)
SEX	MALE	529 (74.0)	0	274 (47.7)	198 (34.4)
	FEMALE	186 (26.0)		103 (17.9)	
COUNTRY	SCANDINAVIA	234 (32.7)	0	219 (38.1)	0
	CONTINENT	158 (22.1)		287 (49.9)	
	UNITED KINGDOM/ IRELAND	323 (45.2)		69 (12.0)	
EMPLOYMENT STATUS	SINGLE	293 (41.0)	6 (0.8)	144 (25.0)	371 (64.5)
	PARTNER	243 (34.0)		24 (4.2)	
	GROUP PRACTICE	130 (18.2)		29 (5.0)	
	EMPLOYED	43 (6.0)		7 (1.2)	
COLLEGE OF GRADUATION	EUROPEAN	352 (49.2)	1 (0.1)	122 (21.2)	245 (42.6)
	AMERICAN	313 (43.8)		187 (32.5)	
	CANADIAN	36 (5.0)		16 (2.8)	
	AUSTRALIAN	13 (1.8)		5 (0.9)	
ACADEMIC DEGREE	YES	205 (28.7)	25 (3.5)	32 (5.6)	543 (94.4)
	NO	485 (67.8)		0	
PRACTICE ADDRESS*	METROPOLITAN	181 (25.3)	7 (1.0)	79 (13.7)	356 (61.9)
	URBAN	259 (36.2)		84 (14.6)	
	SEMI-URBAN	251 (35.1)		55 (9.6)	
	RURAL	17 (2.4)		1 (0.2)	

* Population: Metropolitan (>250.000), Urban (50.000-250.000), Semi-urban (2.000-49.999), Rural (<2.000).

Table 2.3.3 Continuous Demographic Variables - number of cases and percentages for responders and non-responders.

VARIABLE	RESPONDERS (N=715) MEAN (S.D.)	MISSING N (%)	NON-RESPONDERS (N=575) MEAN (S.D.)	MISSING N (%)
AGE (YEARS)	37.2 (9.2)	4 (0.6)	40.7 (11.2)	276 (48.0)
DURATION OF PRACTICE (YEARS)	9.8 (8.0)	1 (0.1)	14.2 (9.8)	374 (65.0)
YEAR OF GRADUATION	1980 (8.2)	0	1977 (10.6)	261 (45.4)

(Tables 2.3.2 & 2.3.3) was due to an unexpected poor state of record keeping. One country (Norway, n=111) reported not having any national records of their members. In other countries little more than date of birth, sex, college and year of graduation was available. Variables such as employment status and possessing an academic degree might have changed without being registered by the national association's secretariat, where such existed. There did not appear to be any standardised format for collecting simple demographic information even in countries which had passed legislation. Hence, though it would seem there are differences between responders and non-responders, we can't be entirely sure. Table 2.3.4 shows the number of missing cases in the original data set for the questionnaire responders only. The loss of demographic information is relatively small in this group.

All practitioners were allocated ID codes on the forms and in the European Chiropractors' Union register. Thus, their name, practice address and country of practice were obtained for the whole sample (n=1290) before mailing the questionnaires. This ensured that no individual was entered twice in the study and that all practitioners were accounted for.

Table 2.3.4 Number of missing cases in the original data set.

	Original data N=715 (100%)	
	Number not missing (%)	Number missing (%)
SEX	715 (100.0)	0 (-)
COUNTRY	715 (100.0)	0 (-)
EMPLOYMENT STATUS	709 (99.2)	6 (0.8)
COLLEGE OF GRADUATION	714 (99.9)	1 (0.1)
ACADEMIC DEGREE	690 (96.5)	25 (3.5)
PRACTICE ADDRESS	708 (99.0)	7 (1.0)
AGE	711 (99.4)	4 (0.6)
DURATION OF PRACTICE	714 (99.9)	1 (0.1)
YEAR OF GRADUATION	715 (100.0)	0 (-)
ONE OR MORE	671 (93.8)	44 (6.2)

2.4 VARIABLES IN THE STUDY

The variables in the study can be divided into the 5 groups below:

1. **Demographic data** (6 categorical and 3 continuous variables)
2. **X-ray procedures** (10 continuous variables)
3. **Examination procedures** (16 continuous variables)
4. **Treatment techniques** (13 continuous variables)
5. **Miscellaneous practice management procedures** (6 continuous variables).

Groups 2-5 consist of self-assessments made by the chiropractors of their usage of various treatment techniques and assessments of other aspects of their practice. They have collectively been labelled "usage" variables, but particularly in group 5, this designation may not be entirely appropriate as, for example one variable measures agreement with a statement that chiropractors should be able to prescribe mild painkillers and similar drugs. The practitioners were asked to report their estimated use (0-100%) of the techniques or procedures above. In each area, with a few exceptions described later, at least one chiropractor reported using each technique or procedure with 100% of his/her patients.

Groups 1-5 will be described in more detail in the following sections.

2.4.1 THE DEMOGRAPHIC VARIABLES

The 9 demographic variables are listed below. Only those whose meaning may not be obvious are explained in more detail.

1) **SEX:** Male/female chiropractor.

2) **COUNTRY:** The countries were grouped into regions (Scandinavia, Continent and United Kingdom/Ireland) as some national associations only had few members. However, more important were the common legal practices in these regions as well as the shared cultural history, especially in Scandinavia. Because of this grouping it is not possible to asses which individual countries contribute more or less to the usage of procedures and treatment techniques.

3) **EMPLOYMENT STATUS:** Chiropractors traditionally practise as single independent clinicians although partnerships and group practices have over the past decade been on the increase. The division of employment status to include both independent, partnership, group practice/health clinic and employed chiropractors might reveal differences in access to equipment or possibly patterns of practice.

4) **COLLEGE OF GRADUATION:** In the past most chiropractors graduated from American colleges. During the last decade a substantial number have come from European colleges, the biggest of which is the Anglo-European College of Chiropractic in Bournemouth; while a few have graduated from Canadian or Australian colleges. Because there tends to be a different approach to training in different parts of the world and due to few numbers in some cases, the college of graduation variable was divided into European, American, Canadian and Australian colleges.

5) **ACADEMIC DEGREE:** Chiropractors are now given BSc degrees from a number of colleges, or degrees may be obtained prior to their chiropractic training. They may also possess other qualifications at certificate or diploma level. In order to be able to analyse the data without the need for reporting several kinds of degrees, certificates or diplomas, this variable only established whether or not any such qualification had been obtained. Nevertheless, the diversity of these achievements may be of interest and they are listed for reference in table 2.4.1.1.

Table 2.4.1.1 The numbers and percentages of chiropractors possessing other qualifications (N=690).

Single qualifications:	**N (%)**	**Combined qualifications:**	**N (%)**
BSc (Physical Education)	9	BSc (Other) + BA	1
BSc (Other)	61 (8.8)	BSc (Physical Education) + BA	1
MSc	2	BSc (Other) + Physio.	15 (2.2)
PhD	1	BSc (Other) + PhD	1
MD	6	BSc (Other) + Techn. Certif.	1
BA	12 (1.7)	BSc (Other) + Teach. Certif.	1
MA	4	BSc (Other) + MSc	3
Physiotherapy	21 (3.0)	BA + Physiotherapy	1
Nurse	7	BA + MA	2
Teaching Certificate	8	MA + MSc	1
Osteopath	2	Acupuncture + Osteopathy	1
Diploma (Languages/Engineering)	3	Teaching Certificate + MA	1
Secretarial/Language Qualif.	1	Nurse + Midwifery	1
College Education (>2 years)	1	Psycho-/Hypnotherapy	1
Business Degree/Diploma	13 (1.9)	Alternative Health Pract.	4
Technical Certificate	4	Physiotherapy + Acupuncture	1
Acupuncture Qualification	3	Acupuncture + Psychotherapy	1
Dentist	2	Teach. Certif. + Business Degr.	1
Podiatrist	1	Teaching Certificate + BA	2
Certified Chiropractic Sports Physician (CCSP)	1	Unclassifiable	3 (0.4)

Possess no other qualifications	=	485 (485/690 = 70.3%)
Single (162) + combined qualific. (43)	=	205 (205/690 = 29.7%)
Total	=	690 (100.0%)
Missing cases	=	25 (25/715 = 3.5%)

6) **PRACTICE ADDRESS:** The practice address variable (ie. population size of the town or city where the chiropractor practised) is based on guidelines for European city populations (35). It was necessary to use an already established reference to avoid an arbitrary division which would not be applicable across Europe. Furthermore, it gave the chiropractors completing the questionnaire a frame of reference and if necessary the category

could be looked up in national or international public records. The four groups of practice address are:

1. **Metropolitan** (Population >250.000)
2. **Urban** (Population 50.000 - 250.000)
3. **Semi-urban** (Population 2.000 - 49.999)
4. **Rural** (Population <2.000)

7) **AGE:** Age of chiropractor in years.

8) **DURATION OF PRACTICE:** In months.

9) **YEAR OF GRADUATION:** Year, for example 1980 is entered as 80.

Age, duration of practice and year of graduation are highly correlated (Table 2.4.1.2). Age and duration of practice increase as year of graduation goes down. In other words the older the chiropractor and the longer he/she has been practising, the longer ago the year of graduation (ie. smaller value for year, baseline 1900) hence, the correlations between variable YEARGRAD and the other two are negative, whereas that between AGE and DURPRAC is positive.

Table 2.4.1.2 **The correlation coefficients between continuous demographic variables.**

N=710

	AGE	DURPRAC	YEARGRAD
AGE	1.000		
DURPRAC	0.8540**	1.000	
YEARGRAD	- 0.8553**	- 0.9929**	1.000

1-tailed test significance: ** $p < 0.001$
Missing cases: Age (4) and duration of practice (1)

The mean age of chiropractors in the study sample was 37.2 years. The mean duration of practice was 9.8 years (s.d. 8.0) and the mean year of graduation was 1980 (Table 2.3.3).

Most practitioners are male with females comprising 26% of the study sample (Table 2.3.2). Almost all the clinicians, 93%, were of European nationality. This variable, nationality, was not included in the analyses because it was considered unlikely to be as important as the other demographic variables in affecting chiropractors' estimated use of various procedures and techniques.

The profession has traditionally been trained in North America, but during the past decade the number of European-trained chiropractors at the Anglo-European College of Chiropractic has increased dramatically. Table 2.3.2 shows a slight predominance of European college graduates in the study.

Most clinicians are self-employed, practising solo or as partners (Table 2.3.2). They usually work in one clinic only (69.8%) and some in at least two clinics (25.7%). These are almost exclusively located in metropolitan, urban or semi-urban areas. Most practitioners were located in the British Isles and Scandinavia and 22.1% practise in the Continent. Almost a third of practitioners had obtained qualifications in addition to their chiropractic training. As table 2.4.1.1 shows, 29.7% of the chiropractors have one or more other qualifications.

2.4.2 THE X-RAY PROCEDURES

Some of the responses in relation to the use of x-ray procedures were conditional upon the availability of such facilities to the clinician (first 5 variables in table 2.4.2). In some countries chiropractors were not allowed to take x-rays. Those "not applicable" (coded 997) were excluded in the analysis reported here therefore, the larger number of missing cases. All chiropractors were asked about the extent to which they used outside facilities (last 5 variables in table 2.4.2). Some were left blank and coded missing even though all practitioners were requested to answer this section. For all variables at least one chiropractor reported using each procedure with none or 100% of his/her patients, except taking skeletal x-rays (range 8 to 100%) (Table 2.4.2).

Table 2.4.2 Summary Statistics of the 10 X-ray Variables.

N = 715*

VARIABLE	MEAN USE % (S.D.)	SKEWNESS	N	MISSING CASES (%)
1. TAKE SKELETAL X-RAYS	72.1 (23.6)	-0.97	540	175 (24.5)
2. TAKE TISSUE X-RAYS	9.0 (9.6)	4.23	540	175 (24.5)
3. ASK ABOUT MENSTRUAL CYCLE	86.8 (24.4)	-2.46	532	183 (25.6)
4. GET ORAL CONSENT	79.7 (32.4)	-1.71	525	190 (26.6)
5. GET WRITTEN CONSENT	16.1 (28.0)	2.15	510	205 (28.7)
6. GET X-RAYS FROM ANOTHER CHIROPRACTOR	16.1 (21.5)	2.41	654	61 (8.5)
7. GET X-RAYS FROM HOSPITAL VIA GENERAL PRACTITIONER	10.8 (14.5)	3.20	640	75 (10.5)
8. GET X-RAYS DIRECTLY FROM HOSPITAL	14.5 (18.2)	2.76	651	64 (9.0)
9. GET X-RAYS FROM PRIVATE RADIOLOGICAL CLINIC	13.0 (19.8)	2.55	644	71 (9.9)
10. PATIENT BRINGS THE X-RAYS	15.2 (19.3)	2.25	653	62 (8.7)

* The range is 0 to 100 for all variables except "Take skeletal x-rays" (range 8 to 100).

The meaning and circumstances related to the individual variables are briefly explained below:

1) **TAKE SKELETAL X-RAYS** - Films to visualise bone structures, for example the spine, pelvis or limbs.

2) **TAKE TISSUE X-RAYS** - Films to visualise soft tissue structures such as the lungs.

3) **ASK ABOUT MENSTRUAL CYCLE** - This is important in order to determine the likelihood of a female patient being pregnant. The risk of irradiating an early stage developing foetus can be reduced by appropriate questioning and applying physical protective measures, such as a lead apron. A pregnant woman should not be x-rayed, at least in the region of the foetus, unless the clinical circumstances are life threatening.

4) **GET ORAL CONSENT** }
5) **GET WRITTEN CONSENT** }

There often appears to be confusion regarding the legal requirements to obtain consent. It might be expected that consent would be sought more often in metropolitan and urban areas compared to rural ones.

6) **GET X-RAYS FROM ANOTHER CHIROPRACTOR** - Especially when not available within the clinic.

Variables 7-10 are most likely to vary across countries as explained below.

7) **GET X-RAYS FROM HOSPITAL VIA GENERAL PRACTITIONER** - As 6, and in countries/areas with good inter-professional co-operation this would be expected to take place more often but, it may also vary across individual chiropractors.

8) **GET X-RAYS DIRECTLY FROM HOSPITAL** - As 7, and in countries where chiropractic is well integrated in the health care system.

9) **GET X-RAYS FROM PRIVATE RADIOLOGY CLINIC** - As 6, especially when prohibited by law from taking films within the practice, notably France.

10) **PATIENT BRINGS THE X-RAYS** - In countries, such as Italy, where radiological services are often ordered by the patients and brought with them for private health care consultations.

2.4.3 THE EXAMINATION PROCEDURES

An overview of the most commonly used examination procedures in practice, is given in Table 2.4.3. These procedures included in the questionnaire are common to both general medical and chiropractic practice. For all variables at least one chiropractor indicated using each procedure, except measuring temperature (range 0 to 93%), with 100% of his/her patients (Table 2.4.3).

The first eight are mainly used to assess the patient's posture, spinal mobility and degree of neurological involvement, for example nerve root compression in disc prolapses. The mean estimated use of these procedures indicates the that most frequently used examination procedures are those dealing with muscle and joint problems of the spine, pelvis and linbs. This is not surprising because, the

TABLE 2.4.3 Summary Statistics of the 16 Examination Variables.

N = 715*

VARIABLE	MEAN USE % (S.D.)	SKEWNESS	N	MISSING CASES (%)
1. POSTURAL SPINAL ANALYSIS	70.8 (32.4)	-1.04	702	13 (1.8)
2. STATIC SPINAL PALPATION	90.0 (17.4)	-3.07	709	6 (0.8)
3. DYNAMIC SPINAL PALPATION	87.9 (19.3)	-2.49	706	9 (1.3)
4. ORTHOPAEDIC - LUMBAR SPINE	87.4 (19.2)	-2.46	711	4 (0.6)
5. ORTHOPAEDIC - CERVICAL SPINE	83.2 (23.0)	-1.83	710	5 (0.7)
6. NEUROLOGICAL - REFLEXES	78.3 (24.0)	-1.32	709	6 (0.8)
7. NEUROLOGICAL - SENSATION	60.9 (28.8)	-0.31	710	5 (0.7)
8. NEUROLOGICAL - MUSCLE TESTS	64.6 (28.1)	-0.47	710	5 (0.7)
9. TAKE PULSE	31.0 (27.4)	1.09	706	9 (1.3)
10. BLOOD PRESSURE	40.2 (28.4)	0.59	711	4 (0.6)
11. RESPIRATION RATE	13.8 (16.5)	2.75	704	11 (1.5)
12. TAKE TEMPERATURE	10.0 (12.3)	3.27	705	10 (1.4)
13. ABDOMEN EXAMINATION	21.4 (21.3)	1.80	706	9 (1.3)
14. HEART AUSCULTATION	16.4 (18.2)	2.28	705	10 (1.4)
15. LUNG AUSCULTATION	15.8 (17.0)	-2.44	707	8 (1.1)
16. MOUTH EXAMINATION	13.1 (18.4)	2.80	708	7 (1.0)

* The range is 0 to 100 for all variables except "Take temperature" (range 0 to 93).

conditions mostly seen by chiropractors are related to disorders of the musculo-skeletal system. The additional data on patients' presenting complaints and diagnoses collected in this study showed a high prevalence of musculoskeletal problems, such as low back and neck pain, confirming several other studies.

The remaining eight examinations are used to test various organ systems, in order to rule out heart/lung conditions or abdominal diseases, which may also produce back pain. The importance of measuring blood pressure and performing abdominal examination relates to the need to rule out conditions which should receive medical attention.

A brief description of the variables is given below.

1) **POSTURAL SPINAL ANALYSIS** - This consists of observation of the patient's posture to detect any abnormalities such as, for example, scoliosis.

2) **STATIC SPINAL PALPATION** - Palpation (feeling) bony structures, joints and soft tissues in a resting position in order to detect gross abnormalities.

3) **DYNAMIC SPINAL PALPATION** - Palpation of bony structures, especially joints, during movement in order to detect abnormalities in the funtion of these joints.

4) **ORTHOPAEDIC TESTS - LUMBAR SPINE** - Commonly used examinations to localise a mechanical problem in the low back and detect the possibility of nerve root irritation when the symptoms extend to the leg.

5) **ORTHOPAEDIC TESTS - CERVICAL SPINE** - Commonly used examinations to localise a mechanical problem in the neck and detect the possibility of nerve root irritation when the symptoms extend to the arm.

6) **NEUROLOGICAL TESTS - REFLEXES** - Testing the extent to which the reflexes are present (normal), exaggerated (pathological, indicating underlying disease) or absent (for example nerve root compression such as disc prolapse).

7) **NEUROLOGICAL TESTS - SENSATION** - Sensation changes on the skin may follow the distribution of the nerves, which makes it possible to localise exactly which ones are involved (though there may be several possibilities for underlying causes). More diffuse sensation changes, taken together with the results of the overall examination, tends to indicate less serious problems and may even be psychological.

8) **NEUROLOGICAL TESTS - MUSCLE TESTS** - The lack of strength and bulk of a muscle may indicate a problem with the nerve(s) supplying this muscle. This could have several causes, for example disc prolapse with nerve root compression or an underlying disease, such as Poliomyelitis.

9) **TAKE PULSE** - This tells us something about the function of the heart and state of the vessels. Although not necessarily routinely done, this may be important in relation to patients who simultaneously suffer from or are at risk of developing problems of the cardiovascular system.

10) **BLOOD PRESSURE** - As 9, and is the most commonly performed examination probably because of the prevalence of high blood pressure in the population. Because this can be done routinely and not just in patients at risk it is an important screening tool as patients usually go to the chiropractor without prior medical consultation. In some patients with head/neck problems this examination is a must to rule out other underlying conditions before manipulating the neck.

11) **RESPIRATION RATE** - How fast or deep people breathe may depend on a number of factors and can be a sign of underlying disease. It can also change in very nervous people resulting in emergency situations, which would normally be regarded as serious but are a physiological consequence of psychological distress. This test may be more related to patients at risk rather than a routine procedure.

12) **MEASURE TEMPERATURE** - This is important when ruling out fever as a consequence of infection, which may be be localised anywhere in the body. Infections may quickly develop into serious and even life threatening conditions. Vigilance is particularly important when dealing with children who may have rather diffuse symptoms and in adults where signs and symptoms don't add up.

This examination is most likely limited to patients at risk rather than a routine procedure.

13) **ABDOMEN EXAMINATION** - A number of abdominal conditions may give rise to back pain. An examination of the abdomen is particularly important in the older age groups where an expansion (aneurysm) of the main artery, abdominal aorta, is common. If the artery is calcified on its inside lining this is often visible on x-rays. Aneurysms also appear in other parts of the cardiovascular system but they are more frequently detected at a non-symptomatic stage by routine examination of the abdomen because, x-rays are taken of the lumbar spine for other reasons, such as establishing the extent of degenerative joint disease ("arthritis"). Although quite rare, inattentive manipulation of the lumbar spine in patients with large abdominal aneurysms may result in rupture of the artery and death.

14) **HEART AUSCULTATION** - As 9, and 10. Additionally, some infections, for example during childhood, tend to damage the valves of the heart giving rise to abnormal heart sounds and these may be detected with a stethoscope. This examination may not be routine but is performed following clues elicited from the patient's past history of illnesses.

15) **LUNG AUSCULTATION** - As 9, and 10, but particularly in patients with a history of lung conditions, such as asthma, tuberculosis or unexplained chest symptoms.

16) **MOUTH EXAMINATION** - A large number of diseases may show changes in the appearance of the tongue, the inside of the cheeks and the throat. Additionally, a neurological examination of the major nerves of the head, ie. cranial nerves, involves checking the function of several anatomical structures in and around the mouth. It is probably mainly in patients with head or neckache that examination of the mouth is performed in chiropractic practice and not as a routine.

2.4.4 THE TREATMENT TECHNIQUES

There are many chiropractic treatment techniques available. Most of these employ various forms of manual spinal manipulation. In this study only the ones most commonly used are explored. For all variables at least one chiropractor reported using each technique, except Toftness (range 0 to 93%), with 100% of his/her patients (Table 2.4.4).

Twelve different manipulative techniques were assessed for frequency of use. An additional group labelled "Biomechanical Principles" was added to include the techniques which may not have been described in training manuals, but where the practitioner based the treatment approach almost entirely on applying the knowledge of normal biomechanics when deciding which is the most appropriate procedure.

Table 2.4.4 Summary Statistics of the 13 Treatment Technique Variables.

N = 715*

VARIABLE	MEAN USE % (S.D.)	SKEWNESS	N	MISSING CASES N (%)
1. DIVERSIFIED	68.0 (30.0)	-0.84	686	29 (4.1)
2. GONSTEAD	37.0 (33.4)	0.51	658	57 (8.0)
3. HIO - HOLE-IN-ONE	16.6 (20.5)	2.07	658	57 (8.0)
4. TOGGLE RECOIL	22.5 (23.0)	1.22	647	68 (9.5)
5. LOGAN BASIC	8.9 (12.4)	2.98	623	92 (12.9)
6. SACRO-OCCIPITAL TECHNIOUE	18.0 (23.7)	1.88	645	70 (9.8)
7. APPLIED KINESIOLOGY	19.5 (24.7)	1.69	661	54 (7.6)
8. NIMMO	43.0 (27.8)	0.21	670	45 (6.3)
9. ACTIVATOR	14.0 (17.8)	1.97	647	68 (9.5)
10. PETTIBON	5.3 (8.6)	4.92	627	88 (12.3)
11. PIERCE-STILLWAGON	6.6 (11.3)	4.43	621	94 (13.1)
12. TOFTNESS	5.1 (8.6)	5.26	621	94 (13.1)
13. BIOMECHANICAL PRINCIPLES	40.2 (30.9)	0.47	639	76 (10.6)

* The range is 0 to 100 for all variables except "Toftness" (range 0 to 93).

No attempt was made to quantify the success of chiropractic treatment or to compare it with any other form of management of musculoskeletal disorders. There are differences in how various techniques are performed, but it has not been established whether or not this results in a dissimilar change in physiology. The advantages of some techniques are in relation to patient and practitioner comfort during the treatment. Furthermore, alternative explanations for frequency of use are most likely their popularity amongst practitioners, the college of graduation, and the country of practice in which some techniques may be promoted more often through courses.

An overview of commonly used treatment techniques is given in table 2.4.4. Most of these are variations of spinal manipulative procedures done by hand. Only in performing the "activator technique" is this done by using a hand held mechanical tool.

The practitioners were requested to tick each technique for frequency of use, but some only recorded those actually used and left the remaining blank. It was not possible to ascertain if the respondents regarded the latter as "not using" (ie. 0) hence, blank responses were coded missing. This accounts for the difference in the number of cases, which are recorded together with the proportions of missing values in table 2.4.4. Diversified, Gonstead and Nimmo techniques appear to be the three most favoured techniques.

A brief description of the treatment technique variables is given below.

1) **DIVERSIFIED** - This is an American system of techniques taught in most colleges around the world (Figures 1a & 1b).

2) **GONSTEAD** - The American Clarence Gonstead developed a set of techniques on the basis of vertebral misalignments found on x-rays. Lines drawn on the films result in a "listing", or mode of misalignment, for which a specifically developed technique is used. Many chiropractors still use this technique although not necessarily based on lines drawn on the x-rays because, there may be few or no clinical reason for taking the films, for example in young patients with no underlying disease.

3) **HIO - TOGGLE** - Hole-in-one (HIO) refers to the anatomical relationship between the upper two (irregular) neck vertebrae of the spine. The uppermost vertebra (C1) forms a circle and part of the second (C2), immediately below, extends upwards (the odontoid peg) to be enclosed by C1. This relationship allows 50% of headrotation to take place between these two vertebrae, and the remaining 50% is shared amongst the other 5 neck vertebrae.

   Toggle is a quick thrust with the hand to a specific contact point on C1, whilst the patient is positioned on his/her side with the head and neck in a relaxed position on a specifically designed treatment couch. This action induces minimal movement between C1 and C2 in order to restore normal function. The lack of such function would be detected through the use of static and dynamic palpation as previously described (Section 2.4.3). During the early days after chiropractic was founded in 1895 many practitioners believed that manipulating only C1/C2 would cure many diseases because, the spinal cord and most nerves of the body have to pass through C1.

4) **TOGGLE RECOIL** - Similar to 3, except this applies to virtually any joint of the skeleton. Recoil refers to the manner in which the chiropractor quickly withdraws his hands after thrusting on the spine (compare with the recoil mechanism of a rifle for example). It is a very quick thrust, not a push, on the contact point of the vertebra after which, the specifically designed headrest (see figure 1) of the treatment couch drops perhaps 1 centimetre to assist in producing movement between two adjacent vertebrae.

5) **LOGAN BASIC** - This American technique, developed by Hugh Logan, mainly consists of gentle pressure to various parts of the hip and buttock muscles in order to restore normal function of the pelvis and low back. It is a non-forceful technique which may be particularly useful in relation to acute patients or when the practitioner is physically disadvantaged in the treatment of heavy patients. For the latter reason it is more likely to be favoured by female chiropractors.

6) **SACRO-OCCIPITAL TECHNIQUE (SOT)** - This is a gentle technique which centres around the relationship between the sacrum and the occiput (base of the Skull) through the membranes surrounding

the spinal cord, especially the dura mater. Because of the way the spinal cord is nourished through its vascular membranes it is believed that stimulation of joints in the skull and gentle manipulation of the sacrum and pelvis will affect the nervous system in a positive way. Through surgical experimental research it has been established that contractions in the dura mater do actually take place but research needs to be done in order to fully explore this relationship.

7) **APPLIED KINESIOLOGY (AK)** - Developed by an American chiropractor, George Goodheart, this is based on the Chinese acupuncture meridian system, which states that there are 12 lines (meridians) of energy running through the body. These can be used to detect disease, and stimulated to affect their course. AK also involves extensive use of muscle testing and the system is used, combined with manipulative techniques, both for detection and treatment of musculoskeletal conditions. In general it can be regarded as a non-forceful method of treating patients.

8) **NIMMO** - This is developed by an American and mainly consists of putting manual pressure on localized areas of muscles which may become tender for example due to contracture of the muscle fibres and a build up of biochemical breakdown products (lactic acid) in the muscles. This often follows overuse or other inappropriate use of the muscles, such as prolonged static working postures. These sore areas, or trigger points, frequently give rise to pain in other parts of the same

anatomical region (referred pain). Thus trigger points in the shoulder girdle muscles may refer pain to the side of the head giving rise to headaches.

9) **ACTIVATOR** - An American technique where a hand held springloaded instrument upon activation applies a gentle thrust onto for example trigger points in order to break up the muscle fibre contractures. It is a non-forceful technique which may be useful when treating acute or heavy patients.

10) **PETTIBON** - In this study the technique relates to the manipulation performed by hand although activator and other instruments may be used.

11) **PIERCE-STILLWAGON** - These techniques were developed by Pierce and Stillwagon and are mainly manual techniques, which are mechanically assisted by drop-piece features of the treatment couch (see figure 1b; for example for pelvic manipulation; compare to HIO and Toggle-Recoil described above).

12) **TOFTNESS** - An American technique in which a hand held instrument with a pressure gauge is used to apply the correct amount of pressure to the muscles being treated.

13) **BIOMECHANICAL PRINCIPLES** - Any other type of technique involving manual spinal manipulation but which may not have been described in training manuals as the other techniques above. Thus, they are almost entirely based on the practitioners' knowledge of normal biomechanics when deciding which is the most appropriate

way to manipulate the spine.

2.4.5 THE MISCELLANEOUS PRACTICE MANAGEMENT VARIABLES

These variables relate to procedures or decisions concerning the management of patients, but which can not easily be grouped with the other usage variables hence, they form a miscellaneous group (Table 2.4.5). They may well be influenced in some way by the 9 demographic variables, such as gender, college of graduation, practice address and country of practice.

A brief description of the variables is given below.

1) **PERFORM HOME VISITS** - Although chiropractors usually perform most of their treatment in the clinic this may, eg. due to geographical circumstances or for acute patients, be extended to include home visits. Furthermore, there is an increasing tendency to have chiropractors perform field duties at sports tournaments which may take place some distance from the clinic.

2) **TREAT BY MANIPULATION ONLY ON FIRST VISIT** - The proportion of patients treated only by manipulation on their first consultation may reflect the attitude of the practitioner. Thus, some chiropractors never use any other methods whereas other practitioners may use massage, ultrasound, etc. It could also reflect the nature of the condition with which the patient presents. Acute low back or neck pain may occasionally require a few days bed rest or the use of ice packs to decrease the pain and inflammation.

Table 2.4.5 Summary Statistics of the 6 Miscellaneous Practice Management Variables.

N = 715

VARIABLE	MEAN USE % (S.D.)	MIN	MAX	SKEWNESS	N	MISSING CASES N (%)
1. PERFORM HOME VISITS	6.9 (7.3)	0	60	3.38	713	2 (0.3)
2. TREAT BY MANIPULATION ONLY ON FIRST VISIT	44.8 (33.1)	0	100	0.12	702	13 (1.8)
3. GIVE EMOTIONAL/SOCIAL COUNSELLING	10.2 (13.4)	0	91	3.08	712	3 (0.4)
4. RATE AGREEMENT TO PRESCRIBE DRUGS*	46.3 (34.6)	0	100	0.15	707	8 (1.1)
5. TIME SPENT WITH PATIENT - FIRST VISIT (MIN.)	38.5 (11.8)	5	90	0.75	709	6 (0.8)
6. TIME SPENT WITH PATIENT - SUBSEQUENT VISITS (MIN.)	13.9 (4.9)	2	45	1.39	708	7 (1.0)

* Range from "No agreement" = 0 to "Complete agreement" = 100.

3) **GIVE EMOTIONAL/SOCIAL COUNSELLING** - Chiropractors are generally associated with back pain and spinal manipulation, and not for giving counselling as the only form of treatment. However, because of the hands on nature of practice this often makes patients open up and talk about other problems, which may have contributed to them presenting with for example a tension headache. Thus, establishing underlying psychosocial factors may be as important as the mechanical side of the symptom picture. The extent to which chiropractors give counselling is not well established because, it tends to blend in with other procedures during patient visits.

4) **RATE AGREEMENT TO PRESCRIBE DRUGS** - Chiropractors are not trained to prescribe drugs or perform surgery. However, there may be circumstances where mild painkillers may be beneficial in acute cases. The prescription of drugs has frequently given rise to heated debates within the chiropractic profession. Thus, this variable relates to the practitioners' opinion which may be influenced by some of the demographic variables. They are asked to rate their agreement (0% [strongly disagree] - 100% [strongly agree]) with the following statement:
"It would be beneficial to the management of patients if chiropractors were allowed to prescribe medication* on a restricted basis, such as dentists".
(* mild analgesics, NSAIDS [Non-Steroidal Anti-Inflammatory Drugs] and muscle relaxants)

5) **TIME SPENT WITH PATIENT AT FIRST VISIT (MINUTES)** - The chiropractors are required to estimate the approximate time in minutes spent with the patients on their first visit, including case history taking, physical examination, x-raying and treatment. This time may vary with the geographical setting, training and experience of the practitioner.

6) **TIME SPENT WITH PATIENT AT SUBSEQUENT VISITS (MINUTES)** - As 5, but only for subsequent visits which mainly relate to treatment.

2.5 THE QUESTIONNAIRE DESIGN

The questions on the practitioner questionnaire were formulated so that they could be answered without consulting practice records. The document was divided into the following six parts (Appendix 1), not including the covering letter and the last page, which contained explanations pertaining to some questions:

Part 1. **Practitioner information** (demography, questions 1-13)
Part 2. **Radiography** (x-rays, questions 14-29)
Part 3. **Laboratory investigations** (questions 30-31)
Part 4. **Examination procedures** (questions 32-38)
Part 5. **Treatment and counselling** (questions 39-55)
Part 6. **Professional issues** (questions 56-58)

Because professional and commercial interests had been shown for this study, some of the questions were for separate analyses to be done at a later stage and thus, are not presented as part of the thesis. The additional data related to establishing priorities for taking x-rays and using gonadal shields, technical aspects of the x-ray equipment, laboratory investigations, technical aspects of treatment couches, other therapies used, staff employed in the clinic and relations with other professions. As previously mentioned only the 9 demographic and 45 core usage variables are analysed here.

The usage variables, described in sections 2.4.2 - 2.4.5 were taken from the following parts of the questionnaire (Appendix 1):

X-ray procedures (10 continuous variables, questions 16, 18-19,22-23)

Examination procedures (16 continuous variables, questions 32-38abcd)

Treatment techniques (13 continuous variables, questions 43a-m)

Miscellaneous practice management variables (6 continuous variables, questions 39,45,46,47 & 54).

They are all in the form of visual analogue scales and were measured to the closest millimetre using a ruler and presented as a proportion on the 0 to 100% scale (rounded down to nearest integer). The value of the nearest integer was entered in the database. The length of line to a response, a tick mark [√] or a vertical bar [¦], was measured unless the response clearly indicated an integer value, for example by circling the number.

The appearance of the scales on the questionnaire is illustrated below with two ways (√ or ¦) of indicating a response (arrows):

Standard scale: 0 20 40 60 80 100

/______/__√__/__¦__/______/______/

↑ ↑

For a few questions (46 & 47, Appendix 1) the scale was elongated and included the value 10 because, it was expected that low numbers would be recorded more often. Hence, the need to make a clearer distinction between low values than was possible on the standard scale above. The calculations followed the same approach as just described. Because of the way the numbers were printed along the line on the questionnaire, there was a tendency for the responses to clump around the values 0, 20, 40, 60, 80 and 100 (Figures 2.5.1 - 2.5.4 for typical variables).

Elongated scale: 0 10 20 40 60 80 100

/______/__√__/__¦______/_________/_________/_________/

↑ ↑

2.6 CODING AND DATA ENTRY

All coding and data entry was done by the author. Missing values on all variables were coded -1 in the SPSS files. Prior to mailing, the questionnaires were marked with ID codes in order to identify individual practitioners and country of practice. This was checked against the full list of ECU members to avoid duplication of cases and sending unnecessary reminders.

Some x-ray variables had responses conditional on previous answers hence, some "not applicable" were initially coded 997 and later recoded -1 to exclude them from the final analysis. All data

Figure 2.5.1 Dot plot showing the distribution of responses on the visual analogue scale for the x-ray variable "Take skeletal x-rays".

Each dot represents 4 points

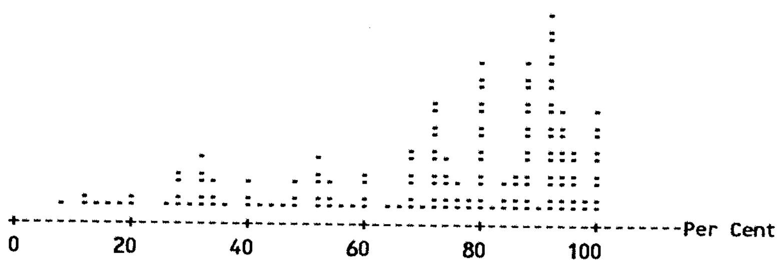


Figure 2.5.2 Dot plot showing the distribution of responses on the visual analogue scale for the examination variable "Neurological examination - muscle tests".

Each dot represents 5 points

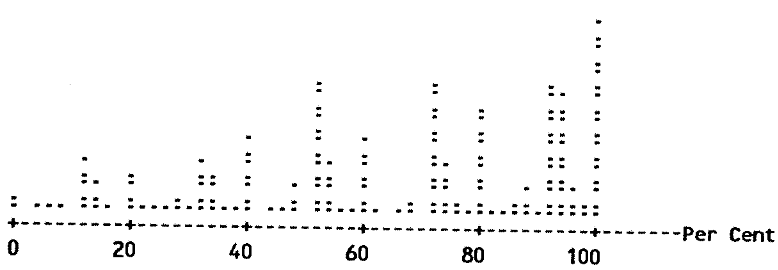


Figure 2.5.3 Dot plot showing the distribution of responses on the visual analogue scale for the treatment technique variable "Nimmo".

Each dot represents 3 points

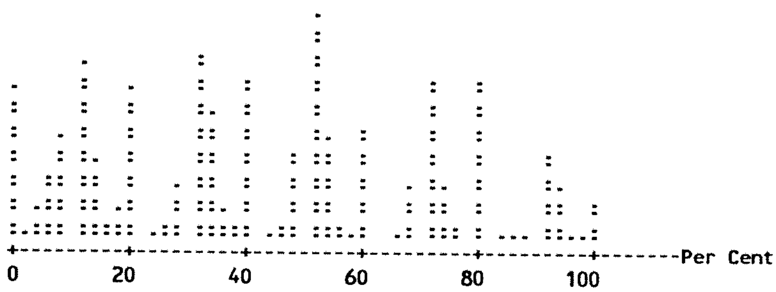
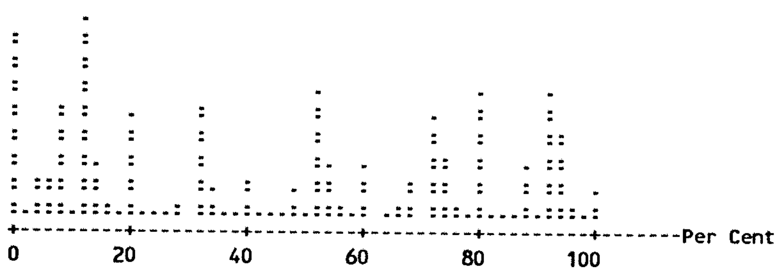


Figure 2.5.4 Dot plot showing the distribution of responses on the visual analogue scale for the miscellaneous practice management variable "Treat by manipulation only on first visit".

Each dot represents 4 points



were entered in the Statistical Package for the Social Sciences Data Entry programme (SPSS/PC+, Data Entry) (34). The SPSS/PC+ package was chosen for data analysis because, several computers at different sites were used and this was the only package installed on all of them.

2.7 CORRELATION WITH PATIENT DATA

As mentioned in section 2.1 data was also collected on individual patients attending clinics of 71 randomly selected chiropractors. Some of this data was used to provide a check for the chiropractors' estimated use of certain procedures and their actual usage based on information from 15 patient returns per chiropractor. The variables from the chiropractor questionnaires are labelled a) and their corresponding variables from the patient case forms are labelled b). Only variables which had a directly corresponding variable in both documents were chosen. These variables were:

Chiropractors' estimates:

1a) SPENVISF - Time in minutes spent on the first visit.

2a) SPENVISS - Time in minutes spent on subsequent visits.

3a) RAYPRCLI - Get x-rays from a private radiological clinic.

4a) RAYDIHOS - Get x-rays directly from hospital.

Actual procedures (patient case form, figures are calculated from the first 15 patients seen by chiropractors after receiving the questionnaire):

1b) MEANVIS1 - Mean time in minutes spent on the first visit.

2b) MEANVIS2 - Mean time in minutes spent on subsequent visits.

3b) PRICLIPT - Percentage of x-rays taken in a private radiological clinic (out of 15).

4b) HOSPPT - Percentage of x-rays taken in hospital (out of 15).

The variables MEAN1, DIFFVIS1, MEAN2, DIFFVIS2, MEADIHOS, MEAPRCLI, DIFDIHOS and DIFPRCLI represent the means of and differences between the two corresponding variables in each document. They were created in MINITAB from the following:

MEAN1:	(SPENVISF + MEANVIS1)/2	} Figure 2.7.1
DIFFVIS1:	(SPENVISF - MEANVIS1)	}
MEAN2:	(SPENVISS + MEANVIS2)/2	} Figure 2.7.2
DIFFVIS2:	(SPENVISS - MEANVIS2)	}
MEADIHOS:	(RAYDIHOS + HOSPPT)/2	} Figure 2.7.3
DIFDIHOS:	(RAYDIHOS - HOSPPT)	}
MEAPRCLI:	(RAYPRCLI + PRICLIPT)/2	} Figure 2.7.4
DIFPRCLI:	(RAYPRCLI - PRICLIPT)	}

Using the method of "limits of agreement" described by Bland and Altman (36) the differences are plotted against the means for each of the four variables in order to assess how good the chiropractors are at estimating their actual use of procedures and time spent with patients, and whether this varies with increasing values (Figures 2.7.1 - 2.7.4). For the time spent on the first visit there are considerable differences between the chiropractors' estimates and the percentage with 15 patients (Range of difference 5-90 minutes, mean difference 38.5, figure 2.7.1), whereas agreement is much better for the time spent on subsequent patient visits

(Range of difference 2-45 minutes, mean difference 13.9, figure 2.7.2). Figure 2.7.3 shows good agreement for low means but this becomes worse for increasing values of the proportion of times they obtain x-rays directly from hospital. A similar trend is noticeable (Figure 2.7.4) when the practitioners estimate the proportion of patients x-rayed in a private radiological clinic but there is somewhat more spread here. This increase in variance with higher proportions reflects variability in proportions. An improvement might be seen using a log-transformation of the data, but with such a small number of cases (15 patients per chiropractor) this was not considered to be very helpful. The data used for the analyses described in this section are given in Appendix 11.

Figure 2.7.1 Chiropractors' estimated time in minutes spent on the first visit - differences plotted against the means.

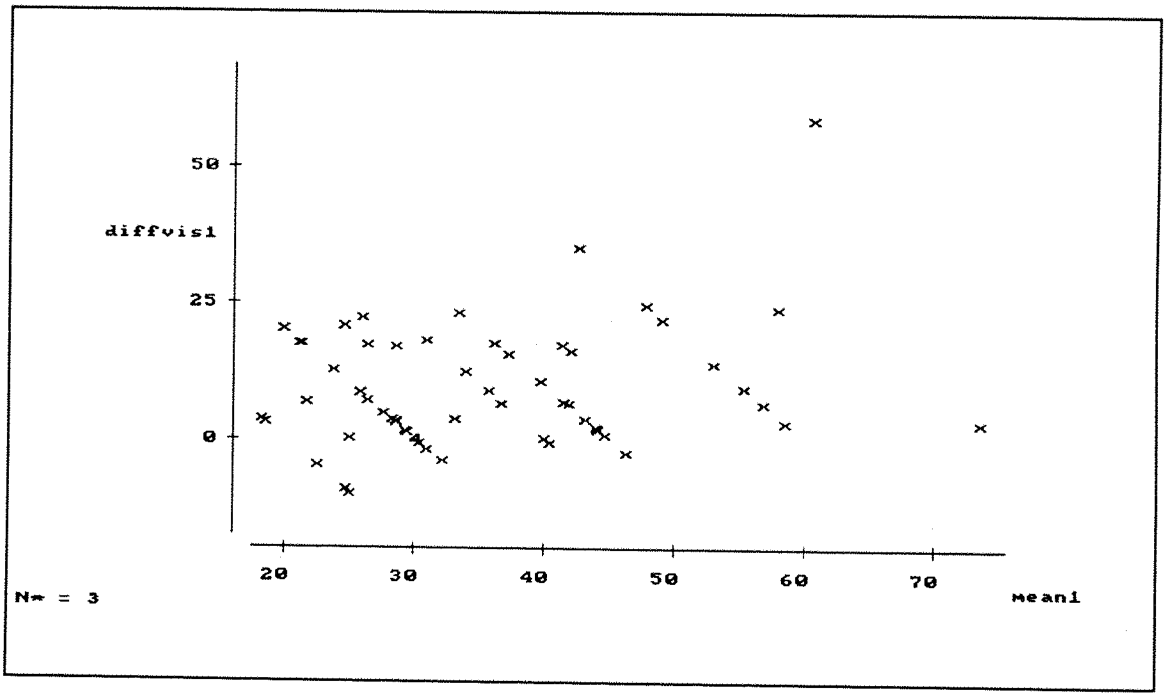


Figure 2.7.2 **Chiropractors' estimated time in minutes spent on subsequent visits - differences plotted against the means.**

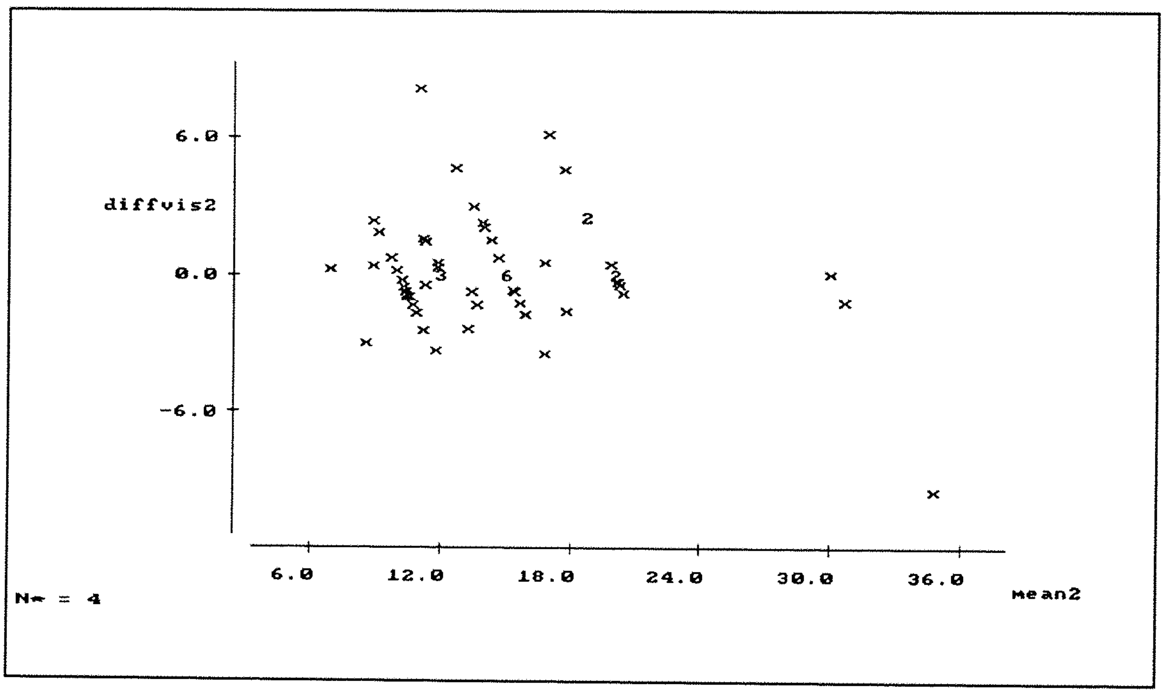


Figure 2.7.3 Chiropractors' estimated proportions of patients for whom x-rays were obtained directly from hospital - differences plotted against the means.

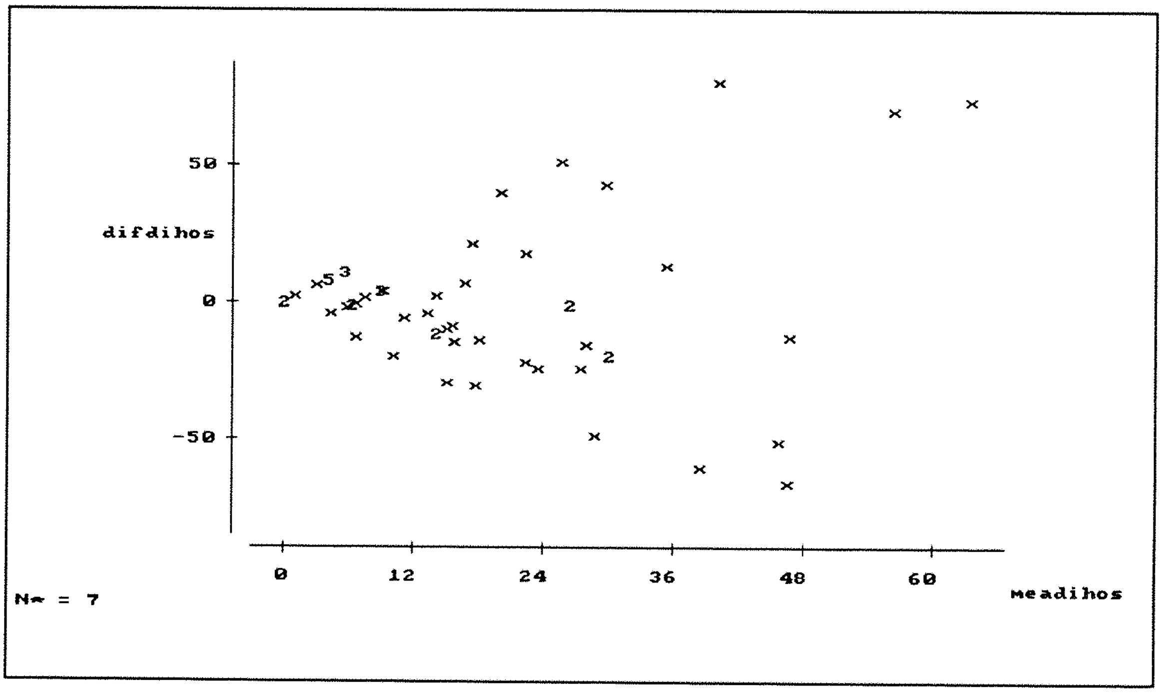
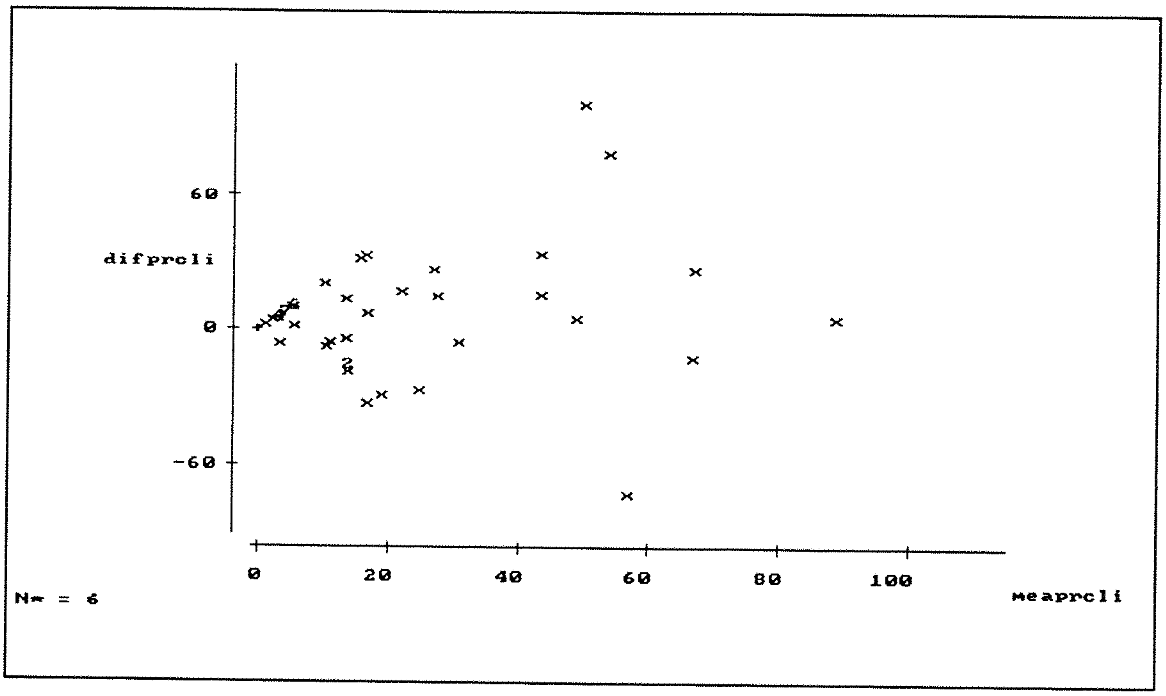


Figure 2.7.4 Chiropractors' estimated proportions of patients for whom x-rays were obtained from a private radiological clinic - differences plotted against the means.



CHAPTER 3

METHODOLOGY

3.1 MULTIPLE REGRESSION

3.1.1 INTRODUCTION

In this chapter the multiple regression analyses used to examine how the demographic variables affect each of the 45 usage variables in turn will be explained. Although there are many textbooks available, Kleinbaum, Kupper and Muller (37) was chosen as the main reference because, it covers regression analysis and analysis of variance in some detail, and gives numerous examples to illustrate the applications of these techniques.

The dependent variables are the ratings on the 0-100% scales described in chapter 2. They reflect the usage of x-rays, examination, treatment and practice management procedures by the chiropractors. The independent variables (6 categorical & 3 continuous) describe the demographic features of these practitioners.

Multiple regression analysis is an extension of simple linear regression, with just one independent variable, to situations where several independent variables are considered. These are generally robust and well tested methods which have been used in numerous areas of application. There are established methods for testing the fit of models and checking assumptions underlying their use.

Dealing with several independent variables simultaneously in a regression analysis is more difficult than the simple one variable case. Some of the reasons for this are:

1. It is more difficult to visualize the data and how well the estimated model fits, since it is not possible to plot directly in more than three dimensions either the data or the fitted model.

2. It may be more difficult to interpret what the best-fitting model means. Hence, it may be preferable to stick to relatively simple models with a limited number of independent variables.

3. Sometimes there are several models that fit the data reasonably well but may have different interpretations. In such situations it may be necessary to report the interpretation of each of them.

The regression models were estimated using the least squares method in program REGRESSION in SPSS/PC+.

3.1.2 THE MULTIPLE REGRESSION MODEL

The general form of a regression model for several covariates is given by

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_k X_k + \varepsilon.$$

The independent variables $(X_1, X_2, \ldots X_k)$ may be either continuous or categorical. In the case of a categorical covariate with r levels there will be r - 1 dummy variables amongst the k independent variables. In this thesis $X_1, X_2, \ldots X_k$ represent the explanatory demographic variables, while the Y represents each of the usage variables in a separate analysis in turn. The parameters $\beta_0, \beta_1, \beta_2, \ldots \beta_k$ are the regression coefficients to be estimated. In general, for a continuous variable Xj the corresponding regression coefficient βj represents the increase in the Y variable for a unit increase in Xj, all other variables remaining constant. For a categorical variable with r levels, the r - 1 coefficients represent the difference between the mean in each of r - 1 levels compared to a chosen reference level, all other variables remaining constant. The ε is the error component reflecting the difference between an individual's observed response Y and the fitted value from the model.

The main interest of the model here was to estimate the βjs describing the influence of each demographic variable on the response variable. This was done for all usage variables in turn. Because, there were so many of them in the study, it was decided not to find the best fitting model but to assess unadjusted and models adjusted for all the demographic variables. The continuous demographic variables (age, duration of practice and year of graduation) were highly internally correlated and they were only adjusted for the other six categorical variables in the adjusted model.

3.1.3 ASSUMPTIONS OF MULTIPLE REGRESSION

There are several assumptions underlying the regression model. In relation to multiple regression they may generally be stated as those concerning linearity, independence, homoscedasticity and normality.

1. **Linearity.** For each observed combination of values of the independent variables $X_1, X_2, \ldots X_k$, Y is a random variable, its mean value is a linear function of $X_1, X_2, \ldots X_k$; that is,

$$E(Y|X_1, X_2, \ldots, X_k) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_k X_k$$

2. **Independence.** The model states that the observed value,

$$Y = E(Y|X_1, X_2, \ldots, X_k) + \varepsilon,$$

is the sum of the linear predictor and an error term ε. The error terms for different cases are assumed to be independent of each other.

3. **Homoscedasticity.** The assumption of homoscedasticity states that, the variance of ε is the same for each combination of $X_1, X_2, \ldots X_k$; that is,

$$\mathrm{Var}(\varepsilon) = \mathrm{Var}(Y|X_1, X_2, \ldots, X_k) = \sigma^2 .$$

According to Kleinbaum, Kupper and Muller (37, section 8-4-1), mild departures from homoscedasticity will not have too adverse an effect on the results. However, no examples are given to support this.

4. **Normality.** The error component ε is normally distributed. This assumption is not necessary for the least-squares fitting of the regression model but it is required for inference, that is testing the importance of variables in the model and for producing confidence intervals for the estimated parameters. The assumption of a Normal distribution is required to justify the use of procedures involving the t and F distributions. In this regard, the usual parametric tests of hypotheses and

confidence intervals used in a regression analysis are robust in the sense that only extreme departures of the distribution of Y from normality can yield spurious results (according to Kleinbaum, Kupper & Muller (37, section 8-4-1), but again no examples are given).

If the model is appropriately specified and we assume the ε are normally distributed (with mean 0 and variance σ^2) then the least squares parameter estimates ($\hat{\beta}$) are normally distributed, $N((X'X)^{-1} X'Y, \sigma^2 (X'X)^{-1})$. The individual error terms ε can be estimated by

$$\hat{\varepsilon} = Y - \hat{Y} = Y - (\hat{\beta}_0 + \hat{\beta}_1 X_1 + \hat{\beta}_2 X_2 + \ldots + \hat{\beta}_k X_k),$$

where $\hat{Y}$ represents the fitted value for Y from the model. These estimates are usually called the residuals.

3.1.4 THE DUMMY VARIABLES

The term dummy, or indicator, describes a 0/1 variable that is set up in order to include categorical covariates in the regression equation. Six of the explanatory demograhic variables were categorical. To describe a categorical covariate with r levels we need r - 1 dummy variables representing contrasts from a reference level (baseline), which is usually chosen to be the most frequently occurring category. The dummy variable representing each category (except the reference) assumes the value 1 if the case falls in that category and 0 otherwise. All or none of the dummy variables representing a covariate must be included in any given model. Although the reference group is normally the most frequently occurring category, the baseline for ACADEMIC DEGREE was chosen to be "Yes". In the case of a variable with only two levels it makes no difference with regard to the confidence intervals, which one is chosen as the reference group. SCANDINAVIAN and METROPOLITAN were chosen as the reference category for the variables COUNTRY and PRACTICE ADDRESS, respectively, because they came naturally to the investigator's background. Table 3.1.4 shows the categories of the demographic variables and the baselines (*) to which comparison is made.

Table 3.1.4 Categories and reference groups in demographic dummy variables.

VARIABLE	CATEGORY	FREQUENCY** N (%)
SEX	Male*	529 (74.0)
	Female	186 (26.0)
COUNTRY	Scandinavia*	234 (32.7)
	Continent	158 (22.1)
	UK/Ireland	323 (45.2)
EMPLOYMENT STATUS	Single/independent*	293 (41.3)
	Partner	243 (34.3)
	Group practice	130 (18.3)
	Employed practitioner	43 (6.1)
COLLEGE OF GRADUATION	European*	352 (49.3)
	American	313 (43.8)
	Canadian	36 (5.0)
	Australian	13 (1.8)
POSSESS ACADEMIC DEGREE	Yes*	205 (29.7)
	No	485 (70.3)
PRACTICE ADDRESS	Metropolitan*	181 (25.6)
	Urban	259 (36.6)
	Semi-urban	251 (35.5)
	Rural	17 (2.4)

* Reference group (baseline)

** Proportions are based on the study sample N=715, missing cases (max. 3.5%) are shown in table 2.3.2.

3.1.5 THE ANOVA TABLE FOR MULTIPLE REGRESSION

An ANOVA table can be used to summarise the results of a multiple regression analysis. The particular form of the ANOVA table varies depending on how the contributions of the independent variables are to be considered (for example individually or collectively in some way). The basic table produced by program regression in SPSS is of the form shown in table 3.1.5 and reflects the contribution that all the k independent variables in a model collectively make to explaining the response variable Y.

Table 3.1.5 General form of ANOVA table for multiple regression.

Source	Degrees of Freedom (df)	Sum of Squares (SS)	Mean Square (MS)	Var. Ratio F-test (p-value)	R^2
Regression	**k**	**SSR=TSS - SSE**	**MSR**	**MSR/MSE** (p)	$\frac{SSR}{TSS}$
Residual	**n - k - 1**	**SSE**	**MSE**		
Total	**n - 1**	**TSS**			

The term TSS (the total sum of squares) represents the total variance of the Y variable <u>before</u> accounting for the independent variables in the model. The term SSE (residual sum of squares or the sum of squares due to error), represents the amount of Y variation left unexplained <u>after</u> the independent variables have been put in the regression equation to explain Y. The regression sum of squares (SSR = TSS - SSE) measures the reduction in variation (or variation explained) due to the independent variables in the regression equation. Thus, the overall equation is:

Total sum of squares (TSS) = **Regression sum of squares** (SSR) + **Residual sum of squares** (SSE)

The regression degrees of freedom (d.f.) is k and is the number of parameters in the model, the residual d.f. is n - k - 1, and the total d.f. is n - 1. The mean-square terms are obtained by dividing the sum-of-squares terms by their corresponding d.f. values.

The ANOVA F-test for the importance of all k independent variables is obtained by dividing the mean-square for regression by the residual mean-square (F = MSR/MSE) and follows a $F_{k,n-k-1}$ distribution, if Y does not depend on the independent variables and if the data are normally distributed.

The null hypotheses for these significance tests can be stated in terms of the unknown parameters (the regression coefficients) in the model

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_k X_k + \varepsilon$$

when considering an overall test for the k independent variables. The null hypothesis is stated as H_0: $\beta_1 = \beta_2 = \ldots = \beta_k = 0$, ie. reducing the full model to only include the intercept term β_0. This is the test performed by SPSS, but it is only useful in producing the unadjusted F-tests and their p-values.

The R^2 (SSR/TSS) provides a quantitative measure of how well the fitted model containing the chosen variables predicts the dependent variable Y. The quantity R^2 lies between 0 and 1, where 1 represents a perfect (100%) fit of the model. When we perform linear regression with only one independent variable, R^2 is exactly the same as the square of the Pearson correlation coefficient. For multiple regression models, the value of R is called the multiple correlation coefficient by analogy, and R^2 can be interpreted as the proportion of the total variance explained by all terms in the model collectively.

3.1.6 SEQUENTIAL ANOVA TABLES AND F-TESTS

When there is more than one covariate included in the model, and these variables are not orthogonal (which only occurs in balanced experiments, and not in observational studies) it is important in which sequence the variables are entered into a model. In these situations it is more appropriate to present sequential ANOVA tables, rather than assess the importance for all variables in the model collectively as in table 3.1.5. The sequential ANOVA table relates to a particular order in which independent variables are entered into the model. The regression sum of squares differ depending on which other variables are controlled for, ie. those which are already in the model (37, section 9-5-1).

When variables are added one by one in stages to a regression equation one talks about sequential F-tests. They are obtained by dividing the mean square for that term in the presence of others by the MSE remaining after all possible variables are put in the model. Table 3.1.6 illustrates the general form of a sequential ANOVA table with four explanatory variables. For example the test for X4 in the presence of X1, X2 and X3 is MS4/MSE and is compared to an $F_{1,n-4-1}$. The sequential F-test is also called the partial F-test of the variable which entered the regression at that stage. The test for addition of a variable after controlling for others attempts to answer the question: "Does the addition of this variable add significantly to the prediction of Y over and above that achieved by other independent variables already present in the model?" The sequential method of assessing the importance of individual explanatory variables and their additional contribution (given others already in the model) consists in breaking down the sum of squares due to regression into various parts as shown in table 3.1.6.

Table 3.1.6 ANOVA table of the sequential sum of squares F-test.

Source of variation		df	SS	MS	F
Regression	**{(X1)**	**1**	**SSR1**	**MS1**	**F1=MS1/MSE**
due to	**{(X2¦X1)**	**1**	**SSR2¦1**	**MS2¦1**	**F2=MS2/MSE**
due to	**{(X3¦X1,X2)**	**1**	**SSR3¦1,2**	**MS3¦1,2**	**F3=MS3/MSE**
due to	**{(X4¦X1,X2,X3)**	**1**	**SSR4¦1,2,3**	**MS4¦1,2,3**	**F4=MS4/MSE**
Residual		**n-4-1**	**SSE**	**MSE**	
Total regression		**n-1**	**TSS4**		

The sum of degrees of freedom (d.f.) and the sum of squares (SS) in the first four rows in table 3.1.6 produces the SS and d.f. for the variables collectively, given by the regression line in table 3.1.5. SPSS does not produce sequential ANOVA tables or F-tests. The sequence of models have to be fitted separately and F-tests computed manually. Each continuous demographic variable was tested in the presence of the categorical demographic variable by including it after all dummy variables. The sequential F test could be compared to $F_{1,n-4-1}(0.95)$ tables or this comparison can be done by computer, here it was done in MINITAB (38,39). If the calculated value of the F-statistic exceeds the critical value for an F on the appropriate d.f. the addition of the variable is deemed significant at the 5% level.

For a categorical demographic covariate with r levels, an adjusted test would be performed by including all the other demographic variables, then additionally including the r - 1 dummy variables for that covariate. The ratio of mean squares would be compared to an $F_{r-1,n-k-1}$ where k is the number of terms in the full model.

The value of R^2 increases with every additional variable sequentially added to the model. However, a very small increase in R^2 may be neither practically nor statistically important. A full model may fit much better, but this is at the expense of including many independent variables. For this reason people have looked at the adjusted R^2 (automatically given in SPSS) which takes account of the number of explanatory variables in the model. If p is the total number of parameters in the fitted model (including β_0), SSR_p is the corresponding residual sum of squares, CTSS denotes the corrected total sum of squares (corrected by dividing by its d.f.) and n is the total number of observations, then R^2 can be defined as

$$R^2 = 1 - \frac{SSR_p}{TSS},$$

and the adjusted R^2 is defined as

$$R_a^2 = 1 - \frac{(SSR_p)/(n - p)}{(CTSS)/(n - 1)} = 1 - (1 - R^2)\left\{\frac{n - 1}{n - p}\right\}.$$

An adjustment has been made for the d.f. of SSR_p and CTSS so that the statistic R_a^2 can be used to compare equations with different numbers of variables included. Because the adjusted R^2 takes account of the number of fitted parameters it can drop when a new variable is added but it is a more reliable measure of the amount of variation explained.

3.1.7 APPROACH TO TESTING THE COVARIATES

The intention was to get an overview of the data and not to obtain a best fitting or parsimonious model. Only F-tests for each covariate on its own (unadjusted) and tests for the full (adjusted) models were obtained. The significance level was chosen to be 5%. It might have been sensible to consider a stricter level, such as 1%, and restrict the number of variables, and this would have produced fewer results deemed significant. Both unadjusted and adjusted F-tests were obtained for each of the 9 demographic explanatory variables. This was done with each of the 45 dependent usage variables in turn.

Because of the high correlation between the 3 continuous demographic variables (age, duration of practice and year of graduation, table 2.4.1.2), for each one of these variables the adjusted test was controlled only for the remaining 6 demographic variables, ie. sex, country, college of graduation, employment status, academic degree and practice address.

Adjusted F-tests were calculated manually from the SPSS print-outs and the corresponding p-values obtained from MINITAB (38,39). An example of the SPSS commands which applied to the 6 categorical demographic variables is given in Appendix 2 and the 3 continuous demograhic variables in Appendix 3. The output from the commands in Appendices 2 and 3 were used to calculate the F-tests for the adjusted models. Examples of these are given in Appendices 4 and 5, respectively, following the format of the SPSS program in order to show how the F-tests were produced.

3.1.8 THE MEANS, CONFIDENCE INTERVALS AND ESTIMATED DIFFERENCES FROM BASE LINE

The means and standard deviations of the dependent variables were obtained from SPSS for each level of the categorical demographic variables. The 95% confidence intervals for the estimated differences from base line were calculated using estimates of B and SE B in the SPSS regression output. These were produced both unadjusted and adjusted for all the demographic variables. The number of cases was large so that 1.96 was a good approximation to the t(0.975) value on the appropriate d.f. and hence, the calculation followed the standard formula B +/- 1.96 x SE B. The estimated slopes and 95% confidence intervals for the slope were calculated for the continuous demographic variables.

3.1.9 MISSING VALUES IN THE REGRESSION ANALYSIS

In the raw data set there were missing values on either x or y variables, or both, as explained in the data section. In order to avoid problems with the interpretation of unadjusted and adjusted results it was decided to exclude missing cases on all the demographic variables in the unadjusted analyses. Thus, the unadjusted and adjusted tests, and parameter estimates and their confidence intervals were based on the same cases. From the data section it appears that the loss of data from using this approach was not excessive for most variables (Tables 2.3.2, 2.3.3 & 2.3.4). There were different numbers missing on each of the y variables hence, the results in chapter 4 appear with different numbers of cases in the tables.

3.1.10 THE LOG-TRANSFORMATIONS AND RESIDUALS

It was evident from the data section that many of the dependent variables were skewed to some extent (Tables 2.4.2 - 2.4.5). This may not be a problem in the multiple regression analysis, because it could reflect the distribution across the x variables rather than lack of normality of the error term ε. Nevertheless, models were fitted to log-transformed dependent variables to see how robust the results were.

In this thesis a graphical method, the Normal Probability (P-P) plot, generated by most computer packages, including REGRESSION in SPSS, was used to check goodness of fit of the competing models.

This is a plot of the cumulative frequency distribution for the residuals against the cumulative frequency distribution for the Normal Distribution. To construct the Normal plot we order the standardised residuals from lowest to highest. We estimate the proportion of the sample below each point and then the Normal deviate for this proportion. The ordered standardised residuals are then plotted against resultant Normal deviates. If the data are normally distributed the resulting plot should be approximately linear. P-P-plots were compared before and after log-transformation for highly or moderately skewed (positive/negative) dependent variables (Tables 2.4.2 - 2.4.5). Only three or four such variables, which on visual inspection looked skewed, were chosen from each group of usage variables. Because some of the original variables had value zero they were changed to 0.5 in order to be able to take the log.

The standardised residuals were obtained for the full model only due to the large number of variables in the study. P-P-plots for each dependent variable were produced in SPSS. By default SPSS gives the 10 worst outliers (standardised residuals) exceeding the values 3 and -3. A separate command was needed to obtain all outliers which, however, were not standardised but required manual calculation.

3.2 CLUSTER ANALYSIS

3.2.1 INTRODUCTION

The main objective in using cluster analysis was to group cases depending on their values of the usage variables (x-rays, examination, treatment and management procedures) which would help in producing a useful description of chiropractors and the way in which they practise. It was hoped that a cross-classification of resulting clusters with the demographic variables would shed light on the difference in practice depending on the demographic features of the chiropractic population. Additionally, the cluster analysis is used to complement the multiple regression with data exploration techniques.

Classification, the organization of objects into generic groups, is fundamental to science. The main aims are to reduce data to manageable number of groups and thus obtain a simplified description of the data. A good classification allows the properties of many individuals to be readily deduced from knowledge of membership of a small number of groups. There has not been much use of numerical cluster analysis in medical applications. One area where cluster analysis has been used is psychiatry. Here it has been used to group psychiatric syndromes (40,41). Few applications have been seen in other medical and paramedical areas. The ones most relevant to this thesis are concerned with the classification of low back pain (42,43).

Different approaches to cluster analysis of any data set will produce groups that differ to some extent, and hence there is a need to check the robustness of groupings against variations in the clustering method. Furthermore, problems are compounded by a lack of common terminology as the techniques of numerical taxonomy are also frequently referred to in the literature as cluster analysis, classification, Q-analysis, typology, grouping and clumping.

The most commonly used term for techniques which seek to separate data into constituent groups is cluster analysis. Such techniques are generally used for the grouping of the objects or individuals under investigation. However, several authors use the term cluster analysis for techniques which seek to group variables. Techniques for grouping variables have been suggested by Tryon (44,45), Cattell (46) and Bromley (47) as alternatives to factor analysis and principal component analysis. The terms cluster analysis and classification will be used interchangeably here to describe methods which seek to group individuals.

This chapter begins with an account of the choice of variables, followed by sections related to the methods used in cluster analysis. It concludes with an overview of some of the statistical packages available to perform these analyses.

3.2.2 THE CHOICE OF VARIABLES

The initial choice of the particular set of measurements used to describe each individual constitutes a frame of reference within which to establish the clusters. The choice of variables reflects their relevance for the purpose of classification. It is important to bear in mind that a degree of subjectivity is necessarily introduced at the beginning in the selection of variables. The variables in the cluster analysis were chosen in an attempt to group the chiropractors on the basis of their use of x-rays, examination, treatment and management procedures, respectively, to form useful profiles with respect to these groups of variables.

3.2.3 DATA FOR A CLUSTER ANALYSIS

In general the raw data for a cluster analysis consists of an Nxp matrix, representing measurements on p variables for N cases, where:

$$
Nxp = \begin{matrix} x11 & x12 & \ldots\ldots & x1p \\ x21 & x22 & \ldots\ldots & x2p \\ : & & & \\ : & & & \\ xN1 & xN2 & \ldots\ldots & xNp \end{matrix}
$$

Value xij is the measurement on the jth variable for the ith individual. The clustering techniques will be discussed from the point of view of clustering the N cases, using the information from the p variables, in this case the x-ray, treatment, examination and practice management variables in turn.

Because of the large number of cases and variables in the survey hardly any statistical computing packages could cope with the cluster analysis. For most clustering techniques the amount of storage, computer time and print out generated increases dramatically with an increase in the number of variables and cases. It may, prior to analysis, be necessary to employ data reduction techniques when the number of variables is large. Principal Component Analysis or Factor Analysis are commonly used reduction methods. Perhaps the simplest way to do this is to use the first few principal component scores as input variables to a clustering procedure.

Instead of using data reduction methods on all the 45 usage variables, it made more sense to look at them in separate groups, ie. x-ray, examination and management procedures and treatment techniques. Initial attempts to include all 45 variables did not produce useful clusters. It was also easier to manage the data when analysing the variables separately. Thus, a maximum of 16 variables were included in the largest group which could more easily be dealt with in mainframe computer packages considered despite the large (approximately 700) number of cases. Because of its versatility as a program set up specifically to deal with cluster analysis CLUSTAN (47) was chosen and the features of this package will be described later.

3.2.4 SIMILARITY COEFFICIENTS AND DISTANCE MEASURES

Similarity coefficients or distance measures are an integral part of most methods of cluster analysis and define the distance between either two cases, or two clusters of cases, in the p dimensional Euclidean space defined by the p measurements. The coefficient or measure on which the clustering is based is specified prior to the analysis. A similarity coefficient is defined to increase as objects get closer, whereas a distance increases as objects get further apart. When items (units or cases) are clustered, proximity is usually indicated by some sort of distance measure. Variables, however, are usually grouped on the basis of correlation coefficients or other measures of association (similarity coefficients). If using a single continuous variable, the idea then is that if two individuals have similar measurements then they are "close", whereas if they have rather different measurements then they are more distant from each other.

Cluster analyses are based on grouping cases that are "close" by some criterion. There are many such criteria of which some may be better than others depending on the purpose of the analysis. In terms of distance between two clusters of cases, they may be "close" if the means of variables across cases in the cluster are similar, or if the distance between the closest cases in the two clusters is small, or some other criterion may be defined. Differences between methods arise in part because of the different ways of defining distance between individuals or groups. In order to check the robustness of the clusters, it is a good idea to use different methods to see whether similar groups arise from using different criteria.

3.2.5 FINDING THE NATURAL CLUSTERS

A description of what constitutes a cluster is given by considering cases as points in a p-dimensional space, with each of the p variables being represented by one of the axes of this space. The variable values for each case now define a p-dimensional co-ordinate in this space. Clusters may now be described as regions of this space containing a relatively high density of points, separated from other such regions by areas ("free space") containing a relatively low density of points. Clusters described in this way are sometimes characterised as natural clusters and correspond to the way one would visualise them in two or three dimensions.

Unfortunately areas of low density of points may sometimes occur between two clusters thus giving rise to "chaining". This may lead to problems with the interpretation and is one reason why a plot of the data points (clusters) should always be considered.

One advantage of considering clusters as described above is that it does not restrict the shape of clusters as rigidly as some other descriptions proposed. Definitions suggesting that cases within a cluster should be "closer" (in some Euclidean sense) to each other than to cases in other clusters impose restrictions to the consideration of mainly spherical clusters. This is problematic because the majority of clustering techniques find clusters of a particular shape. In many investigations there is no reason for believing that clusters are of a particular shape. Hence, by using the "wrong" or "inappropriate" clustering technique one may impose a particular structure on the data, rather than finding the actual structure present. This relates to the distance measure used but also to the overall aim of the investigation. The data set may actually have a structure which is not consistent with any of the descriptions previously mentioned, which again highlights the problems with cluster analysis stemming from many different subject areas.

3.2.6 AN OVERVIEW OF THE CLUSTERING TECHNIQUES

There are many clustering techniques which may be classified into various types. Not all techniques are mutually exclusive and several methods could be placed in more than one category. For the purpose of this overview only two major types are included, namely hierarchical and non-hierarchical techniques.

1) **Hierarchical Techniques.** These are of two types, agglomerative and divisive methods.

   a) **Agglomerative methods** start out with individual cases and link them together based on their similarity or distance. The two cases closest together are fused to form a cluster. The distance between this cluster and the remaining individuals is calculated. At the next step two more cases could fuse, or a case could fuse with the first cluster. This procedure is repeated until all individuals have been fused together to form one large cluster, ie. the entire data set. Any similarity or distance measure can be used. Agglomerative methods usually start with an NxN matrix of distances or similarities between all cases and the number of cases, N, is critical because the matrix of differences between each pair of cases has to be stored during the computer run.

   b) **In divisive methods** the reverse process takes place. Starting out with one cluster (the whole data set) this is then split into two subgroups, which have greatest distance. At the next step one of those two subgroups will be further divided and so on till we are left with individual cases. Again any similarity or distance measure can be used.

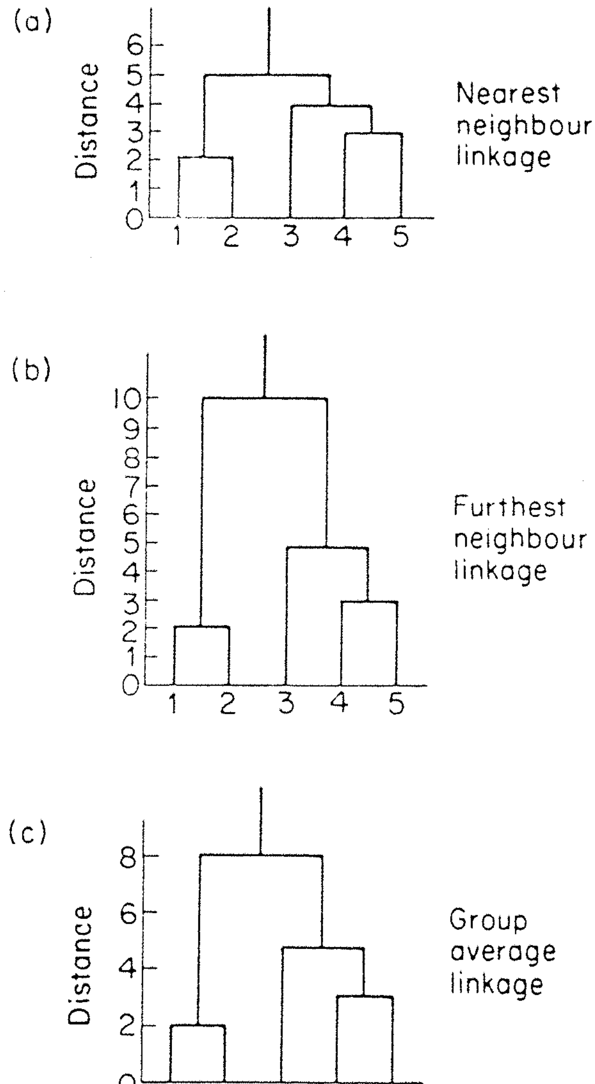
With both a) and b) it is a question of when to stop the process and this is where the investigator's subjective decisions may influence the outcome.

The way the individual cases link in hierarchical techniques can be illustrated with a dendrogram (Figure 3.2.5). However, these become impractical for larger data sets because, each case is represented as a separate line in the dendrogram.

Both types of hierarchical technique may be seen as attempts to find the best stage in the progressive fusion or subdivision of the individuals or population, respectively. This will usually be based on the distances between cases merged or split at each stage. These values may be displayed and in the case of agglomerative methods one might hope to see a series of small values, then followed by rapidly increasing distances as a final few clusters are merged. The investigator must decide at which stage in the analysis is an appropriate place to stop. Divisions or fusions once made are irreversible.

One disadvantage of hierarchical clustering techniques is that there is no provision for re-allocation of individuals who may have been poorly classified at an early stage in the analysis. Thus, one can not correct a poor initial fusion

Figure 3.2.5 This figure shows examples of dendrograms from cluster analyses of five objects.



or partition of the individuals. Hierarchical techniques are probably best suited to biological types of data, such as species and genera for which a hierarchical structure can safely be assumed to exist.

2) **Non-hierarchical Techniques.**

These are clustering techniques which produce a partition of the individuals for a particular number of groups, by either minimizing or maximizing some numerical criterion. Such optimization techniques differ from the hierarchical techniques in not necessarily forming hierarchical classifications of the data. However, hierarchical divisions may arise under some options within the methods. Differences between the methods in this class arise, both because of the variety of distance measures that might be considered, and the various optimization algorithms which might be used.

The objective of using cluster analysis in this study was to group the chiropractors on the basis of the 45 usage variables previously mentioned, and explore differencies in practice patterns between the practitioners. No prior structure of the data was known or assumed and it was hoped that natural clusters could be found. Agglomerative methods are more central to the cluster analysis and the non-hierarchical method used here had similarities to an agglomerative method. Only hierarchical agglomerative and non-hierarchical methods will be described in more detail in the following sections.

3.2.7 AGGLOMERATIVE METHODS

There are a number of different agglomerative methods, which vary in the way that the distances between an individual and a cluster (or two clusters) are calculated. They can all be used with both similarity and distance measures. The basic procedure with all these methods is similar. Each fusion decreases the number of groups by one. All of these methods merge together the two individuals (or clusters) which have the smallest distance between them. Some of the clustering methods available are:

1) **Single linkage** (or nearest neighbour method). Groups initially consisting of single individuals are fused according to the distance between their nearest members, the groups with the smallest distance being fused. For this method then, the distance between groups is defined as the distance between their closest members. This method can produce "chains" of cases.

2) **Complete linkage** (or furthest neighbour method). This method is exactly the opposite of the single linkage method, in that distance between groups is now defined as the distance between their most remote pair of individuals.

3) **Group average.** This method defines distances between groups as the average of the distances between all pairs of individuals in the two groups. Sokal and Michener (49) use this average as a measure of distance between an individual

and a group of individuals, while Lance and Williams (50) extend it to a measure of distance between groups. The procedure can be used with similarity and distance measures provided the concept of an average measure is acceptable.

4) **Centroid.** This method was originally proposed by Sokal and Michener (49) and by King (51,52), who concentrates on the clustering of variables. Groups are depicted to lie in the Euclidean space, and are replaced on formation by the co-ordinates of their centroid. The distance between groups is defined as the distance between the group centroids. The procedure then is to fuse groups according to the distance between their centroids.

5) **Median.** This procedure is similar to the centroid method but uses the group median instead. A disadvantage of the centroid method is that if the sizes of the two groups to be fused are very different the centroid of the new group will be very close to that of the larger group and may remain within that group; the characteristic properties of the smaller group are then virtually lost. The strategy can be made independent of group size by assuming that the groups to be fused are of equal size, the apparent position of the new group will then be halfway between the two groups to be fused. Furthermore, if the centroids of the groups to be fused are represented by (i) and (j), then the distance of the centroid of a third group (h) from the group formed by the fusion of (i) and (j) lies along the median of the

triangle defined by (i), (j) and (h), and it is for this reason that Gower (53), who first suggested this procedure, proposed the name median.

6) **Ward's method.** Ward (54) proposed that at any stage of an analysis the loss of information which results from the grouping of individuals into clusters can be measured by the total sum of squared deviations of every point from the mean of the cluster to which it belongs. At each step in the analysis, union of every possible pair of clusters is considered and the two clusters whose fusion results in the minimum increase in the error sum of squares are combined. This is equivalent to the fusion that minimises

$$\frac{n_i n_j}{n_1 + n_2} \quad d^2_{ij} ,$$

where n_i = number of individuals in cluster i

n_j = number of individuals in cluster j

d_{ij} = Euclidean distance between the means of clusters i and j.

3.2.8 NON-HIERARCHICAL CLUSTERING TECHNIQUES

Non-hierarchical techniques are designed to group items into a collection of k clusters. The number of clusters, k, may either be specified in advance or determined as part of the clustering procedure. Because the matrix of distances between individual cases does not have to be stored during the computer run, non-hierarchical methods can be applied to much larger data sets than hierarchical techniques.

Non-hierarchical methods are usually iterative procedures and starting values need to be specified. These are either; **1)** an initial partition of items into groups, or **2)** an initial set of seed points (ie. starting points), which will form the nuclei of clusters. Good choices for starting configurations should be free of apparant biases. One way to start is to randomly select seed points from among the items or to randomly partition the items into initial groups. The method used in this project was one of the commonly used non-hierarchical procedures, the k-means method.

3.2.9 THE K-MEANS METHOD

MacQueen (55) suggested the term k-means for describing an algorithm that assigns each item to the cluster having the nearest centroid (mean). The k number of clusters is normally chosen to be much greater than the number expected and then fusions down to the final number of clusters required are performed. In its simplest version, the process is composed of the following five steps.

1. Partition the items into k initial clusters.

2. Proceed through the list of items, assigning an item to the cluster whose centroid (mean) is nearest (distance can be computed using any acceptable measure either standardised or unstandardised). This may not be the cluster in which it is currently placed. Recalculate the centroid for the cluster receiving the new item and for the cluster losing the item.

3. Repeat step 2 until no more reassignments (reallocations) take place. The number of times (MAXIT) this is done can be specified.

4. Find the best pair of clusters to combine and repeat steps 2 and 3 with k - 1 clusters. Thus, we progressively end up with k - 1, k - 2, k - 3, etc. clusters until no more groups can be formed.

5. Carry on reducing the number of clusters until the minimum specified number of groups is reached.

Rather than starting with a partition of all items into k preliminary groups in step 1, one could specify k initial centroids (seed points) and then proceed to step 2.

The statistical computing package CLUSTAN (described later in section 3.2.11.4) includes a parameter MAXIT (the maximum number of iterative reallocations of cases allowed) which controls the maximum number of reallocations to be done in step 2. Analyses with MAXIT set at 20 and 30, and starting with either 20 or 30 initial groups resulted in identical five or fewer cluster solutions to those found using MAXIT=10, hence only MAXIT=10 results are reported here, along with MAXIT=0 solutions. When MAXIT=0 no reallocations are allowed to occur and the procedure corresponds to Ward's method.

The final assignment of items to clusters will, to some extent, be dependent upon the initial partition or the initial selection of seed points. Most major changes in the assignment tend to occur with the first reallocation step. To check the stability, or robustness, of the clustering, it is adviseable to rerun the algorithm with a new initial partition. This was done for the final clusters, chosen for each of the four groups of usage variables.

There are good reasons for not fixing the number of clusters, k, in advance. These include the following.

1. If two or more seed points happen to lie within a natural cluster occurring in the data, the resulting clusters will be poorly differentiated.

2. The existence of an outlier might produce a cluster with very diffuse items, and several such clusters might arise.

3. Even if the population is known to consist of k groups, the sampling method may be such that data from the rarest group do not appear in the sample. Forcing the data into k groups could lead to meaningless clusters.

In cases where a single run of the algorithm requires the user to specify k, it is always a good idea to rerun the algorithm for several choices.

3.2.10 STANDARDISATION OF THE DATA

Whether or not to standardise the data is an important consideration which may have more implications with the use of some variables and clustering techniques than others. In most accounts of clustering, standardisation of the variables to zero mean and unit variance is recommended otherwise some variables are effectively given more weight than others. For example techniques using Euclidean distance may give different solutions on the raw and the standardised data whilst other methods will be unaffected by standardisation. For interval scaled variables, the solution suggested most often is standardisation of the variables to zero mean and unit variance, using the standard deviations derived from the complete set of cases (48,56). However, it has been shown that this can have the serious effect of diminishing the differences between groups on the variables which are the best discriminators (57). It would be more effective to standardise using within group standard deviations, but prior knowledge of these is not available. A further disadvantage of standardising each variable separately is that it ignores possible correlations between variables. Some clustering techniques assume that variables are uncorrelated within clusters and hence, may give spurious solutions in cases where this assumption is not true. However, for continuous variables it is generally recomended that standardised variables are used because it will lead to fewer problems with interpretations. In this study all the usage variables were standardised prior to running the cluster analyses.

3.2.11 AN OVERVIEW OF STATISTICAL PACKAGES USED IN CLUSTER ANALYSIS

This section briefly reviews some of the statistical computing packages which were considered.

There are several statistical computer packages commercially available. Of these, the three best known are SPSS (Statistical Package for the Social Sciences, 34), SAS (Statistical Analysis

System, 58) and BMDP (Biomedical Data Programmes, 59). They offer a wide range of basic and advanced statistical techniques including analysis of variance, multiple regression and cluster analysis.

3.2.11.1 SPSS/PC+ (Release 3.1, 34)

This package provides two programmes relevant to cluster analysis, namely CLUSTER and QUICK CLUSTER. The first allows various agglomerative hierarchical techniques to be used. The QUICK CLUSTER allows for specifying the number of desired clusters in advance, which saves computer memory and hence, permits analysis of large data sets. The maximum number of cases and variables is not specified but in trial runs the PC version was very slow even when using only a few variables. Additionally, SPSS is capable of producing dendrograms. Cluster analysis is not a strong feature of SPSS/PC+. The mainframe version might have run the programme faster but still with very limited options for performing cluster analyses.

3.2.11.2 SAS (Mainframe Version 6.06, 58)

The SAS package contains a variety of clustering procedures including eleven different algorithms. The methods are not well described in the manuals, which are daunting. Some of the methods available are:

CLUSTER Performs hierarchical clustering of observations using eleven agglomerative methods.

FASTCLUS Finds clusters using a k-means algorithm. The procedure PROC FASTCLUS is especially suitable for very large data sets (up to 100.000 observations). This programme was not tried although, it looks as if it might have coped with the data set.

TREE — Draws dendrograms using output from eg. the CLUSTER procedure.

OVERCLUS — (Version 5) Finds overlapping clusters from similarity data. Additionally the package can be used to perform principal components analysis.

3.2.11.3 Biomedical Data Programmes - BMDP (59)

The BMDP package contains a number of programmes for cluster analysis although it is perhaps better known in relation to other types of statistical analyses. The maximum number of cases and variables was not specified and this package was not tried. The specialised programmes for clustering are:

BMDP-2M — This programme executes single linkage or centroid hierarchical clustering using one of eleven distance measures.

BMDP-KM — This essentially implements a "k-means" type algorithm. Solutions provide a partition of the individuals into clusters such that each individual belongs to the cluster whose centre is closest in Euclidean distance terms.

BMDP-3M — Here clusters of individuals that are alike for subsets of variables are constructed.

BMDP-1M This programme emphasises clustering of variables by way of a hierarchical scheme.

3.2.11.4 CLUSTAN (Version 3.2 on IBM 3090/150 VM/CMS 4.2, 48)

CLUSTAN was developed specifically for cluster analysis in the 1960s and a number of versions have been produced over the years, the latest in 1987. It implements many of the clustering techniques described in previous sections, including several not available in any other package, and has the most comprehensive set of clustering methods of the four packages considered here.

A wide variety of distance and similarity measures may be used and the clustering methods available include agglomerative hierarchical methods, divisive methods, k-means and many more specialized techniques. Several associated techniques such as principal components analysis are included in the package. It is also possible to import SPSS files for data analysis. CLUSTAN enables plots to be sent to an output file, which can then be produced on a plotter. Therefore, it is possible to get good quality plots which are not available from many other packages. However, the usefulness of dendrograms (common to SPSS, SAS & CLUSTAN) is limited here by the large number of cases in the study.

The RELOCATE procedure (k-means method) is the only method available for large number of cases, but setting options within the procedure cover a variety of different techniques. RELOCATE only handles either all binary or all continuous variables but several distance measures are allowed for either case, and the number of reallocations can be controlled. Only measures that generalise to give the distance between clusters can be specified for the RELOCATE procedure. One coefficient, "Gower", could cope with mixed, continuous, binary and categorical variables, and gave distances between cases and clusters. Unfortunately, it was not available in programme RELOCATE. No reallocations of cases occur at any step if a parameter MAXIT is set to 0 and hence, the distance measure chosen (Euclidean sum of squares) corresponds to Ward's method (48).

Although it was by no means user-friendly, and was unable to cope with missing values in RELOCATE, the versatility and the possibility of using files from SPSS made CLUSTAN the ultimate choice for the clustering procedures.

3.2.12 DATA ENTERING IN CLUSTAN

There are many ways to get data read into CLUSTAN. The data set used could not contain any missing cases on the variables, because procedure RELOCATE did not allow this. Therefore, the data files were first created in SPSS and then written out as an ASCII file excluding all missing cases and fed into Clustan, with the necessary commands added at the top specifying details of the cluster analysis to be performed.

The identification codes for each chiropractor had to be "masked" to exclude them from the calculations and all variables were standardised prior to implementation of the RELOCATION procedure. Various specifications regarding the analysis were given, the nature of which will be explained in the following section.

3.2.13 COEFFICIENTS USED IN CLUSTAN

The following sections give a brief description of the coefficients used, two of which are unique to CLUSTAN. There are several similarity and dissimilarity coefficients available in CLUSTAN. We used 4 coefficients that are suitable for continuous variables and are recommended for clustering cases rather than variables. They all measure distance between cases or clusters. Only measures that generalise to give the distance between clusters can be specified for the RELOCATE procedure. Analyses of each of the four groups of usage variables were repeated with each coefficient so that some idea of robustness to the distance measure chosen could be obtained. Initially, coefficient 1, the Squared Euclidean Distance, looked most appealing.

Coefficient 1 - Squared Euclidean distance. Perhaps the most commonly used measure is Euclidean distance. If the cases are represented by points in a space of p dimensions, where p is the number of variables, the square of the distance between two cases i and k is defined as:

Squared Euclidean distance $$d_{ik}^2 = \frac{1}{p} \Sigma_j (x_{ij} - x_{kj})^2$$

where x_{ij} is the value of the jth variable for the ith case. In more general terms, d_{ij} denotes how close two cases are when measured in terms of all the p variables taken together. The Euclidean distance can also be used to measure the similarity between clusters. It is then the difference between the cluster means, in which case x_{ij} is the mean of the jth variable in the ith cluster.

When the variables are standardised independent normal variates as was the case here, the expected value of the squared Euclidean distance between two cases is 2. This can be a useful guide when deciding on the best number of clusters, since distances between cluster centres which are smaller than 2 can be interpreted as less than the expected distance obtained from random sampling.

Coefficient 24 - Euclidean sum of squares ("error" or "within-groups" sum of squares). Euclidean distance has some useful algebraic properties when constructing geometric similarity measures between groups such as the within-groups Euclidean sum of squares, average distance or variance criteria. For example the Euclidean sum of squares is defined as follows:

Sum of squares for cluster r $$E_r = \frac{1}{p} \Sigma_j (x_{ij} - u_{rj})^2$$

(ie. = 0 for a cluster of 1)

where u_{rj} is the mean of variable j in cluster r and p is the number of variables. The total sum of squares is obtained by summing over all r clusters:

Euclidean sum of squares $$E = \Sigma_r E_r$$

In selecting two clusters r and s for fusion, as in Ward's method, it is customary to minimise the increase in the Euclidean sum of squares which results from the fusion. This is obtained from:

Increase in sum of squares $$I_{rs} = E_{r+s} - E_r - E_s$$

where E_{r+s} is the sum of squares for the combined clusters. I_{rs} simplifies after some arithmetic to a weighted squared distance

$$I_{rs} = \frac{n_r \ n_s}{p(n_r + n_s)} d_{rs}^2$$

where d_{rs} is the Euclidean distance between clusters r and s, and p is the number of variables.

The Euclidean sum of squares is sometimes referred to as the "error" or "within-groups" sum of squares. It is the sum of the distances from the cases to the centres of the clusters to which they belong. Thus it measures the extent of the scatter about cluster centres, and results are characterised by the close clumping of points into spherical clusters of similar size. The Euclidean sum of squares is suitable for finding tight clusters which have the property that each cluster centre represents the constituent cases at a high level of similarity with respect to all the underlying variables.

Coefficient 29 - Size difference & Coefficient 30 - Shape difference. The remaining two measures of similarity for continuous data which were used were coefficients 29 (size difference) and 30 (shape difference). These are unique to CLUSTAN. It has been proposed that the Euclidean distance can be expressed in terms of these 2 components:

Coefficient 29 - Size difference $s_{ik}^2 = \frac{1}{p^2} (\Sigma_j x_{ij} - x_{kj})^2$

Coefficient 30 - Shape difference $h_{ik}^2 = d_{ik}^2 - s_{ik}^2$

where d_{ik}^2 is the squared Euclidean distance statistic, and s_{ik}^2 is the size difference (the summation j=1....p is over the p variables).

The size difference measures differences in size while disregarding shape. It compares the average of the variable values for one case or cluster centre with the average for another, and the difference is squared. Although this method has limited applications in separating groups of similarly sized cases, it is useful in generating starting clusters in Euclidean sum of squares classification as has been done with the RELOCATE procedure.

The shape difference, h_{ik}^2, is the variance of the differences between variable values of two cases or cluster centres (CLUSTAN manual, 48). The shape difference is obtained by subtraction of the size component from the overall squared Euclidean distance. Shape difference produces partitions which are orthogonal to size difference and may differ markedly from those obtained with Euclidean distance.

3.2.14 CLUSTER CRITERIA SELECTION

Cluster analyses with the four different coefficients and using MAXIT 0 and 10 were tried. Initially, there were no clear advantages of any one of the coefficients used in the CLUSTAN package. The following criteria, though not necessarily in the order stated, were used for selecting the most useful clusters.

1) A manageable number of clusters, for example 2, 3 or 4.

2) A sudden increase, in the minimum distance between clusters when the final groups are fused.

3) Clusters should not contain only one or two cases.

4) Robustness when different coefficients and methods are used.

5) The means of the usage variables in the individual clusters must be meaningful in describing differences between the clusters.

The results will be presented mainly in tabular form according to the 4 groups of usage variables, ie. x-rays, examination and management procedures, and treatment techniques.

3.2.15 RANDOMISATION OF CASES AND CHECKS FOR THE ROBUSTNESS OF CLUSTERS

In order to provide a check for the robustness of resulting clusters the cases for each of the four sets of variables, ie. x-ray, examination, treatment technique and miscellaneous practice management, were randomised in SPSS using commands which allocated each case a random number between 1 and 1000. Thus, we achieved new starting points when repeating the analyses. Subsequently these random cases were fed back into CLUSTAN and re-analysed. The resulting clusters and cluster means are presented in chapter 5 (Section 5.7).

CHAPTER 4

RESULTS - MULTIPLE REGRESSION

4.1 INTRODUCTION

This chapter presents the results of the multiple regression analyses used to examine how the demographic variables affect each of the 45 usage variables. The results will be considered for each of the 4 groups of variables (A: x-rays, B: examination, C: treatment technique and D: practice management) and we examine how each of the 9 demographic variables in turn affects the variables in the 4 groups.

In order to get an overview of the results these were combined into a series of tables including all relevant variables in each group. Separate tables are presented for each demographic variable. The continuous demographic variables (age, duration of practice and year of graduation) were combined in one table for each of the 4 types of usage variables. Each row of the tables gives results for a different usage variable and is based on a different number of cases, which are shown in brackets, because of the missing values. Some countries do not permit the use of x-rays hence, they have more missing cases than for the other usage variables (Table 2.4.2). The number of cases in the subgroups of the demographic variables are shown in squared ([ ]) brackets along the top row. These are based on the number of cases in the original data set (N=715). The number of cases in the regression analyses are lower because each analysis was chosen with no cases missing on either usage or the demographic variables.

4.2 SEX

4.2.1 THE X-RAY PROCEDURES (Table 4.2.1)

The results relating to the first 5 x-ray variables were conditional on having x-ray facilities available in the clinic hence, they are based on fewer cases than other groups.

The means of each of the x-ray variables for males and females are presented in table 4.2.1. Additionally, the female-male difference in means, both unadjusted and adjusted, and their 95% confidence intervals are shown. The mean usage of the x-ray procedures between males and females are not strikingly different. The greatest discrepancy is 5 percentage points more for female practitioners obtaining oral consent before taking x-rays but this did not reach significance. Obtaining the films from a private radiological clinic is the only variable reaching significance at the 5% level and this only when adjusted, with females estimating that they get films approaching 4 percentage points more frequently than males.

4.2.2 THE EXAMINATION PROCEDURES (Table 4.2.2)

The emphasis of examination procedures performed in chiropractic practice is on musculoskeletal disorders, such as back pain. Additionally other examinations, eg. listening to the heart and lungs, are carried out in order to exclude other potentially serious underlying conditions. The first 8 procedures in the table relate to the musculoskeletal system whereas the remaining 8 are used for examining other organ systems.

Table 4.2.1 F-tests for the Relationship between SEX and X-ray Procedure Variables. Baseline is "Male".

VARIABLE	MEAN (S.D.)		UNADJUSTED ANALYSIS ESTIMATED DIFFERENCE FROM BASELINE (95% CI)		ADJUSTED ANALYSIS ESTIMATED DIFFERENCE FROM BASELINE (95% CI)	
	MALE (N=529)	FEMALE (N=186)	FEMALE - MALE	p-value	FEMALE - MALE	p-value
1. TAKE SKELETAL X-RAYS (N=513)	**72.29** (23.31)	**71.47** (24.62)	**-0.83** (-5.48,3.82)	**0.7259**	**-3.70** (-8.40,1.01)	**0.1243**
2. TAKE TISSUE X-RAYS (N=513)	**9.37** (10.69)	**7.91** (5.86)	**-1.46** (-3.36,0.44)	**0.1327**	**-2.00** (-4.09,0.08)	**0.0604**
3. ASK ABOUT MENSTRUAL CYCLE (N=506)	**86.70** (25.04)	**87.53** (22.71)	**0.83** (-4.01,5.67)	**0.7365**	**0.57** (-4.61,5.75)	**0.8231**
4. GET ORAL CONSENT (N=499)	**77.87** (34.36)	**82.91** (28.24)	**5.04** (-1.52,11.59)	**0.1327**	**5.65** (-1.33,12.63)	**0.1130**
5. GET WRITTEN CONSENT (N=484)	**15.79** (28.32)	**16.23** (26.36)	**0.43** (-5.27,6.13)	**0.8825**	**-1.35** (-7.23,4.53)	**0.6549**
6. GET X-RAYS FROM ANOTHER CHIROPRACTOR (N=617)	**15.61** (21.28)	**16.68** (21.32)	**1.07** (-2.70,4.84)	**0.5784**	**-0.95** (-4.95,3.05)	**0.6391**
7. GET X-RAYS FROM HOSPITAL VIA GP (N=605)	**10.79** (14.44)	**10.24** (13.76)	**-0.55** (-3.12,2.01)	**0.6725**	**0.56** (-2.04,3.15)	**0.6715**
8. GET X-RAYS DIRECTLY FROM HOSPITAL (N=614)	**14.31** (18.25)	**14.38** (17.76)	**0.07** (-3.15,3.30)	**0.9643**	**0.19** (-3.23,3.63)	**0.9203**
9. GET X-RAYS FROM A PRIVATE RADIOLOGICAL CLINIC (N=609)	**12.69** (19.49)	**12.75** (19.57)	**0.06** (-3.44,3.57)	**0.9715**	**3.88** (0.46,7.29)	**0.0264**
10. THE PATIENT BRINGS THE X-RAYS (N=614)	**16.12** (20.26)	**13.23** (17.16)	**-2.89** (-6.41,0.62)	**0.1073**	**1.99** (-1.21,5.21)	**0.2226**

There appear to be only minor differences between male and female chiropractors in their mean usage of most examination procedures (Table 4.2.2). Females are more likely to take the blood pressure and this difference reached significance both in unadjusted analysis (p=0.0061) and adjusted (p=0.0173). Females are also slightly more likely to perform an overall postural analysis (inspection) but the difference does not reach significance. They use dynamic palpation slightly more and the difference between females and males is only significant in the adjusted analysis.

The importance of gender in explaining the use of examination procedures except for taking the blood pressure and using dynamic palpation (examination of the movement of joints by hand) is not very helpful.

4.2.3 THE TREATMENT TECHNIQUES (Table 4.2.3)

There are many chiropractic treatment techniques available. Most of these employ various forms of manual spinal manipulation. Only the ones most commonly used were investigated in this study.

The mean usage of various techniques for males and females are shown in table 4.2.3. A number of techniques used reveal significant or highly significant differences between the sexes before and after adjusting. The techniques HIO (treating only the upper cervical spine), Toggle Recoil (using a table with a specially designed headrest), Logan, Sacro-Occipital Technique, Nimmo, Activator (using a spring-loaded handheld instrument), Pettibon and Toftness are higher for females, whereas they are less likely to report using Diversified so frequently. The biggest differences

Table 4.2.2 F-tests for the Relationship between SEX and Examination Procedure Variables. Baseline is "Male".

VARIABLE	MEAN (S.D.)		UNADJUSTED ANALYSIS ESTIMATED DIFFERENCE FROM BASELINE (95% CI)		ADJUSTED ANALYSIS ESTIMATED DIFFERENCE FROM BASELINE (95% CI)	
	MALE [N=529]	FEMALE [N=186]	FEMALE - MALE	p-value	FEMALE - MALE	p-value
1. POSTURAL ANALYSIS (N=662)	69.44 (32.81)	73.79 (30.97)	4.34 (-1.25,9.94)	0.1287	3.42 (-2.59, 9.42)	0.2658
2. STATIC PALPATION (N=669)	89.37 (18.44)	91.79 (14.43)	2.42 (-0.59,5.42)	0.1152	1.23 (-2.02,4.48)	0.4585
3. DYNAMIC PALPATION (N=666)	87.39 (20.27)	89.00 (17.78)	1.60 (-1.78,4.99)	0.3532	-4.56 (-7.88,-1.23)	0.0074
4. ORTHOPAEDIC TESTS - LUMBAR SPINE (N=671)	86.81 (19.96)	88.77 (17.37)	1.95 (-1.36,5.27)	0.2484	-1.22 (-4.62,2.18)	0.4841
5. ORTHOPAEDIC TESTS - CERVICAL SPINE (N=670)	81.96 (24.03)	86.15 (20.27)	4.18 (0.21,8.16)	0.0395	-0.35 (-4.44,3.75)	0.8625
6. NEUROLOGICAL TESTS - REFLEXES (N=669)	77.39 (24.13)	80.41 (24.02)	3.02 (-1.13,7.17)	0.1538	-1.28 (-5.40,2.83)	0.5432
7. NEUROLOGICAL TESTS - SENSATION (N=670)	59.97 (29.15)	63.06 (27.63)	3.09 (-1.86,8.04)	0.2212	-0.97 (-6.14,4.19)	0.7084
8. NEUROLOGICAL TESTS - MUSCLE TESTING (N=670)	64.20 (28.73)	65.98 (26.96)	1.78 (-3.09,6.64)	0.4739	-1.36 (-6.41,3.69)	0.5968
9. TAKE PULSE (N=666)	29.89 (27.49)	31.03 (24.99)	1.14 (4.64,5.79)	0.6293	0.92 (-4.01,5.85)	0.7185
10. TAKE BLOOD PRESSURE (N=671)	38.38 (27.97)	45.19 (28.96)	6.82 (1.96,11.67)	0.0061	6.32 (1.13,11.50)	0.0173
11. CHECK RESPIRATION (N=664)	13.54 (16.65)	12.88 (13.50)	-0.67 (-3.41,2.08)	0.6351	0.292 (-2.66,3.23)	0.8415
12. TAKE TEMPERATURE (N=665)	9.82 (12.82)	10.02 (9.27)	0.19 (-1.88,2.27)	0.8543	-0.27 (-2.52,1.98)	0.8231
13. EXAMINE ABDOMEN (N=666)	21.52 (21.84)	20.22 (18.99)	-1.29 (-4.94,2.34)	0.4852	0.33 (-3.47,4.14)	0.8625
14. EXAMINE HEART (N=665)	16.95 (19.05)	14.22 (13.63)	-2.73 (-5.80,0.34)	0.0819	-1.31 (-4.56,1.93)	0.4276
15. EXAMINE LUNGS (N=667)	15.89 (17.36)	14.93 (14.29)	-0.96 (-3.83,1.90)	0.5114	-0.14 (-3.19,2.91)	0.9203
16. MOUTH EXAMINATION (N=668)	13.25 (18.77)	12.18 (16.24)	-1.07 (-4.19,2.05)	0.5011	1.62 (-1.66,4.90)	0.3326

Table 4.2.3 F-tests for the Relationship between SEX and Treatment Technique Variables. Baseline is "Male".

VARIABLE	MEAN (S.D.)		UNADJUSTED ANALYSIS ESTIMATED DIFFERENCE FROM BASELINE (95% CI)		ADJUSTED ANALYSIS ESTIMATED DIFFERENCE FROM BASELINE (95% CI)	
	MALE [N=529]	FEMALE [N=186]	FEMALE - MALE	p-value	FEMALE - MALE	p-value
1. DIVERSIFIED (N=648)	69.85 (29.63)	63.83 (30.65)	-6.02 (-11.25,-0.79)	0.0242	-3.25 (-8.56,2.05)	0.2289
2. GONSTEAD (N=620)	35.53 (33.59)	39.88 (32.40)	4.35 (-1.52,10.22)	0.1468	-2.78 (-8.35,2.79)	0.3276
3. HIO - HOLE-IN-ONE (N=624)	16.16 (20.89)	18.19 (19.63)	2.03 (-1.60,5.66)	0.2738	4.32 (0.47,8.17)	0.0283
4. TOGGLE RECOIL (N=612)	21.17 (22.49)	24.59 (23.53)	3.43 (-0.65,7.50)	0.0996	4.37 (0.09,8.64)	0.0454
5. LOGAN (N=588)	7.93 (10.92)	10.52 (13.59)	2.59 (0.46,4.72)	0.0176	2.72 (0.44,5.01)	0.0195
6. SACRO-OCCIPITAL TECHNIQUE (N=608)	15.53 (21.54)	23.37 (25.90)	7.85 (3.76,11.94)	0.0002	8.33 (4.02,12.64)	0.0002
7. APPLIED KINESIOLOGY (N=625)	20.29 (25.35)	17.48 (22.51)	-2.81 (-7.17,1.54)	0.2055	-0.18 (-4.78,4.41)	0.9203
8. NIMMO (N=633)	39.96 (27.13)	49.07 (28.33)	9.11 (4.27,13.94)	0.0002	7.05 (1.88,12.22)	0.0077
9. ACTIVATOR (N=611)	12.06 (15.42)	18.09 (21.22)	6.03 (2.97,9.09)	0.0001	5.52 (2.34,8.69)	0.0007
10. PETTIBON (N=593)	4.73 (6.85)	6.01 (9.65)	1.27 (-0.12,2.67)	0.0739	1.61 (0.11,3.11)	0.0363
11. PIERCE-STILLWAGON (N=587)	6.25 (11.12)	6.85 (10.25)	0.60 (-1.39,2.59)	0.5535	-0.62 (-2.64,1.39)	0.5487
12. TOFTNESS (N=588)	4.52 (7.33)	5.97 (9.60)	1.46 (-0.37x10^{-4},2.91)	0.0505	1.92 (0.37,3.46)	0.0153
13. BIOMECHANICAL PRINCIPLES (N=604)	41.56 (31.02)	38.11 (30.80)	-3.45 (-8.99,2.10)	0.2241	-2.95 (-8.99,3.09)	0.3378

are found for using Sacro-Occipital and Nimmo techniques. This is not surprising because they are perhaps the least physically demanding. A characteristic of all 8 techniques used more frequently by women is that they are less forceful and may thus be easier to use if the practitioner is small of stature and/or the patient is big. Although preference for the use of certain techniques has not previously been shown on the basis of sex differences, it is a plausible explanation when considering the physical nature of daily practice. Hence, gender is important in explaining the usage of treatment techniques.

4.2.4 THE MISCELLANEOUS PRACTICE MANAGEMENT VARIABLES (Table 4.2.4)

The practice management variables all relate to activities of daily practice. They are difficult to categorise because they are less distinct in nature than the other three groups of usage variables.

The mean estimated perfomance of home visits, usage of emotional/social counselling and time spent with patients is similar for male and female chiropractors. They differ greatly with respect to the mean values of their opinions regarding drug prescription and the mode of treatment (by manipulation only) on the first visit (Table 4.2.4).

The practitioners were asked to what extent they agree (continuous scale 0 - 100%, full agreement = 100%, complete disagreement = 0%) that chiropractors should be allowed to prescribe, for example mild analgesics and muscle relaxants. Males

Table 4.2.4 F-tests for the Relationship between SEX and Miscellaneous Practice Management Variables. Baseline is "Male".

VARIABLE	MEAN (S.D.)		UNADJUSTED ANALYSIS ESTIMATED DIFFERENCE FROM BASELINE (95% CI)		ADJUSTED ANALYSIS ESTIMATED DIFFERENCE FROM BASELINE (95% CI)	
	MALE [N=529]	FEMALE [N=186]	FEMALE - MALE	p-value	FEMALE - MALE	p-value
1. PERFORM HOME VISITS (N=673)	6.83 (7.11)	6.86 (6.87)	0.04 (-1.17,1.25)	0.9527	0.23 (-1.09,1.55)	0.7291
2. TREAT BY MANIPULATION ONLY ON FIRST VISIT (N=662)	48.04 (32.68)	34.84 (31.65)	-13.19 (-18.82,-7.58)	0.0000	-10.40 (-16.27,-4.53)	0.0006
3. GIVE EMOTIONAL/SOCIAL COUNSELLING (N=672)	10.05 (13.43)	9.97 (11.89)	-0.09 (-2.33,2.15)	0.9384	0.18 (-2.18,2.55)	0.8876
4. RATE AGREEMENT TO PRESCRIBE DRUGS (N=668)	49.52 (35.40)	38.46 (31.35)	-11.06 (-16.99,-5.13)	0.0003	-12.69 (-19.07,-6.31)	0.0001
5. TIME SPENT WITH PATIENT - FIRST VISIT (N=669)	37.45 (11.57)	41.30 (11.78)	3.85 (1.85,5.85)	0.0002	2.85 (0.75,4.96)	0.0080
6. TIME SPENT WITH PATIENT - SUBSEQUENT VISITS (N=669)	13.39 (4.79)	14.9 3(4.98)	1.53 (0.69,2.36)	0.0003	1.90 (1.12,2.68)	0.0000

are substantially (about 11% points) more likely to favour prescribing such drugs compared to female practitioners. Male chiropractors indicate that they treat patients by manipulation only (about 10% points more), whereas female practitioners tend to say they include other treatments, such as massage, on the patient's first visit.

There were significant differences between males and females with respect to time spent on first and subsequent visits as well. Female chiropractors tend to spend more time with their patients on the first and subsequent visits.

4.3 COUNTRY

4.3.1 THE X-RAY PROCEDURES (Table 4.3.1)

The use of the x-ray procedures, as expected, show considerable variations between countries. In some countries such procedures are prohibited and this mainly affects the number of cases for the top 5 variables in table 4.3.1. The remaining 5 usage variables are concerned with procedures which could be managed without the need for x-ray facilities within the practice and therefore have more cases.

Apart from taking tissue x-rays (adjusted) all variables show highly significant differences between countries before and after adjusting for the other demographic variables in the model. When asking about menstrual cycle, obtaining oral and written consent before taking x-rays and getting the films from another chiropractor, the UK and Irish practitioners state that they do this

Table 4.3.1 F-tests for the Relationship between COUNTRY and X-ray Procedure Variables. Baseline is "Scandinavia".

VARIABLE	MEAN (S.D.)			UNADJUSTED ANALYSIS ESTIMATED DIFFERENCE FROM BASELINE (95% CI)			ADJUSTED ANALYSIS ESTIMATED DIFFERENCE FROM BASELINE (95% CI)		
	SCANDINAVIA [N=234]	CONTINENT [N=158]	UK/IRELAND [N=323]	CONTINENT	UK/IRELAND	p-value	CONTINENT	UK/IRELAND	p-value
1. TAKE SKELETAL X-RAYS (N=513)	83.27 (18.82)	60.01 (23.67)	67.88 (23.50)	-23.26 (-28.83,-17.69)	-15.39 (-19.60,-11.18)	0.0000	-24.31 (-30.39,-18.24)	-15.90 (-21.41,-10.38)	0.0000
2. TAKE TISSUE X-RAYS (N=513)	9.80 (12.13)	10.38 (9.49)	7.85 (7.20)	0.58 (-1.87,3.02)	-1.95 (-3.79,-0.10)	0.0398	0.12 (-2.57,2.82)	-1.99 (-4.44,0.46)	0.2451
3. ASK ABOUT MENSTRUAL CYCLE (N=506)	81.13 (29.04)	82.66 (28.40)	92.76 (16.69)	1.54 (-4.65,7.72)	11.64 (7.05,16.22)	0.0000	2.02 (-4.76,8.80)	10.44 (4.39,16.50)	0.0034
4. GET ORAL CONSENT (N=499)	69.46 (38.09)	76.76 (34.24)	87.35 (25.40)	7.29 (-1.06,15.64)	17.89 (11.69,24.08)	0.0000	9.33 (0.22,18.44)	12.88 (4.78,20.98)	0.0037
5. GET WRITTEN CONSENT (N=484)	7.27 (14.26)	5.79 (12.59)	26.22 (35.18)	-1.48 (-8.33,5.37)	19.84 (13.79,24.09)	0.0000	-3.12 (-10.67,4.43)	18.55 (11.75,25.35)	0.0000
6. GET X-RAYS FROM ANOTHER CHIROPRACTOR (N=617)	12.67 (16.43)	18.83 (24.83)	12.11 (17.96)	-0.56 (-5.23,4.11)	7.27 (3.52,11.01)	0.0001	1.54 (-3.66,6.74)	9.67 (5.04,14.29)	0.0002
7. GET X-RAYS FROM HOSPITAL VIA GP (N=605)	8.48 (9.14)	19.84 (23.06)	7.96 (9.48)	11.36 (8.38,14.34)	-0.51 (-2.96,1.93)	0.0000	12.63 (9.33,15.93)	-1.38 (-4.37,1.62)	0.0000
8. GET X-RAYS DIRECTLY FROM HOSPITAL (N=614)	14.95 (17.21)	19.42 (21.41)	11.59 (16.63)	4.47 (0.49,8.43)	-3.36 (-6.56,-0.17)	0.0002	4.47 (0.06,8.89)	-5.59 (-9.54,-1.65)	0.0003
9. GET X-RAYS FROM A PRIVATE RADIOLOGICAL CLINIC (N=609)	7.55 (11.15)	28.48 (28.55)	9.05 (14.69)	20.93 (17.02,24.83)	1.50 (-1.71,4.72)	0.0000	19.59 (15.27,23.91)	0.93 (-3.01,4.87)	0.0000
10. THE PATIENT BRINGS THE X-RAYS (N=614)	9.69 (12.33)	34.41 (28.87)	10.13 (12.28)	24.72 (21.09,28.35)	0.43 (-2.59,3.47)	0.0000	22.89 (18.88,26.91)	-0.15 (-3.82,3.51)	0.0000

more frequently than baseline, Scandinavian chiropractors. This is apparant both before and after adjusting for other demographic factors. Continental practitioners also obtain oral consent more often than Scandinavian chiropractors but this difference is not as obvious as that between UK/Ireland and the others.

On the whole the continental chiropractors operate under more legal restrictions in terms of the use of x-rays. It is therefore not surprising that they frequently obtain the films through other sources as the bottom 5 variables in table 4.3.1 indicate. This also influences the extent to which they obtain written consent, which would normally only be done by those actually taking the films. It would not be considered unusual to get oral consent because patients would have to be referred out. Both unadjusted and adjusted these variables show highly significant differences across countries.

4.3.2 THE EXAMINATION PROCEDURES (Table 4.3.2)

The mean usage of virtually all examination procedures are estimated to be slightly to moderately higher for UK/Irish practitioners (Table 4.3.2). Scandinavian chiropractors generally apply these procedures less than their counterparts in the Continent nd UK/Ireland. The unadjusted differences were highly significant for several examination procedures and after adjusting for the other demographic variables in the model many remain significant (Table 4.3.2). From the adjusted model, UK/Irish practitioners seem to use many of the procedures, such as orthopaedic (lumbar & cervical), neurological (reflexes, sensation & muscle tests), take the pulse

Table 4.3.2 F-tests for the Relationship between COUNTRY and Examination Procedure Variables. Baseline is "Scandinavia".

VARIABLE	MEAN (S.D.)			UNADJUSTED ANALYSIS ESTIMATED DIFFERENCE FROM BASELINE (95% CI)			ADJUSTED ANALYSIS ESTIMATED DIFFERENCE FROM BASELINE (95% CI)		
	SCANDINAVIA [N=234]	CONTINENT [N=158]	UK/IRELAND [N=323]	CONTINENT	UK/IRELAND	p-value	CONTINENT	UK/IRELAND	p-value
1. POSTURAL ANALYSIS (N=662)	64.72 (34.52)	71.78 (32.72)	74.28 (29.98)	7.06 (0.34,13.77)	9.56 (3.93,15.19)	0.0036	4.36 (-3.07,11.78)	8.22 (1.39,15.05)	0.0585
2. STATIC PALPATION (N=669)	89.76 (17.56)	88.39 (17.78)	91.00 (17.28)	-1.37 (-5.00,2.26)	1.24 (-1.80,4.28)	0.3198	-1.03 (-5.08,3.01)	2.22 (-1.49,5.94)	0.3204
3. DYNAMIC PALPATION (N=666)	92.11 (13.66)	75.49 (26.59)	90.83 (16.59)	-16.61 (-20.47,-12.76)	-1.28 (-4.51,1.95)	0.0000	-13.77 (-17.92,-9.62)	-1.41 (-5.21,2.39)	0.0000
4. ORTHOPAEDIC TESTS - LUMBAR SPINE (N=671)	83.06 (21.08)	82.89 (22.45)	92.66 (14.39)	-0.18 (-4.07,3.72)	9.59 (6.34,12.85)	0.0000	1.18 (-3.05,5.42)	5.79 (1.92,9.66)	0.0125
5. ORTHOPAEDIC TESTS - CERVICAL SPINE (N=670)	77.96 (25.72)	78.66 (24.30)	89.01 (18.89)	0.71 (-4.62,5.40)	11.06 (7.14,14.97)	0.0000	2.96 (-2.14,8.07)	8.62 (3.96,13.28)	0.0014
6. NEUROLOGICAL TESTS - REFLEXES (N=669)	70.28 (24.40)	73.92 (26.13)	86.16 (20.15)	3.64 (-1.15,8.43)	15.88 (11.88,19.88)	0.0000	6.31 (1.19,11.43)	10.81 (6.13,15.49)	0.0000
7. NEUROLOGICAL TESTS - SENSATION (N=670)	55.72 (28.32)	58.40 (28.05)	65.72 (28.75)	2.68 (-3.22,8.59)	9.99 (5.05,14.94)	0.0002	6.55 (0.14,12.97)	6.43 (0.56,12.29)	0.0401
8. NEUROLOGICAL TESTS - MUSCLE TESTING (N=670)	56.29 (29.31)	65.39 (27.31)	70.54 (26.44)	9.10 (3.37,14.83)	14.25 (9.46,19.04)	0.0000	11.27 (4.99,17.54)	10.49 (4.76,16.24)	0.0001
9. TAKE PULSE (N=666)	23.89 (21.68)	29.57 (26.59)	35.11 (29.35)	5.68 (0.19,11.18)	11.23 (6.61,15.85)	0.0000	4.26 (-1.81,10.34)	8.44 (2.84,14.03)	0.0121
10. TAKE BLOOD PRESSURE (N=671)	34.40 (23.37)	40.23 (28.72)	44.43 (30.81)	5.83 (0.01,11.64)	10.03 (5.15,14.90)	0.0003	5.57 (-0.85,12.00)	5.19 (-0.69,11.09)	0.1127
11. CHECK RESPIRATION (N=664)	10.46 (10.39)	14.34 (17.64)	15.02 (17.90)	3.87 (0.58,7.17)	4.55 (1.79,7.31)	0.0038	2.56 (-1.09,6.21)	4.33 (0.99,7.67)	0.0346
12. TAKE TEMPERATURE (N=665)	8.59 (10.71)	10.45 (10.60)	10.52 (13.41)	1.86 (-0.64,4.35)	1.93 (-0.16,4.02)	0.1565	1.84 (-0.95,4.62)	2.21 (-0.34,4.77)	0.1781
13. EXAMINE ABDOMEN (N=666)	13.37 (13.37)	24.70 (21.58)	25.14 (23.84)	11.33 (7.08,15.58)	11.77 (8.21,15.33)	0.0000	9.93 (5.20,14.65)	8.77 (4.43,13.11)	0.0000
14. EXAMINE HEART (N=665)	11.63 (11.76)	18.00 (19.32)	18.68 (19.96)	6.37 (2.71,10.03)	7.05 (3.98,10.12)	0.0000	4.97 (0.95,8.99)	5.73 (2.01,9.44)	0.0036
15. EXAMINE LUNGS (N=667)	12.55 (11.43)	17.21 (17.05)	17.11 (19.13)	4.67 (1.24,8.09)	4.56 (1.68,7.44)	0.0035	3.75 (-0.03,7.53)	3.82 (0.34,7.29)	0.0439
16. MOUTH EXAMINATION (N=668)	8.12 (8.45)	19.15 (24.57)	13.42 (18.57)	11.03 (7.36,14.69)	5.29 (2.21,8.38)	0.0000	8.88 (4.82,12.94)	3.09 (-0.64,6.83)	0.0001

and check the respiration, more than both Scandinavian and Continental chiropractors.

Chiropractors show differencies between countries when examining the musculoskeletal system, but in the unadjusted and adjusted analyses significant differences are also found between with respect to the examination of organ systems. The Scandinavian chiropractors are low on both types of examinations compared to colleagues from the Continent and UK/Ireland. The country variable is important in explaining differences in usage of these procedures.

4.3.3 THE TREATMENT TECHNIQUES (Table 4.3.3)

Comparisons of the Continent and UK/Ireland to Scandinavia reveal interesting differences between geographical regions in terms of the chiropractors' practice and many of these differences remain significant after adjusting.

In each area at least one chiropractor reported using each technique, except Toftness (range 0 to 93), with 100% of his/her patients. The Continental practitioners said they used the techniques Diversified, HIO and Applied Kinesiology more, and Gonstead less frequently. The UK/Irish chiropractors state that they use Gonstead and Biomechanical Principles less frequently, and Diversified more although, the differences between Scandinavian and Continental practitioners tend to be greater. These trends remain significant after adjusting. The Scandinavians appear to limit themselves to using four major approaches, ie. Diversified, Gonstead, Nimmo and Biomechanical Principles. The emphasis on the former three are most typical of techniques that have for decades

Table 4.3.3 F-tests for the Relationship between COUNTRY and Treatment Technique Variables. Baseline is "Scandinavia".

VARIABLE	MEAN (S.D.)			UNADJUSTED ANALYSIS ESTIMATED DIFFERENCE FROM BASELINE (95% CI)			ADJUSTED ANALYSIS ESTIMATED DIFFERENCE FROM BASELINE (95% CI)		
	SCANDINAVIA [N=234]	CONTINENT [N=158]	UK/IRELAND [N=323]	CONTINENT	UK/IRELAND	p-value	CONTINENT	UK/IRELAND	p-value
1. DIVERSIFIED (N=648)	57.08 (33.09)	78.19 (23.99)	71.44 (27.85)	21.12 (14.99,27.24)	14.36 (9.25,19.48)	0.0000	17.21 (10.60,23.81)	6.69 (0.68,12.71)	0.0000
2. GONSTEAD (N=620)	52.01 (34.42)	24.16 (28.22)	31.07 (30.38)	-27.86 (-34.74,-20.98)	-20.95 (-25.56,-15.33)	0.0000	-23.90 (-30.98,-16.82)	-10.28 (-16.63,-3.93)	0.0000
3. HIO - HOLE-IN-ONE (N=624)	16.20 (20.50)	22.04 (25.32)	14.56 (17.51)	5.84 (1.39,10.27)	-1.65 (-5.31,2.02)	0.0020	6.73 (1.86,11.59)	-0.11 (-4.56,4.34)	0.0158
4. TOGGLE RECOIL (N=612)	16.27 (21.61)	20.54 (22.19)	26.82 (22.95)	4.27 (-0.64,9.19)	10.55 (6.46,14.63)	0.0000	4.76 (-0.58,10.09)	6.52 (1.69,11.34)	0.0205
5. LOGAN (N=588)	8.63 (10.85)	11.14 (14.11)	7.48 (11.00)	2.52 (-0.11,5.15)	-1.15 (-3.31,1.01)	0.0154	3.31 (0.44,6.18)	-1.38 (-3.95,1.19)	0.0133
6. SACRO-OCCIPITAL TECHNIQUE (N=608)	10.03 (13.69)	21.24 (22.61)	21.21 (26.86)	11.21 (6.24,16.19)	11.18 (7.08,15.28)	0.0000	11.58 (6.18,16.99)	10.23 (5.36,15.09)	0.0000
7. APPLIED KINESIOLOGY (N=625)	14.05 (18.13)	28.72 (27.39)	18.99 (25.98)	14.67 (9.44,19.89)	4.94 (0.60,9.29)	0.0000	13.33 (7.51,19.16)	4.82 (-0.39,10.03)	0.0000
8. NIMMO (N=633)	48.09 (26.36)	34.13 (26.13)	42.18 (28.49)	-13.96 (-19.87,-8.06)	-5.92 (-10.78,-1.05)	0.0000	-10.93 (-17.47,-4.39)	-9.31 (-15.17,-3.45)	0.0004
9. ACTIVATOR (N=611)	8.91 (10.21)	13.49 (18.19)	17.13 (20.04)	4.58 (0.79,8.38)	8.22 (5.13,11.32)	0.0000	5.49 (1.40,9.58)	6.14 (2.49,9.79)	0.0012
10. PETTIBON (N=593)	6.06 (9.22)	6.13 (6.83)	3.94 (6.77)	0.07 (-1.66,1.81)	-2.12 (-3.53,-0.71)	0.0032	0.01 (-1.90,1.93)	-0.83 (-2.53,0.88)	0.6007
11. PIERCE-STILLWAGON (N=587)	5.97 (7.05)	8.76 (14.28)	5.65 (11.18)	2.78 (0.33,5.24)	-0.33 (-2.34,1.68)	0.0242	1.93 (-0.61,4.47)	1.02 (-1.27,3.31)	0.3049
12. TOFTNESS (N=588)	4.91 (5.17)	8.05 (13.68)	3.49 (5.46)	3.14 (1.36,4.91)	-1.41 (-2.86,0.04)	0.0000	3.75 (1.79,5.72)	-1.87 (-3.62,-0.11)	0.0000
13. BIOMECHANICAL PRINCIPLES (N=604)	43.53 (32.10)	40.21 (28.74)	38.68 (31.08)	-3.32 (-10.17,3.52)	-4.85 (-10.49,0.78)	0.2377	-1.67 (-9.31,5.98)	-7.66 (-14.49,-0.82)	0.0871

been taught in American colleges. Most (67%) Scandinavian chiropractors in the study graduated from such colleges. Some techniques (Applied Kinesiology & Sacro-Occipital Technique) are commonly used and promoted in continental countries which may explain their higher means.

The comparisons clearly show that the country (geograhical region) variable is important in explaining the usage of treatment technique but, the differences between countries must be seen in the light of the distribution of chiropractors across colleges of graduation which tend to influence the kind of techniques used.

4.3.4 THE MISCELLANEOUS PRACTICE MANAGEMENT VARIABLES (Table 4.3.4)

One would expect management procedures to vary in different countries under the influence of national cultures. The unadjusted and adjusted comparisons show that significant differences remain after adjusting, indicating that UK/Irish practitioners estimate that they spend more time with their patients on the first and subsequent visits. Continental chiropractors, as expected from their cultural background, state that they use significantly more social/emotional counselling. They are also more likely to treat by manipulation only on the patient's first visit but, the significance is lost after adjusting.

Continental chiropractors state that they are less likely to agree to prescribe drugs (prescription medication) but, in many of these countries the use of natural therapies, such as herbalism and homeopathy, is well established amongst non-medical practitioners.

Table 4.3.4 F-tests for the Relationship between COUNTRY and Miscellaneous Practice Management Variables. Baseline is "Scandinavia".

VARIABLE	MEAN (S.D.)			UNADJUSTED ANALYSIS ESTIMATED DIFFERENCE FROM BASELINE (95% CI)			ADJUSTED ANALYSIS ESTIMATED DIFFERENCE FROM BASELINE (95% CI)		
	SCANDINAVIA [N=234]	CONTINENT [N=158]	UK/IRELAND [N=323]	CONTINENT	UK/IRELAND	p-value	CONTINENT	UK/IRELAND	p-value
1. PERFORM HOME VISITS (N=673)	6.15 (6.62)	7.44 (7.11)	7.04 (7.29)	1.29 (-0.16,2.75)	0.89 (-0.33,2.11)	0.1764	1.13 (-0.50,2.77)	0.62 (-0.88,2.12)	0.3720
2. TREAT BY MANIPULATION ONLY ON FIRST VISIT (N=662)	46.10 (33.59)	55.01 (29.73)	38.22 (32.54)	8.91 (2.18,15.64)	-7.88 (-13.52,-2.23)	0.0000	3.77 (-3.51,11.04)	2.50 (-42.21,9.22)	0.5491
3. GIVE EMOTIONAL/SOCIAL COUNSELLING (N=672)	7.84 (9.13)	14.58 (18.00)	9.35 (11.95)	6.74 (4.09,9.39)	1.51 (-0.72,3.73)	0.0000	5.44 (2.51,8.36)	0.65 (-2.04,3.34)	0.0010
4. RATE AGREEMENT TO PRESCRIBE DRUGS (N=668)	47.31 (34.16)	44.41 (36.27)	47.23 (34.37)	-2.89 (-10.10,4.31)	-0.08 (-6.13,5.97)	0.6761	-6.85 (-14.71,1.01)	-6.55 (-13.79,0.69)	0.1041
5. TIME SPENT WITH PATIENT - FIRST VISIT (N=669)	35.84 (10.58)	37.48 (12.88)	40.89 (11.49)	1.65 (-0.74,4.04)	5.06 (3.05,7.07)	0.0000	2.73 (0.13,5.34)	4.25 (1.85,6.65)	0.0016
6. TIME SPENT WITH PATIENT - SUBSEQUENT VISITS (N=669)	11.17 (3.60)	13.87 (5.32)	15.70 (4.59)	2.70 (1.77,3.63)	4.53 (3.75,5.31)	0.0000	2.62 (1.65,3.58)	3.11 (2.21,4.00)	0.0000

In the survey 39.1% (n=631) of chiropractors reported using other non-chiropractic therapies. Distributed across all types of therapies these were Scandinavia 10.9% (n=69), UK/Ireland 12.5% (n=79) and the Continent 15.7% (n=99). The chiropractors state that they do not perform home visits very often and this has traditionally been the case although, there are now trends towards greater involvement in, for example, national sports tournaments and the Olympics.

The country (geographical area) variable is important in explaining the usage of practice management procedures related to direct patient contact.

4.4 EMPLOYMENT STATUS

4.4.1 THE X-RAY PROCEDURES (Table 4.4.1)

There are few differences between single practitioners and those in group practices with respect to the mean usage of most x-ray procedures. The unadjusted comparisons show significant differences between baseline and the group and employed practitioners for obtaining written and oral consent but this is lost after adjusting. Partners, group practitioners and employed chiropractors state that they less frequently obtain x-rays from a private radiological clinic and from patients bringing their own films. These two variables show significant differences in the unadjusted analyses but this is lost in the full models. The discrepancy in mean usage of various procedures is less noticeable between partners and single practitioners but none of the differences for any of the variables remain significant after adjusting.

Table 4.4.1 F-tests for the Relationship between EMPLOYMENT STATUS and X-ray Procedure Variables. Baseline is "Single Practitioner".

VARIABLE	MEAN (S.D.)				UNADJUSTED ANALYSIS ESTIMATED DIFFERENCE FROM BASELINE (95% CI)				ADJUSTED ANALYSIS ESTIMATED DIFFERENCE FROM BASELINE (95% CI)			
	SINGLE (N=293)	PARTNER (N=243)	GROUP (N=130)	EMPLOYED (N=43)	PARTNER	GROUP	EMPLOYED	p-value	PARTNER	GROUP	EMPLOYED	p-value
1. TAKE SKELETAL X-RAYS (N=513)	70.49 (24.04)	72.16 (24.08)	72.47 (22.08)	78.05 (23.53)	1.67 (-3.15,6.48)	1.98 (-3.76,7.72)	7.57 (-0.82,15.95)	0.3652	-0.14 (-4.82,4.53)	5.37 (-0.40,11.13)	7.91 (-0.29,16.11)	0.0654
2. TAKE TISSUE X-RAYS (N=513)	8.77 (8.11)	8.67 (10.35)	9.06 (7.54)	11.49 (16.10)	-0.09 (-2.07,1.87)	0.29 (-2.06,2.64)	2.72 (-0.72,6.15)	0.4291	0.32 (-1.76,2.39)	1.37 (-1.18,3.93)	3.39 (-0.24,7.04)	0.2638
3. ASK ABOUT MENSTRUAL CYCLE (N=506)	85.13 (25.74)	86.94 (25.23)	90.29 (20.24)	85.49 (24.69)	1.81 (-3.21,6.84)	5.17 (-0.80,11.14)	0.36 (-8.34,9.05)	0.3890	0.84 (-4.30,5.99)	-0.69 (-7.03,5.63)	-2.78 (-11.79,6.23)	0.8613
4. GET ORAL CONSENT (N=499)	78.46 (33.26)	75.79 (35.72)	83.29 (29.88)	89.60 (17.51)	-2.67 (-9.44,4.09)	4.83 (-3.23,12.89)	11.14 (-0.79,23.07)	0.0643	-4.15 (-11.05,2.75)	-1.04 (-9.54,7.47)	9.56 (-2.69,21.83)	0.1389
5. GET WRITTEN CONSENT (N=484)	10.39 (23.32)	16.29 (27.18)	22.83 (33.04)	19.60 (29.77)	5.89 (0.11,11.68)	12.43 (5.58,19.29)	9.20 (-0.85,19.25)	0.0040	1.75 (-4.02,7.53)	3.02 (-4.04,10.08)	3.85 (-6.25,13.95)	0.8036
6. GET X-RAYS FROM ANOTHER CHIROPRACTOR (N=617)	14.43 (20.55)	16.63 (21.61)	17.05 (21.96)	17.35 (22.00)	2.20 (-1.69,6.10)	2.62 (-2.07,7.31)	2.92 (-4.21,10.04)	0.5864	0.83 (-3.21,4.87)	-0.88 (-5.91,4.15)	1.14 (-6.21,8.49)	0.9032
7. GET X-RAYS FROM HOSPITAL VIA GP (N=605)	12.02 (16.28)	9.35 (11.89)	10.43 (12.94)	10.05 (16.43)	-2.68 (-5.31,-0.04)	-1.59 (-4.75,1.57)	-1.97 (-6.85,2.91)	0.2534	-0.29 (-2.91,2.31)	1.11 (-2.14,4.35)	-0.38 (-5.19,4.44)	0.8398
8. GET X-RAYS DIRECTLY FROM HOSPITAL (N=614)	14.41 (18.42)	14.16 (17.09)	13.95 (18.93)	15.92 (19.63)	-0.25 (-3.58,3.08)	-0.46 (-4.45,3.53)	1.51 (-4.69,7.72)	0.9468	1.26 (-2.20,4.71)	1.94 (-2.35,6.23)	2.60 (-3.82,9.03)	0.7602
9. GET X-RAYS FROM A PRIVATE RADIOLOGICAL CLINIC (N=609)	16.99 (23.92)	10.55 (16.29)	9.20 (15.05)	8.56 (10.64)	-6.44 (-9.98,-2.90)	-7.79 (-12.07,-3.52)	-8.43 (-14.93,-1.92)	0.0002	-2.85 (-6.29,0.58)	-3.46 (-7.77,0.84)	-3.51 (-9.79,2.78)	0.2837
10. THE PATIENT BRINGS THE X-RAYS (N=614)	19.86 (23.30)	14.42 (18.22)	10.32 (12.98)	7.53 (5.12)	-5.44 (-8.95,-1.93)	-9.53 (-13.75,-5.31)	-12.33 (-18.87,-5.79)	0.0000	-0.37 (-3.57,2.83)	-3.34 (-7.33,0.65)	-5.51 (-11.45,0.43)	0.1404

4.4.2 THE EXAMINATION PROCEDURES (Table 4.4.2)

The single practitioner and to some extent chiropractors in partnerships use many examination procedures less frequently on average than those in group practice and employed practitioners. Neurological examination procedures (reflexes, sensation & muscle tests) showed significantly lower usage for single practitioners in the unadjusted model, differences were reduced after adjusting and became insignificant for muscle tests. Overall the employed chiropractors report somewhat higher usage of most procedures and this trend remained after adjusting but to a reduced and usually insignificant extent. Employment status is only important for explaining differences in a few of the examination procedures.

4.4.3 THE TREATMENT TECHNIQUES (Table 4.4.3)

The mean usage of various treatment techniques does not vary much between the four categories of employment status and none of the techniques show significant differences here in the adjusted analyses. The table shows that employed chiropractors state that they use almost all techniques somewhat more than practitioners from any of the other categories, and only Toftness shows significant differences in the unadjusted model. Generally any differences found were small.

4.4.4 THE MISCELLANEOUS PRACTICE MANAGEMENT VARIABLES (Table 4.4.4)

Management procedures do not vary much between chiropractors of different employment status, except for treating patients by

Table 4.4.2 F-tests for the Relationship between EMPLOYMENT STATUS and Examination Procedure Variables. Baseline is "Single Practitioner".

VARIABLE	MEAN (S.D.)				UNADJUSTED ANALYSIS ESTIMATED DIFFERENCE FROM BASELINE (95% CI)				ADJUSTED ANALYSIS ESTIMATED DIFFERENCE FROM BASELINE (95% CI)			
	SINGLE [N=293]	PARTNER [N=243]	GROUP [N=130]	EMPLOYED [N=43]	PARTNER	GROUP	EMPLOYED	p-value	PARTNER	GROUP	EMPLOYED	p-value
1. POSTURAL ANALYSIS (N=662)	69.72 (33.00)	72.00 (30.98)	69.66 (33.34)	71.18 (34.33)	2.28 (-3.41,7.98)	-0.05 (-6.98,6.88)	1.46 (-9.42,12.35)	0.8627	2.33 (-3.61,8.26)	-3.19 (-10.66,4.27)	-1.62 (-12.88,9.64)	0.5053
2. STATIC PALPATION (N=669)	89.07 (17.27)	90.12 (18.60)	91.24 (17.11)	92.03 (13.05)	1.05 (-2.01,4.11)	2.17 (-1.56,5.89)	2.96 (-2.85,8.76)	0.5874	0.82 (-2.43,4.06)	1.40 (-2.67,5.47)	1.45 (-4.63,7.53)	0.9032
3. DYNAMIC PALPATION (N=666)	84.47 (22.29)	89.85 (17.18)	89.59 (18.25)	93.55 (13.94)	5.39 (1.98,8.79)	5.13 (0.98,9.29)	9.08 (2.62,15.54)	0.0019	1.54 (-1.78,4.86)	-1.34 (-5.50,2.83)	1.26 (-4.96,7.48)	0.5343
4. ORTHOPAEDIC TESTS - LUMBAR SPINE (N=671)	84.66 (21.14)	87.84 (18.59)	91.16 (15.98)	91.00 (17.39)	3.18 (-0.17,6.53)	6.49 (2.40,10.59)	6.34 (-0.03,12.70)	0.0085	2.06 (-1.32,5.44)	0.81 (-3.45,5.07)	2.47 (-3.88,8.82)	0.6416
5. ORTHOPAEDIC TESTS- CERVICAL SPINE (N=670)	79.79 (24.35)	83.50 (23.40)	87.48 (20.34)	89.38 (17.95)	3.70 (-0.31,7.71)	7.68 (2.78,12.59)	9.58 (1.95,17.20)	0.0046	2.39 (-1.67,6.46)	1.01 (-4.12,6.14)	3.88 (-3.76,11.53)	0.5958
6. NEUROLOGICAL TESTS - REFLEXES (N=669)	73.20 (25.39)	78.76 (24.08)	85.25 (19.73)	87.35 (19.31)	5.56 (1.43,9.69)	12.04 (6.99,17.09)	14.15 (6.29,21.99)	0.0000	4.56 (0.47,8.65)	4.29 (-0.87,9.45)	9.47 (1.78,17.15)	0.0362
7. NEUROLOGICAL TESTS - SENSATION (N=670)	55.38 (28.01)	62.13 (29.33)	66.34 (28.13)	73.05 (25.45)	6.75 (1.80,11.69)	10.97 (4.92,17.01)	17.67 (8.27,27.08)	0.0001	6.68 (1.54,11.81)	5.86 (-0.61,12.33)	13.45 (3.81,23.09)	0.0111
8. NEUROLOGICAL TESTS - MUSCLE TESTING (N=670)	61.93 (27.71)	63.21 (29.34)	69.86 (26.13)	76.23 (28.04)	1.28 (-3.62,6.17)	7.93 (1.95,13.91)	14.29 (4.99,23.59)	0.0028	2.35 (-2.67,7.37)	2.99 (-3.34,9.33)	10.85 (1.42,20.28)	0.1554
9. TAKE PULSE (N=666)	28.53 (26.93)	27.61 (24.30)	36.32 (30.21)	37.48 (25.97)	-0.92 (-5.59,3.76)	7.79 (2.11,13.46)	8.94 (0.10,17.79)	0.0056	-0.11 (-4.99,4.79)	5.4 (2.31,11.56)	8.28 (-0.85,17.42)	0.1002
10. TAKE BLOOD PRESSURE (N=671)	38.77 (27.49)	39.23 (27.21)	42.84 (32.29)	47.10 (27.59)	0.46 (-4.49,5.40)	4.07 (-1.96,10.09)	8.33 (-1.07,17.73)	0.2216	0.68 (-4.47,5.84)	0.81 (-5.66,7.29)	5.25 (-4.44,14.93)	0.7674
11. CHECK RESPIRATION (N=664)	12.95 (16.84)	13.29 (13.99)	13.82 (16.93)	15.33 (16.27)	0.35 (-2.44,3.14)	0.87 (-2.51,4.26)	2.38 (-2.95,7.72)	0.8278	1.60 (-1.32,4.53)	1.03 (-2.61,4.68)	3.57 (-1.95,9.09)	0.5342
12. TAKE TEMPERATURE (N=665)	9.29 (11.29)	10.12 (12.66)	9.93 (11.98)	12.33 (12.83)	0.83 (-1.27,2.94)	0.63 (-1.92,3.19)	3.04 (-0.98,7.07)	0.4970	1.19 (-1.04,3.42)	0.43 (-2.36,3.22)	2.77 (-1.46,6.99)	0.5168
13. EXAMINE ABDOMEN (N=666)	20.35 (21.27)	20.84 (19.87)	23.99 (23.84)	20.13 (17.96)	0.49 (-3.22,4.19)	3.65 (-0.85,8.14)	-0.22 (-7.23,6.79)	0.4298	2.04 (-1.76,5.83)	2.22 (-2.52,6.97)	2.00 (-5.10,9.10)	0.7033
14. EXAMINE HEART (N=665)	16.03 (17.84)	14.16 (14.33)	19.32 (23.11)	20.03 (15.81)	-1.86 (-4.98,1.25)	3.29 (-0.49,7.08)	3.99 (-1.89,9.88)	0.0346	-0.92 (-4.15,2.31)	2.58 (-1.46,6.62)	6.56 (0.53,12.59)	0.0547
15. EXAMINE LUNGS (N=667)	15.05 (16.23)	14.84 (13.89)	16.89 (20.46)	20.33 (19.70)	-0.21 (-3.11,2.69)	1.84 (-1.69,5.36)	5.27 (-0.23,10.77)	0.1909	0.34 (-2.69,3.38)	1.38 (-2.42,5.18)	6.73 (1.04,12.41)	0.1299
16. MOUTH EXAMINATION (N=668)	13.92 (19.99)	11.61 (15.70)	13.74 (19.03)	11.95 (14.59)	-2.31 (-5.49,0.86)	-0.18 (-4.04,3.68)	-1.97 (-8.05,4.11)	0.4930	-0.36 (-3.62,2.91)	0.81 (-3.28,4.89)	1.13 (-5.06,7.31)	0.9296

Table 4.4.3 F-tests for the Relationship between EMPLOYMENT STATUS and Treatment Technique Variables. Baseline is "Single Practitioner".

VARIABLE	MEAN (S.D.)				UNADJUSTED ANALYSIS ESTIMATED DIFFERENCE FROM BASELINE (95% CI)				ADJUSTED ANALYSIS ESTIMATED DIFFERENCE FROM BASELINE (95% CI)			
	SINGLE [N=293]	PARTNER [N=243]	GROUP [N=130]	EMPLOYED [N=43]	PARTNER	GROUP	EMPLOYED	p-value	PARTNER	GROUP	EMPLOYED	p-value
1. DIVERSIFIED (N=648)	68.86 (29.77)	65.23 (31.51)	71.73 (27.47)	70.61 (29.82)	-3.64 (-8.97,1.69)	2.87 (-3.57,9.32)	1.74 (-8.44,11.92)	0.2411	0.39 (-5.66,4.88)	2.23 (-4.35,8.80)	8.05 (-1.91,18.01)	0.3698
2. GONSTEAD (N=620)	33.79 (32.17)	40.99 (34.03)	32.97 (32.77)	44.75 (35.72)	7.19 (1.14,13.24)	-0.82 (-8.04,6.39)	10.95 (-0.62,22.52)	0.0286	2.94 (-2.68,8.57)	-0.02 (-6.91,6.87)	0.87 (-9.75,11.49)	0.7316
3. HIO - HOLE-IN-ONE (N=624)	16.30 (20.08)	18.83 (23.03)	13.13 (15.72)	19.00 (21.77)	2.53 (-1.21,6.27)	-3.18 (-7.63,1.27)	2.69 (-4.29,9.69)	0.0910	4.31 (0.42,8..21)	0.61 (-4.17,5.39)	6.23 (-0.97,13.43)	0.0762
4. TOGGLE RECOIL (N=612)	19.66 (20.94)	22.72 (23.65)	24.69 (23.89)	27.06 (25.65)	3.06 (-1.12,7.24)	5.04 (0.06,10.01)	7.39 (-0.64,15.44)	0.1010	2.77 (-1.49,7.03)	2.49 (-2.75,7.75)	8.33 (0.19,16.48)	0.2030
5. LOGAN (N=588)	8.37 (10.75)	9.46 (13.44)	7.04 (8.61)	10.63 (15.57)	1.08 (-1.12,3.29)	-1.34 (-3.99,1.31)	2.26 (-1.75,6.27)	0.2409	1.85 (-0.45,4.14)	0.06 (-2.78,2.90)	2.16 (-1.99,6.31)	0.3243
6. SACRO-OCCIPITAL TECHNIQUE (N=608)	19.39 (24.69)	15.40 (20.86)	17.86 (23.44)	17.41 (21.37)	-3.98 (-8.25,0.28)	-1.53 (-6.57,3.51)	-1.98 (-9.93,5.97)	0.3387	-4.44 (-8.72,-0.16)	-4.45 (-9.69,0.79)	-5.25 (-13.22,2.72)	0.1536
7. APPLIED KINESIOLOGY (N=625)	20.85 (24.18)	17.17 (23.29)	20.14 (26.38)	21.86 (29.12)	-3.68 (-8.16,0.79)	-0.71 (-6.07,4.66)	1.02 (-7.47,9.49)	0.3794	-0.74 (-5.36,3.87)	2.39 (-3.30,8.10)	6.64 (-2.04,15.31)	0.3242
8. NIMMO (N=633)	38.55 (27.34)	45.05 (27.27)	44.17 (28.48)	48.22 (28.31)	6.50 (1.52,11.48)	5.62 (-0.35,11.59)	9.67 (0.17,19.17)	0.0275	4.29 (-0.87,9.46)	4.37 (-2.01,10.75)	4.31 (-5.48,14.10)	0.3526
9. ACTIVATOR (N=611)	13.16 (16.92)	14.94 (19.34)	12.44 (14.88)	14.84 (17.00)	1.78 (-1.43,4.99)	-0.72 (-4.53,3.09)	1.68 (-4.33,7.69)	0.5617	1.64 (-1.59,4.88)	-2.96 (-6.89,0.98)	-1.38 (-7.36,4.61)	0.1334
10. PETTIBON (N=593)	5.51 (8.45)	5.46 (7.81)	3.92 (6.61)	3.89 (4.74)	-0.05 (-1.49,1.40)	-1.59 (-3.29,0.12)	-1.62 (-4.32,1.08)	0.1954	0.16 (-1.36,1.69)	-0.61 (-2.46,1.24)	-1.88 (-4.69,0.94)	0.4886
11. PIERCE-STILLWAGON (N=587)	7.55 (12.12)	5.52 (8.93)	4.54 (7.21)	9.86 (18.42)	-2.03 (-4.07,0.01)	-3.01 (-5.40,-0.62)	2.31 (-1.48,6.10)	0.0115	-1.24 (-3.28,0.79)	-2.28 (-4.74,0.18)	1.06 (-2.68,4.79)	0.1836
12. TOFTNESS (N=588)	6.18 (10.79)	4.50 (5.43)	3.12 (4.78)	4.56 (4.97)	-1.68 (-3.18,-0.18)	-3.06 (-4.82,-1.29)	-1.62 (-4.41,1.17)	0.0060	-0.79 (-2.36,0.78)	-1.81 (-3.71,0.09)	-1.39 (-4.28,1.49)	0.2943
13. BIOMECHANICAL PRINCIPLES (N=604)	38.69 (30.24)	43.72 (30.54)	39.43 (31.89)	39.54 (34.77)	5.02 (-0.71,10.75)	0.73 (-6.16,7.62)	0.84 (-9.63,11.31)	0.3574	5.11 (-0.91,11.13)	0.51 (-7.01,8.03)	2.15 (-8.85,13.15)	0.3655

Table 4.4.4 F-tests for the Relationship between EMPLOYMENT STATUS and Miscellaneous Practice Management Variables. Baseline is "Single Practitioner".

VARIABLE	MEAN (S.D.)				UNADJUSTED ANALYSIS ESTIMATED DIFFERENCE FROM BASELINE (95% CI)				ADJUSTED ANALYSIS ESTIMATED DIFFERENCE FROM BASELINE (95% CI)			
	SINGLE [N=293]	PARTNER [N=243]	GROUP [N=130]	EMPLOYED [N=43]	PARTNER	GROUP	EMPLOYED	p-value	PARTNER	GROUP	EMPLOYED	p-value
1. PERFORM HOME VISITS (N=673)	6.79 (6.98)	6.91 (6.69)	6.89 (8.42)	6.60 (4.73)	0.12 (-1.10,1.35)	0.09 (-1.40,1.60)	-0.19 (-2.53,2.15)	0.9930	0.41 (-0.90,1.72)	0.16 (-1.49,1.82)	-0.03 (-2.49,2.43)	0.9360
2. TREAT BY MANIPULATION ONLY ON FIRST VISIT (N=662)	49.38 (32.60)	44.88 (33.33)	36.91 (31.71)	32.97 (29.95)	-4.49 (-10.21,1.21)	-12.47 (-19.44,-5.49)	-16.40 (-27.45,-5.36)	0.0006	-2.50 (-8.33,3.33)	-6.11 (-13.44,1.22)	-8.36 (-19.49,2.76)	0.2768
3. GIVE EMOTIONAL/SOCIAL COUNSELLING (N=672)	10.87 (14.07)	9.08 (10.85)	9.13 (13.16)	12.55 (16.28)	-1.79 (-4.06,0.48)	-1.74 (-4.51,1.04)	1.68 (-2.63,6.00)	0.2160	-0.10 (-2.45,2.25)	-0.09 (-3.05,2.87)	2.82 (-1.59,7.23)	0.6086
4. RATE AGREEMENT TO PRESCRIBE DRUGS (N=668)	47.59 (34.09)	43.50 (34.81)	49.21 (36.04)	50.28 (33.98)	-4.09 (-10.15,1.97)	1.62 (-5.80,9.04)	2.69 (-8.82,14.19)	0.3617	-5.34 (-11.64,0.95)	-1.95 (-9.89,6.00)	4.22 (-7.60,16.05)	0.2416
5. TIME SPENT WITH PATIENT - FIRST VISIT (N=669)	37.93 (12.05)	37.19 (10.92)	40.34 (12.12)	43.85 (11.29)	-0.74 (-2.78,1.29)	2.41 (-0.07,4.89)	5.92 (2.06,9.78)	0.0019	-0.72 (-2.82,1.37)	1.13 (-1.51,3.76)	3.85 (-0.08,7.77)	0.1070
6. TIME SPENT WITH PATIENT - SUBSEQUENT VISITS (N=669)	14.45 (5.89)	12.88 (3.84)	14.14 (4.12)	13.63 (4.19)	-1.58 (-2.42,-0.73)	-0.32 (-1.35,0.72)	-0.83 (-2.44,0.78)	0.0031	-1.41 (-2.19,-0.63)	-1.54 (-2.52,-0.56)	-1.40 (-2.86,0.06)	0.0012

manipulation only on their first visit, and this only when unadjusted. Chiropractors in group practice and employed practitioners tend state that they to use additional treatment modalities on the patient's initial consultation. Many of the employed clinicians are recent graduates. They also appear to spend more time with the patient on the first consultation but the significant differences between the groups are lost in the adjusted analysis. The unadjusted and adjusted comparisons show that although there are significant differences between groups in the time they spent with patients on subsequent visits, these are not large. As for the other groups of usage variables employment status is not particularly useful in explaining differences in the miscellaneous practice management variables.

4.5 COLLEGE OF GRADUATION

4.5.1 THE X-RAY PROCEDURES (Table 4.5.1)

The teaching of subjects varies from one college to another and this may affect the extent to which some procedures are used, but it will also depend upon the circumstances in which the chiropractor practises. Overall the mean usage of different x-ray procedures show a moderate degree of variation between graduates of European, American, Canadian and Australian colleges. The unadjusted comparisons show significant differences in the means for taking skeletal x-rays, obtaining written and oral consent, asking about the menstrual cycle, getting x-rays from a private radiological clinic and the patient bringing the x-rays. For a number of these variables graduates from Australian colleges tend to have significantly higher usage, whereas the reverse is true when

Table 4.5.1 F-tests for the Relationship between COLLEGE OF GRADUATION and X-ray Procedure Variables. Baseline is "European College".

VARIABLE	MEAN (S.D.)				UNADJUSTED ANALYSIS ESTIMATED DIFFERENCE FROM BASELINE (95% CI)				ADJUSTED ANALYSIS ESTIMATED DIFFERENCE FROM BASELINE (95% CI)			
	EUROPEAN [N=352]	AMERICAN [N=313]	CANADIAN [N=36]	AUSTRALIAN [N=13]	AMERICAN	CANADIAN	AUSTRALIAN	p-value	AMERICAN	CANADIAN	AUSTRALIAN	p-value
1. TAKE SKELETAL X-RAYS (N=513)	69.45 (23.76)	75.69 (23.05)	64.21 (24.25)	85.40 (12.07)	6.24 (2.05,10.44)	-5.23 (-14.37,3.90)	15.95 (-4.76,36.67)	0.0042	1.89 (-3.54,7.32)	-4.74 (-14.15,4.66)	17.67 (-1.79,37.13)	0.1407
2. TAKE TISSUE X-RAYS (N=513)	7.96 (7.70)	10.16 (11.16)	8.96 (12.49)	7.40 (2.19)	2.19 (0.47,3.93)	0.99 (-2.76,4.76)	-0.56 (-9.10,7.97)	0.0969	1.43 (-0.98,3.84)	0.15 (-4.02,4.32)	-0.98 (-9.62,7.65)	0.6551
3. ASK ABOUT MENSTRUAL CYCLE (N=506)	91.25 (19.92)	81.74 (28.23)	89.39 (22.60)	87.80 (16.02)	-9.51 (-13.85,-5.16)	-1.86 (-11.25,7.54)	-3.45 (-24.75,17.85)	0.0004	-2.65 (-8.65,3.35)	3.79 (-6.57,14.14)	-6.82 (-28.18,14.48)	0.4723
4. GET ORAL CONSENT (N=499)	86.19 (27.09)	72.77 (36.05)	64.59 (42.05)	95.20 (5.45)	-13.41 (-19.25,-7.57)	-21.59 (-34.36,-8.83)	9.01 (-19.44,37.47)	0.0000	-9.21 (-17.26,-1.16)	-18.37 (-32.36,-4.39)	5.62 (-22.83,34.07)	0.0370
5. GET WRITTEN CONSENT (N=484)	21.28 (32.38)	10.51 (21.10)	9.63 (19.48)	31.60 (41.05)	-10.77 (-15.80,-5.73)	-11.65 (-22.52,-0.77)	10.32 (-13.87,34.52)	0.0002	4.09 (-2.59,10.78)	3.38 (-8.14,14.89)	5.79 (-17.57,29.16)	0.6551
6. GET X-RAYS FROM ANOTHER CHIROPRACTOR (N=617)	17.71 (23.19)	13.67 (18.38)	14.94 (19.06)	20.18 (30.82)	-4.04 (-7.53,-0.54)	-2.77 (-10.28,4.75)	2.47 (-10.29,15.24)	0.1316	1.78 (-2.79,6.36)	2.81 (-5.37,10.99)	3.35 (-9.45,16.16)	0.8253
7. GET X-RAYS FROM HOSPITAL VIA GP (N=605)	8.98 (10.89)	12.29 (16.48)	12.53 (19.68)	13.80 (19.45)	3.30 (0.95,5.66)	3.55 (-1.61,8.72)	4.82 (-4.11,13.75)	0.0343	0.84 (-2.05,3.73)	-2.48 (-7.79,2.83)	1.67 (-6.89,10.24)	0.5895
8. GET X-RAYS DIRECTLY FROM HOSPITAL (N=614)	13.13 (19.55)	15.16 (16.13)	16.73 (17.45)	20.27 (22.19)	2.03 (-0.95,5.01)	3.59 (-2.90,10.09)	7.14 (-3.74,18.02)	0.3003	-2.27 (-6.15,1.61)	-1.99 (-9.02,5.04)	4.76 (-6.18,15.69)	0.4997
9. GET X-RAYS FROM A PRIVATE RADIOLOGICAL CLINIC (N=609)	9.86 (15.86)	14.79 (21.08)	19.84 (27.11)	21.18 (31.88)	4.93 (1.74,8.12)	9.99 (2.96,17.02)	11.33 (-0.28,22.93)	0.0011	-1.11 (-4.91,2.69)	-0.29 (-7.27,6.68)	2.29 (-8.53,13.13)	0.8963
10. THE PATIENT BRINGS THE X-RAYS (N=614)	10.98 (13.98)	18.54 (21.33)	26.38 (29.76)	27.09 (33.89)	7.56 (4.43,10.69)	15.39 (8.68,22.12)	16.11 (4.69,27.52)	0.0000	0.80 (-2.75,4.36)	3.19 (-3.17,9.55)	5.41 (-4.74,15.55)	0.5958

obtaining written and oral consent for American and Canadian graduates. The Australian and Canadian trained practitioners are very few in numbers so, the significance is more likely to be due to smaller changes across bigger groups. After adjusting for other demographic factors significant differences remain for oral consent with American trained practitioners 9 percentage points less likely to get consent than European trained chiropractors but otherwise all differences between colleges become insignificant.

4.5.2 THE EXAMINATION PROCEDURES (Table 4.5.2)

Chiropractors trained in various parts of the world would be expected to differ to some degree in their application of certain procedures. This may be a consequence of a slightly different curriculum from one college to another. Table 4.5.2 shows that American trained chiropractors' mean usage of musculoskeletal examinations (1-8) is generally low for most procedures. European trained practitioners have a general tendency to high usage of most procedures with Canadian trained chiropractors in between. Australian trained practitioners tend to report higher estimated means than American graduates and almost equal to Canadians for half of the variables. The unadjusted and adjusted comparisons show that American trained chiropractors use most procedures less frequently than those from European and other colleges. Unadjusted tests for postural analysis, dynamic palpation, orthopaedic tests (lumbar & cervical), neurological examination (reflexes, sensation & muscle tests), taking the pulse and blood pressure, and examining the abdomen show highly significant differences across colleges. Only

Table 4.5.2 F-tests for the Relationship between COLLEGE OF GRADUATION Examination Procedure Variables. Baseline is "European College".

VARIABLE	MEAN (S.D.)				UNADJUSTED ANALYSIS ESTIMATED DIFFERENCE FROM BASELINE (95% CI)				ADJUSTED ANALYSIS ESTIMATED DIFFERENCE FROM BASELINE (95% CI)			
	EUROPEAN [N=352]	AMERICAN [N=313]	CANADIAN [N=36]	AUSTRALIAN [N=13]	AMERICAN	CANADIAN	AUSTRALIAN	p-value	AMERICAN	CANADIAN	AUSTRALIAN	p-value
1. POSTURAL ANALYSIS (N=662)	71.86 (31.79)	66.79 (33.81)	83.34 (24.41)	88.33 (9.88)	-5.07 (-10.16,0.02)	11.49 (0.30,22.67)	16.48 (-2.02,34.97)	0.0036	-2.02 (-8.69,4.65)	13.57 (1.42,25.71)	13.97 (-4.77,32.71)	0.0266
2. STATIC PALPATION (N=669)	89.90 (18.17)	89.78 (17.19)	92.23 (14.93)	92.08 (13.17)	-0.12 (-2.88,2.63)	2.33 (-3.78,8.43)	2.18 (-7.91,12.27)	0.8511	1.68 (-1.94,5.30)	4.00 (-2.64,10.64)	3.49 (-6.76,13.74)	0.5894
3. DYNAMIC PALPATION (N=666)	91.64 (15.38)	84.58 (22.29)	85.26 (18.71)	68.25 (31.73)	-7.05 (-10.08,-4.02)	-6.38 (-13.07,0.31)	-23.39 (-34.44,-12.33)	0.0000	-0.57 (-4.29,3.15)	2.24 (-4.56,9.03)	-16.03 (-26.50,-5.55)	0.0203
4. ORTHOPAEDIC TESTS - LUMBAR SPINE (N=671)	92.62 (13.73)	81.41 (22.71)	89.14 (15.08)	79.75 (29.27)	-11.21 (-14.12,-8.29)	-3.47 (-9.94,2.99)	-12.87 (-23.56,-2.18)	0.0000	-6.65 (-10.42,-2.87)	0.18 (-6.76,7.12)	-10.71 (-21.43,0.003)	0.0010
5. ORTHOPAEDIC TESTS - CERVICAL SPINE (N=670)	87.80 (19.20)	77.68 (26.09)	83.06 (22.22)	82.42 (24.79)	-10.12 (-13.69,-6.55)	-4.74 (-12.65,3.16)	-5.38 (-18.46,7.69)	0.0000	-3.46 (-8.10,1.10)	-0.18 (-8.53,8.17)	-3.63 (-16.52,9.27)	0.4511
6. NEUROLOGICAL TESTS - REFLEXES (N=669)	85.27 (19.42)	69.87 (26.71)	81.54 (18.67)	75.00 (26.98)	-15.40 (-19.02,-11.79)	-3.73 (-11.73,4.28)	-10.27 (-24.07,3.54)	0.0000	-8.10 (-12.66,-3.55)	0.74 (-7.64,9.12)	-10.38 (-23.82,3.06)	0.0012
7. NEUROLOGICAL TESTS - SENSATION (N=670)	65.22 (28.01)	55.22 (29.00)	63.94 (27.44)	64.25 (27.67)	-10.01 (-14.48,-5.54)	-1.28 (-11.18,8.62)	-0.97 (-17.34,15.39)	0.0002	-4.19 (-9.89,1.52)	0.87 (-9.63,11.38)	-1.00 (-17.26,15.25)	0.4511
8. NEUROLOGICAL TESTS - MUSCLE TESTING (N=670)	68.95 (25.89)	59.26 (30.53)	65.91 (23.58)	74.58 (25.58)	-9.69 (-14.08,-5.29)	-3.04 (-12.76,6.68)	5.63 (-10.44,21.70)	0.0002	-2.56 (-8.14,3.03)	-0.29 (-10.57,9.99)	3.99 (-11.90,19.89)	0.7387
9. TAKE PULSE (N=666)	33.20 (28.29)	26.75 (25.16)	32.46 (23.44)	24.75 (27.22)	-6.46 (-10.67,-2.24)	-0.74 (-10.05,8.56)	-8.45 (-23.84,6.93)	0.0213	-1.05 (-6.49,4.39)	3.57 (-6.39,13.54)	-11.19 (-26.59,4.20)	0.3969
10. TAKE BLOOD PRESSURE (N=671)	43.89 (29.04)	35.35 (26.97)	45.23 (25.80)	40.67 (35.15)	-8.53 (-12.95,-4.11)	1.34 (-8.45,11.14)	-3.22 (-19.41,12.97)	0.0015	-6.16 (-11.89,-0.43)	2.65 (-7.90,13.20)	-7.09 (-23.41,9.24)	0.0835
11. CHECK RESPIRATION (N=664)	13.61 (16.58)	12.61 (14.93)	15.59 (15.05)	18.75 (20.45)	-0.99 (-3.51,1.51)	1.98 (-3.63,7.58)	5.14 (-4.01,14.29)	0.4282	0.50 (-2.76,3.76)	2.71 (-3.29,8.71)	2.37 (-6.82,11.56)	0.8036
12. TAKE TEMPERATURE (N=665)	9.73 (11.81)	9.49 (11.37)	13.65 (16.37)	12.17 (16.31)	-0.23 (-2.12,1.66)	3.92 (-0.32,8.15)	2.43 (-4.47,9.34)	0.2473	1.42 (-1.07,3.91)	5.17 (0.58,9.76)	1.93 (-5.09,8.96)	0.1678
13. EXAMINE ABDOMEN (N=666)	23.71 (22.53)	17.56 (18.99)	24.80 (18.09)	28.33 (26.39)	-6.15 (-9.45,-2.85)	1.09 (-6.20,8.38)	4.62 (-7.43,16.67)	0.0013	-4.58 (-8.79,-0.37)	0.13 (-7.61,7.87)	-0.48 (-12.45,11.49)	0.1477
14. EXAMINE HEART (N=665)	17.58 (18.41)	14.68 (17.25)	16.00 (14.85)	17.73 (21.59)	-2.90 (-5.71,-0.09)	-1.58 (-7.87,4.70)	0.14 (-10.55,10.84)	0.2420	-1.54 (-5.15,2.06)	-1.70 (-8.36,4.95)	-4.43 (-14.98,6.13)	0.7387
15. EXAMINE LUNGS (N=667)	16.19 (17.12)	14.46 (15.97)	19.60 (16.91)	17.73 (15.51)	-1.73 (-4.35,0.88)	3.41 (-2.37,9.19)	1.54 (-8.43,11.50)	0.2606	-0.63 (-4.02,2.76)	3.57 (-2.63,-9.78)	-2.36 (-12.30,7.59)	0.9986
16. MOUTH EXAMINATION (N=668)	13.02 (18.31)	11.97 (17.28)	19.23 (22.49)	17.67 (17.25)	-1.05 (-3.89,1.80)	6.21 (-0.09,12.51)	4.65 (-5.78,15.07)	0.1183	-2.94 (-6.55,0.68)	2.19 (-4.48,8.85)	-0.95 (-11.26,9.36)	0.2328

postural analysis, dynamic palpation, orthopaedic lumbar tests and testing reflexes remain significant after adjusting and with Australian trained graduates notably different from baseline.

The non-musculoskeletal examination procedures (9-16) are generally used less frequently but in the unadjusted analyses Australian trained chiropractors' mean usage, except for taking the pulse and blood pressure, tends to be higher than most of the other college graduates. Examinations related to the heart (pulse and blood pressure) and abdomen receive more attention than any other organ system. Again, Australian trained practitioners tend to estimate using these examination procedures more and American trained clinicians use them less. None of these procedures showed significant differences across colleges in the adjusted model.

The college of graduation is related to differences in frequency of examining the musculoskeletal system, especially neurological (testing reflexes), lumbar orthopaedic tests, dynamic palpation and postural analysis.

4.5.3 THE TREATMENT TECHNIQUES (Table 4.5.3)

In chiropractic colleges the teaching of treatment techniques has for decades been strongly influenced by different ideologies and philosophies, so it is not surprising if this is reflected in the chiropractors usage of such techniques. There are considerable variations between chiropractors graduating from different colleges in terms of their stated mean usage of treatment techniques. The unadjusted analyses show that Australian graduates frequently use more techniques than their colleagues from other colleges (Table

Table 4.5.3 F-tests for the Relationship between COLLEGE OF GRADUATION and Treatment Technique Variables. Baseline is "European College".

VARIABLE	MEAN (S.D.)				UNADJUSTED ANALYSIS ESTIMATED DIFFERENCE FROM BASELINE (95% CI)				ADJUSTED ANALYSIS ESTIMATED DIFFERENCE FROM BASELINE (95% CI)			
	EUROPEAN (N=352)	AMERICAN (N=313)	CANADIAN (N=36)	AUSTRALIAN (N=13)	AMERICAN	CANADIAN	AUSTRALIAN	p-value	AMERICAN	CANADIAN	AUSTRALIAN	p-value
1. DIVERSIFIED (N=648)	72.77 (26.99)	60.44 (32.36)	86.94 (19.01)	72.67 (29.55)	-12.32 (-16.99,-7.65)	14.18 (4.02,24.34)	-0.09 (-16.88,16.68)	0.0000	-16.36 (-22.21,-10.52)	6.12 (-4.52,16.75)	-7.78 (-24.19,8.63)	0.0000
2. GONSTEAD (N=620)	28.02 (27.96)	49.27 (35.49)	10.39 (11.73)	52.80 (39.07)	21.25 (16.16,26.33)	-17.64 (-29.12,-6.15)	24.78 (5.18,44.37)	0.0000	27.52 (21.36,33.67)	-5.23 (-16.89,6.43)	31.30 (12.81,49.79)	0.0000
3. HIO - HOLE-IN-ONE (N=624)	14.12 (16.29)	19.37 (24.18)	21.09 (22.20)	14.80 (24.73)	5.25 (1.92,8.59)	6.97 (-0.45,14.40)	0.68 (-12.18,13.54)	0.0114	2.15 (-2.16,6.46)	3.13 (-4.88,11.13)	-1.27 (-14.09,11.57)	0.7458
4. TOGGLE RECOIL (N=612)	25.71 (22.69)	16.33 (21.26)	28.75 (22.86)	29.36 (33.09)	-9.39 (-13.08,-5.69)	3.04 (-5.08,11.15)	3.65 (-9.77,17.07)	0.0000	-8.66 (-13.38,-3.95)	3.59 (-5.09,12.27)	0.82 (-12.56,14.19)	0.0004
5. LOGAN (N=588)	7.44 (11.36)	9.68 (12.06)	10.89 (10.90)	12.00 (15.11)	2.24 (0.27,4.21)	3.45 (-1.01,7.92)	4.56 (-2.82,11.93)	0.0726	1.00 (-1.49,3.51)	2.19 (-2.58,6.97)	4.32 (-3.04,11.68)	0.5343
6. SACRO-OCCIPITAL TECHNIQUE (N=608)	18.37 (24.68)	15.62 (20.29)	16.77 (18.14)	48.50 (28.96)	-2.75 (-6.51,1.00)	-1.59 (-9.98,6.78)	30.13 (15.83,44.42)	0.0001	0.60 (-4.19,5.39)	-1.03 (-9.89,7.84)	27.29 (13.30,41.29)	0.0021
7. APPLIED KINESIOLOGY (N=625)	17.33 (23.89)	20.42 (24.07)	24.53 (28.27)	47.64 (30.28)	3.09 (-0.88,7.06)	7.19 (-1.64,16.04)	30.30 (15.69,44.92)	0.0003	1.25 (-3.83,6.32)	2.08 (-7.39,11.55)	27.38 (12.77,41.98)	0.0038
8. NIMMO (N=633)	43.83 (27.47)	40.13 (28.02)	42.19 (27.41)	59.11 (24.12)	-3.71 (-8.18,0.77)	-1.64 (-11.63,8.55)	15.28 (-3.04,33.59)	0.1140	-5.91 (-11.63,-0.19)	-0.55 (-11.35,10.25)	16.72 (-1.36,34.79)	0.0367
9. ACTIVATOR (N=611)	15.30 (18.17)	11.13 (14.68)	9.00 (10.44)	43.80 (34.40)	-4.17 (-6.95,-1.39)	-6.30 (-12.52,-0.09)	28.49 (17.88,39.11)	0.0000	-1.94 (-5.49,1.62)	-5.02 (-11.69,1.67)	26.81 (16.28,37.34)	0.0000
10. PETTIBON (N=593)	3.79 (5.59)	6.61 (9.77)	6.31 (5.53)	3.50 (5.21)	2.83 (1.55,4.10)	2.53 (-0.38,4.01)	-0.29 (-5.08,4.51)	0.0002	2.57 (0.90,4.23)	2.38 (-0.79,5.55)	-0.13 (-5.01,4.74)	0.0239
11. PIERCE-STILLWAGON (N=587)	4.15 (7.31)	8.42 (12.68)	7.00 (5.38)	22.50 (29.55)	4.27 (2.51,6.04)	2.85 (-1.15,6.85)	18.35 (11.73,24.97)	0.0000	5.35 (3.11,7.59)	4.06 (-0.16,8.28)	18.58 (12.11,25.05)	0.0000
12. TOFTNESS (N=588)	4.43 (9.59)	5.34 (5.93)	6.17 (5.11)	5.10 (8.25)	0.91 (-0.44,2.26)	1.74 (-1.32,4.80)	0.67 (-4.39,5.73)	0.4722	-1.06 (-2.76,0.65)	-0.75 (-3.99,2.49)	0.64 (-4.35,5.62)	0.6550
13. BIOMECHANICAL PRINCIPLES (N=604)	41.79 (32.00)	38.20 (29.67)	49.97 (32.03)	34.50 (21.53)	-3.58 (-8.72,1.56)	8.18 (-2.77,19.13)	-7.29 (-26.75,12.18)	0.1403	-7.68 (-14.45,-0.90)	2.88 (-9.19,14.96)	-7.06 (-26.78,12.66)	0.0651

4.5.3). More than half of techniques retain significant association with college of graduation after adjusting.

In the adjusted model the techniques Diversified, Gonstead, Toggle Recoil, Sacro-Occipital Technique, Applied Kinesiology, Nimmo, Activator, Pettibon and Pierce-Stillwagon are significantly different in usage compared to baseline (European college). The different group sizes are likely to be part of the reason. However, the literature reveals similar trends for the profession on the Australian continent. Why they more frequently use so many techniques is not entirely clear although, it is most likely due to their training. For Greek practitioners , for example, who are almost all Australian trained, there are cultural traditions for using many different treatment and management procedures during a consultation. In contrast, there is a large degree of similarity of practice in North America from where many chiropractors graduated. They are also exposed to numerous kinds of techniques through promotion campaigns and courses. Nevertheless, the practitioners from American and Canadian colleges said that they only use a limited number of techniques more frequently, as shown in the unadjusted and adjusted analyses (Table 4.5.3). This tends to indicate that the training received in college does significantly affect the extent to which practitioners report using certain treatment techniques in practice. However, the fact that the choice of learning different techniques is much greater in North America does not appear to influence its use noticeably. Instead there is a tendency to concentrate on a few long established treatment techniques. Nevertheless, it is clear that the college of graduation is an important factor in explaining the use of treatment techniques.

4.5.4 THE MISCELLANEOUS PRACTICE MANAGEMENT VARIABLES (Table 4.5.4)

The chiropractors graduating from various colleges show interesting differences in some of their opinions and practice management procedures. Australian graduates tend to perform more home visits and give much more emotional/social counselling but, together with their American trained colleagues, they are less likely to agree to prescribe drugs. In this group of variables mentioned only the question of drug prescription is significant in the unadjusted and adjusted comparisons.

American, Canadian and Australian trained practitioners are much more likely to treat by manipulation only on the patient's first visit than their European trained counterparts. This, together with the types of technique they use, tends to indicate that they also spend less time with the patient on the first consultation compared to the Europeans. However, the comparison of time spent on the first visit loses significance in the adjusted model (Table 4.5.4). European chiropractors said that they used significantly more time with the patients on subsequent visits, as shown in both unadjusted and adjusted analyses. Thus, after adjusting for other demographic factors, the college of graduation is useful in explaining the variables treating by manipulation, agreement to prescribe drugs and time spent on subsequent patient visits.

Table 4.5.4 F-tests for the Relationship between COLLEGE OF GRADUATION and Miscellaneous Practice Management Variables. Baseline is "European College".

VARIABLE	MEAN (S.D.)				UNADJUSTED ANALYSIS ESTIMATED DIFFERENCE FROM BASELINE (95% CI)				ADJUSTED ANALYSIS ESTIMATED DIFFERENCE FROM BASELINE (95% CI)			
	EUROPEAN [N=352]	AMERICAN [N=313]	CANADIAN [N=36]	AUSTRALIAN [N=13]	AMERICAN	CANADIAN	AUSTRALIAN	p-value	AMERICAN	CANADIAN	AUSTRALIAN	p-value
1. PERFORM HOME VISITS (N=673)	6.80 (7.37)	6.66 (6.35)	7.46 (5.52)	10.25 (14.56)	-0.14 (-1.24,0.97)	0.66 (-1.79,3.11)	3.45 (-0.61,7.50)	0.3510	-0.03 (-1.49,1.42)	0.46 (-2.22,3.15)	2.83 (-1.32,6.99)	0.5831
2. TREAT BY MANIPULATION ONLY ON FIRST VISIT (N=662)	35.83 (30.80)	53.60 (33.05)	50.91 (29.23)	48.75 (35.42)	17.78 (12.74,22.81)	15.09 (3.99,26.17)	12.92 (-5.40,31.25)	0.0000	14.49 (7.93,21.04)	11.37 (-0.55,23.29)	9.52 (-8.86,27.89)	0.0003
3. GIVE EMOTIONAL/SOCIAL COUNSELLING (N=672)	9.16 (12.73)	10.39 (12.49)	11.69 (14.43)	20.75 (23.25)	1.23 (-0.80,3.27)	2.53 (-1.98,7.04)	11.59 (4.13,19.06)	0.0151	-0.46 (-3.07,2.16)	0.08 (-4.73,4.89)	9.47 (2.03,16.91)	0.0824
4. RATE AGREEMENT TO PRESCRIBE DRUGS (N=668)	51.01 (34.26)	41.19 (34.33)	52.49 (33.94)	39.82 (42.91)	-9.82 (-15.24,-4.39)	1.48 (-10.51,13.47)	-11.19 (-31.86,9.49)	0.0030	-13.11 (-20.13,-6.08)	-0.38 (-13.29,12.54)	-11.84 (-32.56,8.88)	0.0013
5. TIME SPENT WITH PATIENT - FIRST VISIT (N=669)	40.09 (10.76)	36.89 (12.75)	36.57 (10.13)	37.50 (11.38)	-3.19 (-5.03,-1.36)	-3.52 (-7.58,0.55)	-2.59 (-9.30,4.13)	0.0056	-0.05 (-2.38,2.28)	-0.65 (-4.92,3.63)	-1.88 (-8.49,4.73)	0.9422
6. TIME SPENT WITH PATIENT - SUBSEQUENT VISITS (N=669)	15.43 (4.52)	12.15 (4.59)	11.34 (4.13)	16.08 (7.46)	-3.28 (-4.00,-2.55)	-4.09 (-5.69,-2.49)	0.65 (-1.99,3.30)	0.0000	-2.32 (-3.19,-1.45)	-3.55 (-5.14,-1.96)	-0.63 (-3.09,1.83)	0.0000

4.6 ACADEMIC DEGREE

4.6.1 THE X-RAY PROCEDURES (Table 4.6.1)

In the past it was unusual for chiropractors to possess other academic qualifications. Nowadays an increasing number of college graduates are awarded a BSc degree and many gain academic or other qualifications before or after training as chiropractors. The unadjusted comparisons show that, apart from taking skeletal x-rays and obtaining films from another chiropractor, practitioners with other qualifications are more likely to use the procedures listed in table 4.6.1. However, only when they said that patients brought the x-rays and obtaining films directly from hospital do the analyses remain significant after adjusting.

4.6.2 THE EXAMINATION PROCEDURES (Table 4.6.2)

The chiropractors state that the mean usage of musculoskeletal examination procedures (1-8) is similar for practitioners with none or additional academic qualifications. Only performing a postural analysis reveals significant differences in the unadjusted and adjusted models.

In contrast, comparisons of the non-musculoskeletal examinations (9-16) show significant differences for all the unadjusted models. After adjusting, taking pulse and blood pressure, and performing abdominal, heart and lung examinations remain significant. Chiropractors without other qualifications said that they used all these procedures less but, although the differences are significant, they are not large. One might imagine that more educated practitioners would conduct examinations more comprehensively but

Table 4.6.1 F-tests for the Relationship between ACADEMIC DEGREE and X-ray Procedure Variables. Baseline is "Yes - possesses degree".

VARIABLE	MEAN (S.D.)		UNADJUSTED ANALYSIS ESTIMATED DIFFERENCE FROM BASELINE (95% CI)		ADJUSTED ANALYSIS ESTIMATED DIFFERENCE FROM BASELINE (95% CI)	
	YES [N=205]	NO [N=485]	NO	p-value	NO	p-value
1. TAKE SKELETAL X-RAYS (N=513)	69.13 (22.89)	73.07 (23.83)	3.94 (-0.77,8.65)	0.1016	-1.51 (-6.43,3.40)	0.5488
2. TAKE TISSUE X-RAYS (N=513)	9.63 (11.06)	8.77 (9.17)	-0.86 (-2.79,1.07)	0.3846	-1.10 (-3.29,1.08)	0.3202
3. ASK ABOUT MENSTRUAL CYCLE (N=506)	88.86 (22.14)	86.27 (25.15)	-2.59 (-7.49,2.32)	0.3023	-1.15 (-6.56,4.25)	0.6802
4. GET ORAL CONSENT (N=499)	82.98 (30.37)	77.94 (33.66)	-5.04 (-11.72,1.63)	0.1393	-1.58 (-8.84,5.68)	0.6715
5. GET WRITTEN CONSENT (N=484)	20.54 (33.42)	14.29 (25.42)	-6.24 (-11.88,-0.60)	0.0305	-3.12 (-9.14,2.89)	0.3083
6. GET X-RAYS FROM ANOTHER CHIROPRACTOR (N=617)	14.94 (21.61)	16.28 (21.15)	1.34 (-2.39,5.07)	0.4816	1.62 (-2.58,5.83)	0.4505
7. GET X-RAYS FROM HOSPITAL VIA GP (N=605)	12.73 (17.38)	9.82 (12.73)	-2.91 (-5.42,-0.39)	0.0235	-0.64 (-3.36,2.08)	0.6469
8. GET X-RAYS DIRECTLY FROM HOSPITAL (N=614)	16.36 (20.80)	13.55 (16.93)	-2.81 (-6.01,0.39)	0.0860	-4.29 (-7.93,-0.67)	0.0207
9. GET X-RAYS FROM A PRIVATE RADIOLOGICAL CLINIC (N=609)	16.49 (23.69)	11.19 (17.35)	-5.29 (-8.70,-1.89)	0.0024	-2.79 (-6.34,0.74)	0.1226
10. THE PATIENT BRINGS THE X-RAYS (N=614)	21.13 (24.54)	13.03 (16.55)	-8.10 (-11.45,-4.75)	0.0000	-4.06 (-7.34,-0.77)	0,0158

Table 4.6.2 F-tests for the Relationship between ACADEMIC DEGREE and Examination Procedure Variables. Baseline is "Yes - possesses degree".

VARIABLE	MEAN (S.D.)		UNADJUSTED ANALYSIS ESTIMATED DIFFERENCE FROM BASELINE (95% CI)		ADJUSTED ANALYSIS ESTIMATED DIFFERENCE FROM BASELINE (95% CI)	
	YES [N=205]	NO [N=485]	NO	p-value	NO	p-value
1. POSTURAL ANALYSIS (N=662)	73.98 (31.11)	69.14 (32.82)	-4.84 (-10.22,0.53)	0.0780	-5.92 (-12.02,0.19)	0.0131
2. STATIC PALPATION (N=669)	88.13 (19.97)	90.82 (16.27)	2.69 (-0.19,5.57)	0.0685	1.65 (-1.67,4.98)	0.3300
3. DYNAMIC PALPATION (N=666)	83.88 (23.23)	89.49 (17.66)	5.62 (2.39,8.85)	0.0007	1.64 (-1.78,5.05)	0.3485
4. ORTHOPAEDIC TESTS - LUMBAR SPINE (N=671)	86.08 (22.09)	87.86 (17.99)	1.78 (-1.41,4.97)	0.2734	0.43 (-3.02,3.89)	0.8065
5. ORTHOPAEDIC TESTS - CERVICAL SPINE (N=670)	81.44 (24.23)	83.75 (22.69)	2.31 (-1.52,6.15)	0.2372	0.51 (-3.66,4.68)	0.8066
6. NEUROLOGICAL TESTS - REFLEXES (N=669)	77.63 (25.91)	78.41 (23.35)	0.78 (-3.22,4.79)	0.7019	-0.58 (-4.78,3.61)	0.7914
7. NEUROLOGICAL TESTS - SENSATION (N=670)	60.78 (30.09)	60.78 (28.23)	-1.82×10^{-3} (-4.77,4.77)	0.9994	-0.61 (-5.88,4.65)	0.8231
8. NEUROLOGICAL TESTS - MUSCLE TESTING (N=670)	66.98 (27.79)	63.69 (28.44)	-3.29 (-7.97,1.39)	0.1687	-0.73 (-5.89,4.42)	0.7774
9. TAKE PULSE (N=666)	35.26 (30.86)	28.04 (24.68)	-7.21 (-11.64,-2.78)	0.0015	-5.05 (-10.05,-0.05)	0.0484
10. TAKE BLOOD PRESSURE (N=671)	44.41 (30.92)	38.38 (27.06)	-6.03 (-10.71,-1.35)	0.0118	-6.66 (-11.94,-1.37)	0.0138
11. CHECK RESPIRATION (N=664)	16.61 (18.79)	11.99 (14.27)	-4.61 (-7.23,-1.99)	0.0006	-2.48 (-5.47,0.51)	0.1040
12. TAKE TEMPERATURE (N=665)	11.38 (13.94)	9.23 (11.01)	-2.15 (-4.14,-0.16)	0.0343	-1.53 (-3.82,0.75)	0.1888
13. EXAMINE ABDOMEN (N=666)	25.46 (24.12)	19.38 (19.47)	-6.09 (-9.57,-2.60)	0.0007	-4.07 (-7.97,-0.17)	0.0415
14. EXAMINE HEART (N=665)	20.14 (21.62)	14.57 (15.67)	-5.56 (-8.49,-2.63)	0.0002	-3.73 (-7.04,-0.43)	0.0273
15. EXAMINE LUNGS (N=667)	19.29 (21.05)	14.09 (14.06)	-5.20 (-7.93,-2.47)	0.0002	-4.14 (-7.26,-1.03)	0.0093
16. MOUTH EXAMINATION (N=668)	16.24 (21.57)	11.58 (16.28)	-4.66 (-7.64,-1.67)	0.0023	-3.16 (-6.51,0.19)	0.0656

possessing additional academic qualifications mainly appears to be important with respect to some non-musculoskeletal examinations.

4.6.3 THE TREATMENT TECHNIQUES (Table 4.6.3)

One might imagine that chiropractors with a more comprehensive educational background would also be more critical and tend to limit their use of techniques such as Applied Kinesiology and Sacro-Occipital Technique, which have lead to much controversy within the profession. Although widely promoted and used they still lack convincing studies showing their efficacy. Nevertheless, the unadjusted and adjusted comparisons show that differences in the use of various techniques are not large. The three most popular, Diversified, Gonstead and Nimmo are the only ones to reach significance unadjusted, but all lose it in the adjusted models. Here Diversified is used less, and Gonstead and Nimmo slightly more by those without further qualifications. The possession of additional qualifications is not helpful in explaining the use of treatment techniques.

4.6.4 THE MISCELLANEOUS PRACTICE MANAGEMENT VARIABLES (Table 4.6.4)

There is little difference in the mean usage of practice management procedures or opinions between chiropractors with and those without additional academic qualifications. The comparisons show significant differences with respect to giving emotional/social counselling and time spent with the patient on subsequent visits with those with an academic degree more likely to state to give counselling and spending more time but, only the former remains significant after adjusting. Less comprehensively educated

Table 4.6.3 F-tests for the Relationship between ACADEMIC DEGREE and Treatment Technique Variables. Baseline is "Yes - possesses degree".

VARIABLE	MEAN (S.D.)		UNADJUSTED ANALYSIS ESTIMATED DIFFERENCE FROM BASELINE (95% CI)		ADJUSTED ANALYSIS ESTIMATED DIFFERENCE FROM BASELINE (95% CI)	
	YES (N=205)	NO (N=485)	NO	p-value	NO	p-value
1. DIVERSIFIED (N=648)	72.37 (27.71)	66.49 (30.79)	-5.87 (-10.89,-0.86)	0.0221	-4.98 (-10.39,0.44)	0.0723
2. GONSTEAD (N=620)	31.69 (30.90)	38.79 (34.06)	7.10 (1.36,12.84)	0.0157	3.41 (-2.38,9.20)	0.2492
3. HIO - HOLE-IN-ONE (N=624)	18.28 (22.84)	16.06 (19.53)	-2.23 (-5.77,1.32)	0.2183	-1.01 (-5.01,2.99)	0.6243
4. TOGGLE RECOIL (N=612)	22.53 (23.29)	21.90 (22.62)	-0.63 (-4.59,3.32)	0.7539	-1.40 (-5.78,2.98)	0.5325
5. LOGAN (N=588)	8.80 (11.54)	8.57 (11.54)	-0.24 (-2.33,1.86)	0.8257	-0.37 (-2.73,1.99)	0.7642
6. SACRO-OCCIPITAL TECHNIQUE (N=608)	18.39 (22.49)	17.32 (23.28)	-1.07 (-5.10,2.96)	0.6034	1.54 (-2.87,5.94)	0.4932
7. APPLIED KINESIOLOGY (N=625)	21.39 (25.40)	18.74 (24.28)	-2.65 (-6.87,1.57)	0.2185	1.58 (-3.16,6.32)	0.5122
8. NIMMO (N=633)	39.09 (28.43)	43.78 (27.34)	4.69 (-0.03,9.41)	0.0521	-1.28 (-6.64,4.09)	0.6392
9. ACTIVATOR (N=611)	15.64 (20.41)	12.93 (15.96)	-2.71 (-5.75,0.32)	0.0798	-1.09 (-4.42,2.22)	0.5171
10. PETTIBON (N=593)	5.15 (7.49)	5.05 (7.83)	-0.09 (-1.46,1.28)	0.8969	0.12 (-1.44,1.68)	0.8875
11. PIERCE-STILLWAGON (N=587)	7.11 (12.14)	6.12 (10.33)	-0.99 (-2.93,0.94)	0.3153	-0.02 (-2.09,2.06)	0.9877
12. TOFTNESS (N=588)	4.91 (6.71)	4.91 (8.52)	-2.45×10^{-3} (-1.43,1.42)	0.9973	0.62 (-0.97,2.22)	0.4427
13. BIOMECHANICAL PRINCIPLES (N=604)	38.52 (29.54)	41.50 (31.54)	2.98 (-2.43,8.40)	0.2808	2.08 (-4.17,8.34)	0.5122

Table 4.6.4 F-tests for the Relationship between ACADEMIC DEGREE and Miscellaneous Practice Management Variables. Baseline is "Yes - possesses degree".

VARIABLE	MEAN (S.D.)		UNADJUSTED ANALYSIS ESTIMATED DIFFERENCE FROM BASELINE (95% CI)		ADJUSTED ANALYSIS ESTIMATED DIFFERENCE FROM BASELINE (95% CI)	
	YES [N=205]	NO [N=485]	NO	p-value	NO	p-value
1. PERFORM HOME VISITS (N=673)	7.49 (7.43)	6.56 (6.85)	-0.93 (-2.09,0.23)	0.1149	-0.59 (-1.93,0.75)	0.3868
2. TREAT BY MANIPULATION ONLY ON FIRST VISIT (N=662)	46.82 (32.29)	43.67 (33.15)	-3.15 (-8.66,2.36)	0.2628	-1.91 (-7.92,4.09)	0.5325
3. GIVE EMOTIONAL/SOCIAL COUNSELLING (N=672)	12.73 (16.18)	8.87 (11.24)	-3.86 (-5.99,-1.72)	0.0004	-3.81 (-6.21,-1.41)	0.0019
4. RATE AGREEMENT TO PRESCRIBE DRUGS (N=668)	47.69 (34.99)	46.17 (34.61)	-1.53 (-7.28,4.23)	0.6038	-4.91 (-11.37,1.55)	0.1367
5. TIME SPENT WITH PATIENT - FIRST VISIT (N=669)	39.39 (13.05)	38.06 (11.12)	-1.33 (-3.27,0.61)	0.1788	-0.12 (-2.26,2.02)	0.9204
6. TIME SPENT WITH PATIENT - SUBSEQUENT VISITS (N=669)	15.09 (6.27)	13.24 (4.04)	-1.86 (-2.65,-1.06)	0.0000	-0.72 (-1.52,0.08)	0.0763

practitioners are less likely to give emotional/social counselling, and are generally also less likely to use any of the other procedures or agree to prescribe drugs. Thus, academic diligence does not generally help explaining patient management related activities.

4.7 PRACTICE ADDRESS

4.7.1 THE X-RAY PROCEDURES (Table 4.7.1)

The practice address, for example metropolitan versus rural, may give an indication of the population served or the affluence of an area. It is possible that metropolitan clinics would have easier access to x-ray facilities or use procedures which involve co-operation with other professions in health centres or hospitals. Table 4.7.1 shows significant differences between the groups, both unadjusted and adjusted, with respect to asking about menstrual cycle and the patient bringing the x-rays. In rural practices the chiropractors are less likely to ask about the former, but only slightly less likely to have the patient bring the x-rays. Rural practitioners are also much less likely to obtain written consent, but the significance is lost in the adjusted analysis. Compared to baseline (metropolitan) the urban, semi-urban and rural chiropractors said that they obtained x-rays less frequently from a private radiological clinic, but the difference is only significant in the unadjusted analysis. One might imagine that rural practitioners would more frequently obtain x-rays from another chiropractor due to the costs of maintaining equipment. However, although the unadjusted differences failed to reach significance,

Table 4.7.1 F-tests for the Relationship between PRACTICE ADDRESS and X-ray Procedure Variables. Baseline is "Metropolitan Practice".

VARIABLE	MEAN (S.D.)				UNADJUSTED ANALYSIS ESTIMATED DIFFERENCE FROM BASELINE (95% CI)				ADJUSTED ANALYSIS ESTIMATED DIFFERENCE FROM BASELINE (95% CI)			
	METROPOLITAN [N=181]	URBAN [N=259]	SEMI-URBAN [N=251]	RURAL [N=17]	URBAN	SEMI-URBAN	RURAL	p-value	URBAN	SEMI-URBAN	RURAL	p-value
1. TAKE SKELETAL X-RAYS (N=513)	71.69 (23.13)	71.53 (24.56)	72.67 (23.36)	76.11 (18.69)	-0.16 (-5.60,5.28)	0.98 (-4.43,6.39)	4.42 (-11.64,20.49)	0.9150	-0.37 (-5.44,4.69)	-1.58 (-6.71,3.55)	8.61 (-6.51,23.73)	0.5770
2. TAKE TISSUE X-RAYS (N=513)	8.88 (8.09)	9.13 (9.87)	8.88 (10.42)	9.67 (9.08)	0.25 (-1.98,2.48)	-3.80×10^{-3} (-2.22,2.21)	0.79 (-5.79,7.36)	0.9886	0.42 (-1.83,2.67)	-0.29 (-2.57,1.99)	1.64 (-5.07,8.35)	0.8684
3. ASK ABOUT MENSTRUAL CYCLE (N=506)	92.33 (16.10)	83.73 (28.50)	87.02 (23.49)	81.22 (32.53)	-8.60 (-14.21,-3.00)	-5.32 (-10.89,0.26)	-11.11 (-27.57,5.35)	0.0235	-7.66 (-13.23,-2.09)	-2.29 (-7.96,3.38)	-11.62 (-28.18,4.93)	0.0257
4. GET ORAL CONSENT (N=499)	80.60 (32.49)	80.54 (31.66)	77.26 (34.02)	74.44 (42.36)	-0.07 (-7.73,7.59)	-3.35 (-10.96,4.27)	-6.16 (-28.52,16.19)	0.7150	0.72 (-6.76,8.19)	0.45 (-7.16,8.06)	-13.17 (-35.34,8.99)	0.6686
5. GET WRITTEN CONSENT (N=484)	20.66 (32.04)	18.20 (29.62)	11.34 (22.59)	2.78 (4.35)	-2.46 (-8.95,4.02)	-9.33 (-15.79,-2.86)	-17.89 (-36.59,0.82)	0.0092	-1.14 (-7.36,5.08)	-4.47 (-10.81,1.87)	-19.11 (-37.35,-0.88)	0.1191
6. GET X-RAYS FROM ANOTHER CHIROPRACTOR (N=617)	13.88 (18.57)	15.48 (21.35)	18.25 (23.31)	8.13 (7.57)	1.60 (-2.76,5.96)	4.37 (0.05,8.70)	-5.75 (-16.67,5.16)	0.0936	1.83 (-2.54,6.19)	5.81 (1.41,10.20)	-7.77 (-18.78,3.24)	0.0110
7. GET X-RAYS FROM HOSPITAL VIA GP (N=605)	11.76 (16.32)	10.32 (14.37)	10.42 (12.81)	7.27 (9.22)	-1.44 (-4.39,1.51)	-1.35 (-4.29,1.60)	-4.49 (-12.06,3.07)	0.5831	-0.71 (-3.52,2.11)	-0.93 (-3.79,1.92)	-3.12 (-10.40,4.16)	0.8181
8. GET X-RAYS DIRECTLY FROM HOSPITAL (N=614)	15.03 (19.71)	13.56 (17.26)	14.88 (17.84)	10.69 (17.73)	-1.47 (-5.18,2.24)	-0.15 (-3.87,3.57)	-4.34 (-13.66,4.99)	0.6866	-1.07 (-4.79,2.65)	-0.28 (-4.07,3.49)	-0.54 (-9.95,8.87)	0.9483
9. GET X-RAYS FROM A PRIVATE RADIOLOGICAL CLINIC (N=609)	16.59 (23.69)	12.03 (17.88)	10.82 (17.77)	9.06 (10.59)	-4.57 (-8.55,-0.59)	-5.78 (-9.74,-1.82)	-7.53 (-17.51,2.44)	0.0262	-3.39 (-7.08,0.29)	-4.98 (-8.67,-1.28)	-5.46 (-14.72,3.81)	0.0618
10. THE PATIENT BRINGS THE X-RAYS (N=614)	19.13 (24.32)	15.45 (18.79)	12.55 (15.78)	15.75 (18.74)	-3.68 (-7.65,0.29)	-6.58 (-10.55,-2.61)	-3.38 (-13.37,6.59)	0.0150	-2.64 (-6.07,0.79)	-5.75 (-9.24,-2.26)	-0.09 (-8.77,8.58)	0.0115

the adjusted analysis showed a significant difference between the groups, although it was not large. In terms of explaining differences in usage of x-ray procedures the practice address revealed little of interest.

4.7.2 THE EXAMINATION PROCEDURES (Table 4.7.2)

The unadjusted and adjusted comparisons show significant differences between practitioners with respect to their reported use of neurological examination (sensation), checking respiration, and heart and oral examinations. Compared to baseline the urban, semi-urban and particularly rural chiropractors are less likely to perform neurological examination (sensation). The differences are not large, except for the rural practitioners. The differences are even smaller in the analyses checking respiration, heart and oral examination. The analyses comparing abdominal and neurological (muscle tests) examinations show significant, though small, differences in the unadjusted models only. Practice address is generally not helpful in explaining the usage of examination variables.

4.7.3 THE TREATMENT TECHNIQUES (Table 4.7.3)

The unadjusted and adjusted comparisons show significant and large differences between chiropractors practising in rural areas and any other group with respect to their higher reported usage of Toggle Recoil, Logan and Pierce-Stillwagon techniques. These chiropractors also said they used Biomechanical Principles, HIO and Gonstead more, whilst the remaining techniques were used to the same extent by all groups, and none of these latter techniques reached

Table 4.7.2 F-tests for the Relationship between PRACTICE ADDRESS and Examination Procedure Variables. Baseline is "Metropolitan Practice".

VARIABLE	MEAN (S.D.)				UNADJUSTED ANALYSIS ESTIMATED DIFFERENCE FROM BASELINE (95% CI)				ADJUSTED ANALYSIS ESTIMATED DIFFERENCE FROM BASELINE (95% CI)			
	METROPOLITAN (N=181)	URBAN (N=259)	SEMI-URBAN (N=251)	RURAL (N=17)	URBAN	SEMI-URBAN	RURAL	p-value	URBAN	SEMI-URBAN	RURAL	p-value
1. POSTURAL ANALYSIS (N=662)	73.85 (30.89)	68.15 (33.77)	70.95 (31.63)	67.63 (36.47)	-5.71 (-12.08,0.67)	-2.89 (-9.29,3.49)	-6.23 (-22.82,10.37)	0.3561	-4.76 (-11.15,1.64)	-1.55 (-8.05,4.96)	-6.05 (-22.68,10.59)	0.4668
2. STATIC PALPATION (N=669)	91.03 (16.53)	88.12 (20.54)	90.74 (15.02)	96.59 (4.08)	-2.91 (-6.33,0.52)	-0.28 (-3.72,3.15)	5.56 (-3.14,14.26)	0.1002	-2.78 (-6.27,0.70)	-0.13 (-3.68,3.42)	6.11 (-2.79,15.02)	0.1016
3. DYNAMIC PALPATION (N=666)	86.36 (21.76)	87.56 (20.70)	89.40 (16.17)	83.53 (26.96)	1.20 (-2.66,5.07)	3.05 (-0.82,6.91)	-2.83 (-12.63,6.96)	0.3408	0.45 (-3.12,4.02)	1.87 (-1.75,5.49)	-3.07 (-12.17,6.03)	0.5768
4. ORTHOPAEDIC TESTS - LUMBAR SPINE (N=671)	88.77 (19.72)	86.99 (20.21)	86.66 (17.80)	87.29 (23.56)	-1.78 (-5.57,2.02)	-2.11 (-4.05,1.69)	-1.48 (-11.12,8.17)	0.7301	-1.52 (-5.16,2.13)	-0.93 (-4.63,2.77)	-2.17 (-11.48,7.14)	0.8613
5. ORTHOPAEDIC TESTS - CERVICAL SPINE (N=670)	86.30 (19.87)	81.25 (25.88)	83.05 (22.00)	76.38 (26.63)	-5.05 (-9.58,-0.52)	-3.25 (-7.79,1.29)	-9.93 (-21.77,1.92)	0.1047	-4.68 (-9.07,-0.29)	-2.04 (-6.49,2.41)	-11.13 (-22.57,0.32)	0.0771
6. NEUROLOGICAL TESTS - REFLEXES (N=669)	82.05 (22.27)	76.88 (26.09)	77.25 (23.03)	71.35 (25.01)	-5.17 (-9.89,-0.45)	-4.80 (-9.53,-0.08)	-10.69 (-22.68,1.29)	0.0782	-4.18 (-8.58,0.22)	-1.99 (-6.45,2.48)	-11.39 (-22.65,-0.15)	0.1016
7. NEUROLOGICAL TESTS - SENSATION (N=670)	65.30 (28.48)	58.17 (29.26)	61.15 (28.28)	47.12 (25.11)	-7.14 (-12.74,-1.54)	-4.15 (-9.76,1.46)	-18.19 (-32.45,-3.92)	0.0174	-6.18 (-11.70,-0.66)	-2.05 (-7.65,3.55)	-17.77 (-31.89,-3.66)	0.0214
8. NEUROLOGICAL TESTS - MUSCLE TESTING (N=670)	69.96 (27.09)	62.08 (29.74)	63.78 (27.24)	60.88 (27.85)	-7.88 (-13.39,-2.36)	-6.18 (-11.69,-0.65)	-9.08 (-23.11,4.95)	0.0354	-6.34 (-11.74,-0.93)	-3.74 (-9.22,1.74)	-11.26 (-25.07,2.55)	0.0903
9. TAKE PULSE (N=666)	33.82 (28.13)	28.68 (26.58)	28.93 (25.75)	32.94 (31.15)	-5.15 (-10.41,0.12)	-4.89 (-10.17,0.38)	-0.88 (-14.25,12.49)	0.2050	-4.16 (-9.39,1.08)	-2.80 (-8.13,2.52)	-5.22 (-18.59,8.16)	0.4563
10. TAKE BLOOD PRESSURE (N=671)	43.68 (27.99)	38.29 (28.89)	39.34 (27.69)	43.41 (32.95)	-5.39 (-10.94,0.15)	-4.34 (-9.90,1.22)	-0.27 (-14.40,13.86)	0.2497	-4.68 (-10.22,0.86)	-2.96 (-8.59,2.66)	-2.74 (-16.92,11.44)	0.4307
11. CHECK RESPIRATION (N=664)	16.01 (19.72)	11.35 (12.72)	13.38 (15.48)	15.76 (16.29)	-4.67 (-7.78,-1.55)	-2.64 (-5.75,0.48)	-0.25 (-8.13,7.64)	0.0297	-4.26 (-7.39,-1.12)	-1.51 (-4.69,1.67)	-2.19 (-10.18,5.78)	0.0540
12. TAKE TEMPERATURE (N=665)	10.13 (12.03)	9.39 (12.36)	10.07 (11.59)	11.35 (12.68)	-0.73 (-3.09,1.63)	-0.06 (-2.43,2.30)	1.22 (-4.77,7.21)	0.8550	-0.25 (-2.65,2.15)	0.48 (-1.95,2.91)	0.97 (-5.14,7.07)	0.9116
13. EXAMINE ABDOMEN (N=666)	25.22 (23.23)	19.96 (20.51)	19.42 (19.43)	22.29 (26.17)	-5.26 (-9.39,-1.14)	-5.81 (-9.94,-1.67)	-2.93 (-13.41,7.55)	0.0321	-4.43 (-8.49,-0.36)	-3.05 (-7.18,1.08)	-4.35 (-14.75,6.05)	0.1954
14. EXAMINE HEART (N=665)	20.13 (20.16)	14.55 (17.55)	15.32 (16.36)	14.18 (10.49)	-5.58 (-9.07,-2.09)	-4.81 (-8.30,-1.31)	-5.95 (-14.79,2.88)	0.0112	-4.78 (-8.24,-1.31)	-2.79 (-6.31,0.73)	-8.23 (-17.07,0.60)	0.0321
15. EXAMINE LUNGS (N=667)	18.32 (17.91)	14.45 (17.12)	15.09 (15.33)	13.12 (9.12)	-3.86 (-7.12,-0.61)	-3.23 (-6.48,0.03)	-5.20 (-13.46,3.06)	0.0976	-3.11 (-6.37,0.15)	-1.76 (-5.06,1.54)	-6.60 (-14.93,1.72)	0.1834
16. MOUTH EXAMINATION (N=668)	17.41 (21.69)	11.78 (16.94)	10.58 (14.52)	18.53 (29.94)	-5.64 (-9.15,-2.13)	-6.83 (-10.35,-3.32)	1.12 (-7.82,10.05)	0.0006	-4.91 (-8.41,-1.41)	-5.42 (-8.97,-1.87)	1.21 (-7.74,10.17)	0.0086

Table 4.7.3 F-tests for the Relationship between PRACTICE ADDRESS and Treatment Technique Variables. Baseline is "Metropolitan Practice".

VARIABLE	MEAN (S.D.)				UNADJUSTED ANALYSIS ESTIMATED DIFFERENCE FROM BASELINE (95% CI)				ADJUSTED ANALYSIS ESTIMATED DIFFERENCE FROM BASELINE (95% CI)			
	METROPOLITAN (N=181)	URBAN (N=259)	SEMI-URBAN (N=251)	RURAL (N=17)	URBAN	SEMI-URBAN	RURAL	p-value	URBAN	SEMI-URBAN	RURAL	p-value
1. DIVERSIFIED (N=648)	73.61 (28.30)	66.55 (31.92)	66.36 (29.05)	64.93 (27.77)	-7.06 (-13.00,-1.12)	-7.25 (-13.19,-1.31)	-8.68 (-24.48,7.12)	0.0656	-4.85 (-10.49,0.79)	-3.21 (-8.93,2.49)	-6.69 (-21.75,8.36)	0.3742
2. GONSTEAD (N=620)	34.94 (31.34)	36.94 (34.71)	37.16 (33.56)	44.38 (28.44)	1.99 (-4.88,8.88)	2.22 (-4.63,9.07)	9.43 (-7.75,26.62)	0.7239	0.34 (-5.74,6.43)	-2.29 (-8.42,3.82)	13.93 (-1.43,29.29)	0.1906
3. HIO - HOLE-IN-ONE (N=624)	16.49 (20.46)	16.71 (21.76)	16.10 (18.50)	26.59 (28.56)	0.22 (-3.95,4.38)	-0.39 (-4.59,3.81)	10.09 (-0.18,20.37)	0.2477	-0.02 (-4.17,4.12)	-0.27 (-4.49,3.96)	10.13 (-0.19,20.46)	0.2540
4. TOGGLE RECOIL (N=612)	24.09 (23.67)	21.45 (22.03)	20.04 (21.48)	40.67 (33.99)	-2.63 (-7.27,2.01)	4.05 (-8.66,0.56)	16.58 (4.60,28.55)	0.0042	-2.14 (-6.69,2.41)	-1.43 (-6.02,3.17)	14.83 (3.06,26.61)	0.0367
5. LOGAN (N=588)	8.32 (11.42)	8.48 (11.45)	8.30 (10.64)	18.60 (24.92)	0.16 (-2.30,2.62)	-0.02 (-2.47,2.43)	10.28 (4.08,16.48)	0.0109	0.13 (-2.34,2.60)	-0.49 (-2.98,2.01)	11.33 (5.12,17.54)	0.0027
6. SACRO-OCCIPITAL TECHNIQUE (N=608)	21.43 (26.68)	17.02 (22.29)	15.49 (20.42)	18.43 (26.81)	-4.41 (-9.13,0.29)	-5.94 (-10.65,-1.24)	-3.20 (-16.19,9.79)	0.0959	-3.73 (-8.29,0.83)	-5.39 (-10.02,-0.77)	-5.96 (-18.53,6.61)	0.1387
7. APPLIED KINESIOLOGY (N=625)	21.93 (27.23)	19.38 (24.39)	17.63 (21.98)	24.64 (34.93)	-2.56 (-7.53,2.41)	-4.30 (-9.27,0.67)	2.71 (-10.73,16.15)	0.3217	-0.72 (-5.62,4.18)	-2.27 (-7.25,2.71)	4.59 (-8.67,17.85)	0.6550
8. NIMMO (N=633)	43.14 (28.49)	40.08 (28.08)	44.54 (26.85)	37.43 (26.33)	-3.07 (-8.66,2.53)	1.39 (-4.22,7.00)	-5.72 (-20.86,9.43)	0.3155	-3.09 (-8.61,2.43)	0.96 (-4.66,6.57)	-3.31 (-18.27,11.64)	0.4258
9. ACTIVATOR (N=611)	15.17 (18.69)	13.11 (17.78)	13.01 (16.39)	17.87 (10.99)	-2.06 (-5.64,1.51)	-2.61 (-5.73,1.40)	2.69 (-6.53,11.92)	0.4623	-2.18 (-5.63,1.27)	-1.63 (-5.11,1.85)	0.56 (-8.39,9.50)	0.6151
10. PETTIBON (N=593)	4.93 (7.70)	4.99 (9.01)	5.35 (6.40)	4.00 (5.32)	0.06 (-1.56,1.68)	0.42 (-1.19,1.66)	-0.93 (-5.31,3.46)	0.8963	-0.07 (-1.68,1.55)	-0.25 (-1.89,1.39)	-0.73 (-5.12,3.66)	0.9807
11. PIERCE-STILLWAGON (N=587)	6.76 (11.48)	5.68 (10.59)	5.84 (6.97)	21.33 (30.08)	-1.08 (-3.32,1.15)	-0.92 (-3.16,1.31)	14.57 (8.92,20.22)	0.0000	-0.45 (-2.62,1.71)	-1.37 (-3.56,0.83)	15.15 (9.66,20.63)	0.0000
12. TOFTNESS (N=588)	4.20 (5.56)	4.68 (8.51)	5.60 (8.99)	5.38 (6.39)	0.48 (-1.21,2.16)	1.39 (-0.28,3.08)	1.18 (-3.37,5.73)	0.3990	0.46 (-1.21,2.13)	0.71 (-0.97,2.39)	1.69 (-2.80,6.18)	0.7964
13. BIOMECHANICAL PRINCIPLES (N=604)	43.38 (31.31)	39.49 (31.19)	40.44 (30.59)	31.00 (30.02)	-3.89 (-10.35,2.57)	-2.93 (-9.34,3.48)	-12.38 (-29.93,5.18)	0.4359	-3.91 (-10.48,2.66)	-2.89 (-9.52,3.74)	-9.52 (-27.31,8.27)	0.5644

significance in the unadjusted and adjusted analyses. Explaining these usage variables by means of practice address has limited applications.

4.7.4 THE MISCELLANEOUS PRACTICE MANAGEMENT VARIABLES (Table 4.7.4)

The mean reported usage of practice management procedures is very similar for chiropractors in metropolitan, semi-urban, urban and rural areas. Only the agreement to prescribe drugs is rated somewhat lower by rural practitioners. They also said that they spent less time with patients on the first and subsequent visits, but the differences were not large. The time spent on subsequent visits was the only difference to reach significance, and then only in the adjusted model.

4.8 AGE, DURATION OF PRACTICE AND YEAR OF GRADUATION

4.8.1 THE X-RAY PROCEDURES (Table 4.8.1)

The age of the chiropractor, duration of practice and year of graduation (Table 2.4.1.2) were only adjusted for the remaining six categorical variables in the full model. The unadjusted analyses show that with increasing age the chiropractors were more likely to get x-rays from a private radiological clinic and have the patients bring the films, whereas they were less likely to ask about the menstrual cycle, obtain written consent and get x-rays from another chiropractor (Table 4.8.1). However, none of the adjusted analyses retained significance, except getting x-rays from hospital via the general medical practitioner, and this only adjusted. This observation was also made with respect to the duration of practice and the year of graduation, where recent graduates were more likely

Table 4.7.4 F-tests for the Relationship between PRACTICE ADDRESS and Miscellaneous Practice Management Variables. Baseline is "Metropolitan Practice".

VARIABLE	MEAN (S.D.)				UNADJUSTED ANALYSIS ESTIMATED DIFFERENCE FROM BASELINE (95% CI)				ADJUSTED ANALYSIS ESTIMATED DIFFERENCE FROM BASELINE (95% CI)			
	METROPOLITAN (N=181)	URBAN (N=259)	SEMI-URBAN (N=251)	RURAL (N=17)	URBAN	SEMI-URBAN	RURAL	p-value	URBAN	SEMI-URBAN	RURAL	p-value
1. PERFORM HOME VISITS (N=673)	7.33 (7.11)	6.57 (7.38)	6.67 (6.49)	8.00 (8.95)	-0.75 (-2.13,0.62)	-0.65 (-2.03,0.73)	0.67 (-2.84,4.19)	0.6232	-0.59 (-2.00,0.81)	-0.38 (-1.81,1.05)	0.72 (-2.89,4.33)	0.7891
2. TREAT BY MANIPULATION ONLY ON FIRST VISIT (N=662)	42.19 (32.78)	45.14 (33.72)	46.02 (32.19)	40.88 (33.98)	2.95 (-3.53,9.43)	3.83 (-2.66,10.32)	-1.31 (-18.19,15.57)	0.6549	2.99 (-3.28,9.25)	3.55 (-3.12,9.91)	2.84 (-13.47,19.16)	0.7173
3. GIVE EMOTIONAL/SOCIAL COUNSELLING (N=672)	9.93 (13.39)	9.33 (10.25)	10.71 (15.33)	11.47 (9.63)	-0.60 (-3.15,1.95)	0.78 (-1.77,3.34)	1.54 (-4.96,8.04)	0.6653	0.09 (-2.43,2.62)	1.36 (-1.20,3.92)	2.93 (-3.53,9.39)	0.5583
4. RATE AGREEMENT TO PRESCRIBE DRUGS (N=668)	47.75 (34.62)	47.56 (34.97)	45.50 (34.30)	37.76 (38.69)	-0.19 (-6.99,6.63)	-2.24 (-9.08,4.59)	-9.98 (-27.30,7.34)	0.6351	0.99 (-5.79,7.77)	-1.32 (-8.21,5.56)	-6.28 (-23.63,11.06)	0.7891
5. TIME SPENT WITH PATIENT - FIRST VISIT (N=669)	37.73 (10.64)	38.45 (12.15)	39.13 (11.94)	36.59 (13.87)	0.72 (-1.58,3.03)	1.39 (-0.91,3.71)	-1.14 (-7.00,4.72)	0.6008	1.08 (-1.17,3.33)	1.76 (-0.52,4.04)	-4.11 (-9.85,1.63)	0.1333
6. TIME SPENT WITH PATIENT - SUBSEQUENT VISITS (N=669)	14.51 (5.37)	13.47 (4.35)	13.61 (5.10)	14.13 (3.46)	-1.03 (-1.99,-0.08)	-0.89 (-1.85,0.07)	-0.38 (-2.88,2.12)	0.1682	-0.98 (-1.81,-0.14)	-0.53 (-1.37,0.32)	-2.89 (-5.08,-0.69)	0.0200

Table 4.8.1 F-tests for the Relationship between AGE, DURATION OF PRACTICE, YEAR OF GRADUATION and X-ray Procedure Variables.

VARIABLE	AGE UNADJUSTED ANALYSIS		[N=711] ADJUSTED ANALYSIS		DURATION OF PRACTICE UNADJUSTED ANALYSIS		[N=714] ADJUSTED ANALYSIS		YEAR OF GRADUATION UNADJUSTED ANALYSIS		[N=715] ADJUSTED ANALYSIS	
	ESTIMATED SLOPE (95% CI)	p-value	ESTIMATED SLOPE (95% CI)	p-value	ESTIMATED SLOPE (95% CI)	p-value	ESTIMATED SLOPE (95% CI)	p-value	ESTIMATED SLOPE (95% CI)	p-value	ESTIMATED SLOPE (95% CI)	p-value
1. TAKE SKELETAL X-RAYS (N=513)	0.11 (-0.11,0.33)	0.3484	0.08 (-0.16,0.32)	0.5123	0.02 (0.001,0.04)	0.0401	0.02 (-0.003,0.04)	0.0881	-0.23 (-0.47,0.01)	0.0635	-0.22 (-0.49,0.04)	0.0955
2. TAKE TISSUE X-RAYS (N=513)	-0.002 (-0.09,0.09)	0.9611	-0.07 (-0.18,0.04)	0.2023	6.99×10^{4} (-0.01,0.01)	0.8704	-4.45×10^{3} (-0.01,0.01)	0.3775	-0.01 (-0.11,0.09)	0.8533	0.05 (-0.06,0.17)	0.3627
3. ASK ABOUT MENSTRUAL CYCLE (N=506)	-0.23 (-0.46,-0.001)	0.0499	-0.06 (-0.32,0.21)	0.6802	-0.03 (-0.05,-0.005)	0.0172	-6.34×10^{3} (-0.03,0.02)	0.6172	0.32 (0.07,0.57)	0.0127	0.08 (-0.21,0.37)	0.5779
4. GET ORAL CONSENT (N=499)	-0.20 (-0.51,0.11)	0.2038	0.26 (-0.10,0.62)	0.1632	-0.03 (-0.06,0.002)	0.0689	0.02 (-0.01,0.05)	0.2699	0.31 (-0.03,0.64)	0.0725	-0.23 (-0.62,0.16)	0.2441
5. GET WRITTEN CONSENT (N=484)	-0.35 (-0.62,-0.09)	0.0100	-0.13 (-0.43,0.17)	0.4032	-0.04 (-0.07,-0.02)	0.0006	-0.02 (-0.05,0.01)	0.1665	0.51 (0.22,0.79)	0.0006	0.21 (-0.11,0.53)	0.2065
6. GET X-RAYS FROM ANOTHER CHIROPRACTOR (N=617)	-0.19 (-0.38,-0.01)	0.0375	-0.09 (-0.31,0.12)	0.3867	-0.02 (-0.03,0.001)	0.0697	-6.94×10^{3} (-0.03,0.01)	0.4978	0.22 (0.01,0.43)	0.0402	0.11 (-0.13,0.35)	0.3684
7. GET X-RAYS FROM HOSPITAL VIA GP (N=605)	-0.02 (-0.15,0.10)	0.6997	-0.16 (-0.30,-0.03)	0.0191	-3.98×10^{3} (-0.02,0.01)	0.5147	-0.02 (-0.03,-0.003)	0.0129	0.05 (-0.09,0.19)	0.4834	0.22 (0.06,0.37)	0.0053
8. GET X-RAYS DIRECTLY FROM HOSPITAL (N=614)	-0.07 (-0.23,0.09)	0.3700	-0.17 (-0.35,0.02)	0.0745	-3.47×10^{4} (-0.02,0.01)	0.9639	-5.05×10^{3} (-0.02,0.01)	0.5659	-4.29×10^{3} (-0.18,0.17)	0.9617	0.06 (-0.15,0.26)	0.5904
9. GET X-RAYS FROM A PRIVATE RADIOLOGICAL CLINIC (N=609)	0.20 (0.03,0.37)	0.0189	-3.09×10^{3} (-0.18,0.18)	0.9749	0.02 (0.01,0.04)	0.0032	9.29×10^{3} (-0.01,0.03)	0.2818	-0.30 (-0.49,-0.11)	0.0018	-0.10 (-0.30,0.09)	0.3201
10. THE PATIENT BRINGS THE X-RAYS (N=614)	0.34 (0.18,0.51)	0.0001	-0.01 (-0.18,0.15)	0.8875	0.03 (0.02,0.05)	0.0001	4.00×10^{3} (-0.01,0.02)	0.6172	-0.39 (-0.57,-0.20)	0.0000	-0.02 (-0.20,0.17)	0.8415

to obtain the films from hospital via the general practitioner.

The longer chiropractors had been practising the more likely they were to take skeletal x-rays, get the films from a private radiological clinic and have the patients bring them, and less likely to obtain written consent, but the significance was lost in the adjusted analyses.

Recent graduates said that they much more frequently asked about menstrual cycle, obtained written consent and requested x-rays from another chiropractor, but less frequently obtained the films from a private radiological clinic and had the patients bring the x-rays. None of these reached significance in the adjusted analyses.

The age, duration of practice and year of graduation are generally not helpful in explaining chiropractors' use of x-ray procedures.

4.8.2 THE EXAMINATION PROCEDURES (Table 4.8.2)

There are noticeable differences between musculoskeletal and non-musculoskeletal examination procedures in terms of how they are influenced by the demographic variables. The usage variables dynamic palpation, orthopaedic tests (lumbar and cervical) and neurological examinations (reflexes, sensation & muscle tests) showed highly significant associations with age, duration of practice and year of graduation in both unadjusted and adjusted analyses. Older chiropractors who had been in practice for longer said that they used all these procedures less, whereas recent graduates used them much more. Postural analysis is used less by

Table 4.8.2 F-tests for the Relationship between AGE, DURATION OF PRACTICE, YEAR OF GRADUATION and Examination Procedure Variables.

VARIABLE	AGE UNADJUSTED ANALYSIS		[N=711] ADJUSTED ANALYSIS		DURATION OF PRACTICE UNADJUSTED ANALYSIS		[N=714] ADJUSTED ANALYSIS		YEAR OF GRADUATION UNADJUSTED ANALYSIS		[N=715] ADJUSTED ANALYSIS	
	ESTIMATED SLOPE (95% CI)	p-value	ESTIMATED SLOPE (95% CI)	p-value	ESTIMATED SLOPE (95% CI)	p-value	ESTIMATED SLOPE (95% CI)	p-value	ESTIMATED SLOPE (95% CI)	p-value	ESTIMATED SLOPE (95% CI)	p-value
1. POSTURAL ANALYSIS (N=662)	-0.27 (-0.54,-0.01)	0.0455	-0.26 (-0.57,0.05)	0.1053	-0.02 (-0.05,0.001)	0.0568	-0.02 (-0.05,0.01)	0.2797	0.26 (-0.03,0.56)	0.0822	0.15 (-0.19,0.50)	0.3837
2. STATIC PALPATION (N=669)	-0.12 (-0.26,0.02)	0.0974	-0.07 (-0.23,0.10)	0.4426	-5.41×10^{-3} (-0.02,0.01)	0.4356	-1.48×10^{-3} (-0.02,0.01)	0.8625	0.06 (-0.10,0.22)	0.4838	5.50×10^{-3} (-0.18,0.19)	0.9563
3. DYNAMIC PALPATION (N=666)	-0.65 (-0.81,-0.49)	0.0000	-0.54 (-0.71,-0.36)	0.0000	-0.06 (-0.07,-0.04)	0.0000	-0.05 (-0.07,-0.03)	0.0000	0.71 (0.53,0.88)	0.0000	0.59 (0.39,0.79)	0.0000
4. ORTHOPAEDIC TESTS - LUMBAR SPINE (N=671)	-0.48 (-0.63,-0.33)	0.0000	-0.33 (-0.50,-0.15)	0.0002	-0.05 (-0.06,-0.03)	0.0000	-0.03 (-0.04,-0.01)	0.0008	0.51 (0.34,0.68)	0.0000	0.30 (0.10,0.49)	0.0025
5. ORTHOPAEDIC TESTS - CERVICAL SPINE (N=670)	-0.66 (-0.85,-0.48)	0.0000	-0.52 (-0.73,-0.30)	0.0000	-0.06 (-0.07,0.07)	0.0000	-0.04 (-0.06,-0.02)	0.0001	0.65 (0.45,0.86)	0.0000	0.45 (0.22,0.69)	0.0001
6. NEUROLOGICAL TESTS - REFLEXES (N=669)	-0.70 (-0.89,-0.52)	0.0000	-0.47 (-0.68,-0.25)	0.0000	-0.06 (-0.08,-0.17)	0.0000	-0.04 (-0.06,-0.02)	0.0002	0.74 (0.53,0.96)	0.0000	0.42 (0.18,0.65)	0.0005
7. NEUROLOGICAL TESTS - SENSATION (N=670)	-0.66 (-0.88,-0.43)	0.0000	-0.48 (-0.75,-0.22)	0.0003	-0.06 (-0.08,-0.04)	0.0000	-0.04 (-0.07,-0.02)	0.0005	0.73 (0.47,0.98)	0.0000	0.52 (0.22,0.81)	0.0005
8. NEUROLOGICAL TESTS - MUSCLE TESTING (N=670)	-0.55 (-0.77,-0.32)	0.0000	-0.45 (-0.71,-0.19)	0.0007	-0.06 (-0.08,-0.04)	0.0000	-0.05 (-0.07,-0.03)	0.0001	0.73 (0.48,0.98)	0.0000	0.58 (0.29,0.87)	0.0001
9. TAKE PULSE (N=666)	-0.12 (-0.34,0.09)	0.2675	-7.64×10^{-3} (-0.26,0.25)	0.9496	-0.03 (-0.05,-0.01)	0.0055	-0.01 (-0.04,0.01)	0.3013	0.34 (0.09,0.58)	0.0070	0.13 (-0.15,0.41)	0.3568
10. TAKE BLOOD PRESSURE (N=671)	-0.31 (-0.54,-0.08)	0.0078	-0.15 (-0.42,0.11)	0.2583	-0.04 (-0.06,-0.01)	0.0016	-0.01 (-0.04,0.01)	0.3512	0.41 (0.15,0.66)	0.0018	0.13 (-0.17,0.43)	0.3867
11. CHECK RESPIRATION (N=664)	0.12 (-0.01,0.25)	0.0786	0.14 (-0.01,0.29)	0.0764	-6.68×10^{-5} (-.01,0.01)	0.9917	4.26×10^{-3} (-0.01,0.02)	0.5658	-2.15×10^{-3} (-0.15,0.14)	0.9771	-0.06 (-0.23,0.12)	05272
12. TAKE TEMPERATURE (N=665)	-0.05 (-0.15,0.05)	0.3355	-0.07 (-0.19,0.05)	0.2439	-8.43×10^{-3} (-0.02,0.001)	0.0813	-8.83×10^{-3} (-0.02,0.002)	0.1172	0.10 (-0.01,0.21)	0.0641	0.11 (-0.02,0.24)	0.0863
13. EXAMINE ABDOMEN (N=666)	0.07 (-0.11,0.24)	0.4619	0.11 (-0.08,0.31)	0.2583	-4.81×10^{-4} (-0.02,0.02)	0.9547	0.01 (-0.01,0.03)	0.2405	-7.80×10^{-4} (-0.19,0.19)	0.9937	-0.14 (-0.36,0.08)	0.2077
14. EXAMINE HEART (N=665)	0.14 (-0.008,0.29)	0.0637	0.19 (0.02,0.36)	0.0267	5.68×10^{-3} (0.01,0.02)	0.4331	0.02 (0.001,0.03)	0.0403	-0.05 (-0.22,0.11)	0.5157	-0.18 (-0.37,0.01)	0.0585
15. EXAMINE LUNGS (N=667)	0.07 (-0.07,0.21)	0.3878	0.10 (-0.06,0.26)	0.2135	1.05×10^{-3} (-0.01,0.01)	0.8758	9.09×10^{-3} (-0.01,0.02)	0.2388	5.33×10^{-3} (0.15,0.16)	0.9460	-0.08 (-0.26,0.09)	0.3597
16. MOUTH EXAMINATION (N=668)	0.19 (0.04,0.34)	0.0141	0.16 (-0.01,0.33)	0.0684	0.02 (0.001,0.03)	0.0315	0.02 (0.002,0.03)	0.0262	-0.19 (-0.36,-0.03)	0.0234	-0.22 (-0.41,-0.03)	0.0218

older practitioners in long established clinics, and this was only found to be significant in the unadjusted analyses.

Oral examination was the only non-muscoskeletal examination variable consistently showing significant association with these three demographic variables. Older chiropractors performed oral examination slightly more (unadjusted only), and likewise for those longer in practice, whereas recent graduates said that they used this significantly less. The unadjusted analyses also showed older practitioners with more experience to take the blood pressure and pulse less frequently, whereas recent graduates were much more likely to do so. However, significant associations were lost in the adjusted models. Heart examination showed a significant positive association with increasing age and longer duration of practice, and a negative association with more recent year of graduation, and these in the adjusted models only.

The age of the practitioner, duration of practice and year of graduation are very important in explaining the variation in almost all the musculoskeletal examination procedures but not to such an extent in relation to the non-musculoskeletal examinations.

4.8.3 THE TREATMENT TECHNIQUES (Table 4.8.3)

One might expect that the three demographic variables would influence the choice of treatment techniques used because of the strong ideological and philosophical differences that have always existed between groups of chiropractors. As described in the data section (2.4.4) HIO and Toggle Recoil were the techniques developed

Table 4.8.3 F-tests for the Relationship between AGE, DURATION OF PRACTICE, YEAR OF GRADUATION and Treatment Technique Variables.

VARIABLE	AGE UNADJUSTED ANALYSIS		[N=711] ADJUSTED ANALYSIS		DURATION OF PRACTICE UNADJUSTED ANALYSIS		[N=714] ADJUSTED ANALYSIS		YEAR OF GRADUATION UNADJUSTED ANALYSIS		[N=715] ADJUSTED ANALYSIS	
	ESTIMATED SLOPE (95% CI)	p-value	ESTIMATED SLOPE (95% CI)	p-value	ESTIMATED SLOPE (95% CI)	p-value	ESTIMATED SLOPE (95% CI)	p-value	ESTIMATED SLOPE (95% CI)	p-value	ESTIMATED SLOPE (95% CI)	p-value
1. DIVERSIFIED (N=648)	0.04 (-0.21,0.29)	0.7560	0.09 (-0.18,0.37)	0.5026	2.36×10^{-3} (-0.02,0.03)	0.8480	0.02 (-0.01,0.05)	0.1384	-0.08 (-0.36,0.20)	0.5846	-0.29 (-0.60,0.02)	0.0614
2. GONSTEAD (N=620)	-0.36 (-0.65,-0.06)	0.0184	-0.67 (-0.97,-0.36)	0.0000	-0.02 (-0.05,0.01)	0.1745	-0.06 (-0.09,-0.03)	0.0000	0.28 (-0.05,0.62)	0.0964	0.78 (0.44,1.12)	0.0000
3. HIO - HOLE-IN-ONE (N=624)	0.32 (0.14,0.49)	0.0005	0.29 (0.09,0.51)	0.0044	0.03 (0.01,0.05)	0.0008	0.03 (0.01,0.05)	0.0059	-0.33 (-0.53,-0.13)	0.0012	-0.29 (-0.53,-0.07)	0.0111
4. TOGGLE RECOIL (N=612)	0.04 (-0.16,0.25)	0.6886	0.32 (0.09,0.55)	0.0068	8.59×10^{-3} (-0.01,0.03)	0.3801	0.04 (0.02,0.06)	0.0003	-0.08 (-0.30,0.15)	0.4891	-0.45 (-0.70,-0.20)	0.0004
5. LOGAN (N=588)	-0.03 (-0.14,0.08)	0.6202	-0.05 (-0.18,0.07)	0.4204	5.96×10^{-4} (-0.01,0.01)	0.9094	-1.83×10^{-3} (-0.01,0.01)	0.7642	-6.79×10^{-3} (-0.13,0.11)	0.9118	0.03 (-0.11,0.16)	0.6802
6. SACRO-OCCIPITAL TECHNIQUE (N=608)	-0.21 (-0.41,0.001)	0.0517	-0.12 (-0.35,0.12)	0.3251	-0.02 (-0.04,0.001)	0.0642	-0.01 (-0.03,0.01)	0.3226	0.22 (-0.02,0.45)	0.0676	0.14 (-0.12,0.39)	0.3036
7. APPLIED KINESIOLOGY (N=625)	0.28 (0.07,0.49)	0.0101	0.21 (-0.03,0.46)	0.0913	0.02 (0.004,0.04)	0.0188	0.02 (-0.01,0.04)	0.1274	-0.31 (-0.54,-0.07)	0.0126	-0.22 (-0.49,0.05)	0.1143
8. NIMMO (N=633)	-0.37 (-0.61,-0.13)	0.0030	-0.09 (-0.37,0.18)	0.5025	-0.02 (-0.04,0.01)	0.1330	5.08×10^{-3} (-0.02,0.03)	0.6986	0.23 (-0.04,0.49)	0.0985	-0.06 (-0.37,0.25)	0.6986
9. ACTIVATOR (N=611)	-0.19 (-0.35,-0.04)	0.0151	-0.08 (-0.26,0.09)	0.3541	-0.02 (-0.04,-0.01)	0.0056	-9.55×10^{-3} (-0.03,0.01)	0.2492	0.25 (0.07,0.42)	0.0057	0.11 (-0.08,0.29)	0.2757
10. PETTIBON (N=593)	0.03 (-0.04,0.09)	0.4427	-0.01 (-0.09,0.07)	0.7642	2.14×10^{-3} (-0.005,0.01)	0.5386	-3.16×10^{-3} (-0.01,0.005)	0.4204	-0.03 (-0.11,0.05)	0.5174	0.04 (-0.05,0.13)	0.3805
11. PIERCE-STILLWAGON (N=587)	-0.05 (-0.16,0.05)	0.3033	-0.19 (-0.31,-0.08)	0.0008	-5.87×10^{-3} (-0.02,0.004)	0.2442	-0.02 (-0.03,-0.01)	0.0011	0.06 (-0.05,0.18)	0.2955	0.21 (0.09,0.34)	0.0010
12. TOFTNESS (N=588)	-0.02 (-0.09,0.05)	0.5648	-0.05 (-0.13,0.03)	0.2306	-3.68×10^{-3} (-0.01,0.004)	0.3155	-6.82×10^{-3} (-0.01,0.001)	0.0936	0.04 (-0.05,0.12)	0.3843	0.08 (-0.01,0.18)	0.0802
13. BIOMECHANICAL PRINCIPLES (N=604)	0.04 (-0.24,0.32)	0.7709	0.06 (-0.27,0.38)	0.7402	4.66×10^{-3} (-0.02,0.03)	0.7270	3.76×10^{-3} (-0.03,0.03)	0.8065	-0.04 (-0.35,0.27)	0.7945	-0.03 (-0.39,0.32)	0.8625

and most used from the early days after the foundation of chiropractic in 1895. Therefore, it is not surprising that these two techniques show highly significant associations with age, duration of practice and year of graduation. Older chiropractors with more practice experience use HIO and Toggle Recoil (adjusted only) more than recent graduates (Table 4.8.3). Younger practitioners with less experience (adjusted only) and who graduated recently (adjusted only) said that they more frequently used Gonstead and Pierce-Stillwagon. The unadjusted analyses showed that Sacro-Occipital Technique, Nimmo and Activator were used more by younger, less experienced, and Applied Kinesiology more frequently by older, practitioners.

The age, duration of practice and year of graduation are helpful in explaining several of the treatment technique variables. Similar results have been reported in studies from other continents.

4.8.4 THE MISCELLANEOUS PRACTICE MANAGEMENT VARIABLES (Table 4.8.4)

There is no doubt that chiropractors' opinions and ways of practising change with an increasing number of years in private practice. It has not previously been established how or which factors might be associated with such changes. The analyses show that age and duration of practice are strongly positively associated with only using manipulation as the treatment modality on the patient's first visit, although age only unadjusted. On this visit recent graduates are more likely to use more than just manipulation, such as for example massage. The older practitioners were more likely to spend less time with the patient on the first visit (only

Table 4.8.4 F-tests for the Relationship between AGE, DURATION OF PRACTICE, YEAR OF GRADUATION and Miscellaneous Practice Management Variables.

VARIABLE	AGE UNADJUSTED ANALYSIS		[N=711] ADJUSTED ANALYSIS		DURATION OF PRACTICE UNADJUSTED ANALYSIS		[N=714] ADJUSTED ANALYSIS		YEAR OF GRADUATION UNADJUSTED ANALYSIS		[N=715] ADJUSTED ANALYSIS	
	ESTIMATED SLOPE (95% CI)	p-value	ESTIMATED SLOPE (95% CI)	p-value	ESTIMATED SLOPE (95% CI)	p-value	ESTIMATED SLOPE (95% CI)	p-value	ESTIMATED SLOPE (95% CI)	p-value	ESTIMATED SLOPE (95% CI)	p-value
1. PERFORM HOME VISITS (N = 673)	0.01 (-0.05,0.07)	0.6892	4.58×10^{3} (-0.06,0.07)	0.8876	1.40×10^{4} (0.005,0.006)	0.9598	2.33×10^{4} (-0.01,0.01)	0.9203	5.72×10^{5} (-0.06,0.06)	0.9986	-3.23×10^{4} (-0.08,0.07)	0.9913
2. TREAT BY MANIPULATION ONLY ON FIRST VISIT (N = 662)	0.69 (0.43,0.96)	0.0000	0.19 (-0.12,0.49)	0.2241	0.08 (0.05,0.10)	0.0000	0.03 (0.003,0.06)	0.0289	-0.89 (-1.19,-0.60)	0.0000	-0.35 (-0.68,-0.01)	0.0438
3. GIVE EMOTIONAL/SOCIAL COUNSELLING (N = 672)	-0.02 (-0.13,0.09)	0.7070	-0.09 (-0.22,0.02)	0.1114	-1.15×10^{3} (-0.01,0.01)	0.8235	-3.74×10^{3} (-0.02,0.01)	0.5222	-7.20×10^{3} (-0.13,0.11)	0.9050	0.03 (-0.11,0.16)	0.7185
4. RATE AGREEMENT TO PRESCRIBE DRUGS (N = 668)	-0.15 (-0.44,0.13)	0.2949	-0.20 (-0.53,0.12)	0.2226	-0.01 (-0.04,0.02)	0.4301	-5.04×10^{3} (-0.04,0.03)	0.7519	0.11 (-0.21,0.43)	0.4923	0.03 (-0.34,0.39)	0.8876
5. TIME SPENT WITH PATIENT - FIRST VISIT (N = 669)	-0.20 (-0.29,-0.11)	0.0000	-0.10 (-0.21,0.01)	0.0633	-0.03 (-0.04,-0.02)	0.0000	-0.02 (-0.03,-0.01)	0.0005	0.31 (0.21,0.37)	0.0000	0.21 (0.08,0.33)	0.0008
6. TIME SPENT WITH PATIENT - SUBSEQUENT VISITS (N = 669)	-0.03 (-0.07,0.01)	0.1730	0.03 (-0.02,0.07)	0.2211	-8.61×10^{3} (-0.01,-0.005)	0.0000	-1.53×10^{3} (-0.01,0.002)	0.4276	0.09 (0.05,0.14)	0.0000	0.02 (-0.03,0.06)	0.4886

unadjusted significant) and a significant negative association was also found between this observation and practice experience. Alternatively, recent graduates spent significantly more time with the patient, as has also been reported in other studies. On the patient's subsequent visits the age of the practitioner was not important. However, the unadjusted analyses for duration of practice and year of graduation showed that the more experience the chiropractor had, the less time was spent with the patient, and that recent graduates also spent significantly more time on this visit.

Thus, the experience of the chiropractor and year of graduation are useful in describing some of the management variables related to direct patient contact, especially the time spent with patients. Knowledge of age on its own is of little use.

4.9 THE ADJUSTED R^2 (Tables 4.9.1 - 4.9.4)

The R^2 gives a quantitative measure of how well the fitted models containing the demographic variables predict the dependent variables. The adjusted R^2 takes account of the number of explanatory variables in the model. Tables 4.9.1 - 4.9.4 show that the values for R^2 and the adjusted R^2 in the full model of the 4 types of usage variables are quite low. Adjusted R^2s may be lower when controlling for unnecessary demographic variables. The highest values are obtained for getting x-rays from a private clinic, patients bringing the films, Gonstead technique and time spent on subsequent visits.

Table 4.9.1 Adjusted R^2 for the Full Model - X-ray Procedure Variables.

VARIABLE	R^2	ADJUSTED R^2
1. TAKE SKELETAL X-RAYS (N=513)	0.17900	0.15252
2. TAKE TISSUE X-RAYS (N=513)	0.03515	0.00402
3. ASK ABOUT MENSTRUAL CYCLE (N=506)	0.07937	0.04925
4. GET ORAL CONSENT (N=499)	0.09590	0.06589
5. GET WRITTEN CONSENT (N=484)	0.14766	0.11845
6. GET X-RAYS FROM ANOTHER CHIROPRACTOR (N=617)	0.05843	0.03332
7. GET X-RAYS FROM HOSPITAL VIA GP (N=605)	0.14073	0.11735
8. GET X-RAYS DIRECTLY FROM HOSPITAL (N=614)	0.02440	0.00160
9. GET X-RAYS FROM A PRIVATE RADIOLOGICAL CLINIC (N=609)	0.20752	0.18610
10. THE PATIENT BRINGS THE X-RAYS (N=614)	0.30837	0.28983

Table 4.9.2 Adjusted R^2 for the Full Model - Examination Procedure Variables.

VARIABLE	R^2	ADJUSTED R^2
1. POSTURAL ANALYSIS (N=662)	0.05306	0.02957
2. STATIC PALPATION (N=669)	0.02764	0.00378
3. DYNAMIC PALPATION (N=666)	0.19593	0.17611
4. ORTHOPAEDIC TESTS - LUMBAR SPINE (N=671)	0.12867	0.10735
5. ORTHOPAEDIC TESTS - CERVICAL SPINE (N=670)	0.12317	0.10169
6. NEUROLOGICAL TESTS - REFLEXES (N=669)	0.18365	0.16362
7. NEUROLOGICAL TESTS - SENSATION (N=670)	0.09655	0.07442
8. NEUROLOGICAL TESTS - MUSCLE TESTING (N=670)	0.10389	0.08193
9. TAKE PULSE (N=666)	0.06933	0.04639
10. TAKE BLOOD PRESSURE (N=671)	0.06251	0.03958
11. CHECK RESPIRATION (N=664)	0.05346	0.03006
12. TAKE TEMPERATURE (N=665)	0.02897	0.00500
13. EXAMINE ABDOMEN (N=666)	0.09107	0.06867
14. EXAMINE HEART (N=665)	0.07847	0.05572
15. EXAMINE LUNGS (N=667)	0.05716	0.03395
16. MOUTH EXAMINATION (N=668)	0.08458	0.06208

Table 4.9.3 Adjusted R^2 for the Full Model - Treatment Technique Variables.

VARIABLE	R^2	ADJUSTED R^2
1. DIVERSIFIED (N=648)	0.15620	0.13481
2. GONSTEAD (N=620)	0.26161	0.24202
3. HIO - HOLE-IN-ONE (N=624)	0.06667	0.04207
4. TOGGLE RECOIL (N=612)	0.10358	0.07948
5. LOGAN (N=588)	0.06416	0.03794
6. SACRO-OCCIPITAL TECHNIQUE (N=608)	0.11700	0.09309
7. APPLIED KINESIOLOGY (N=625)	0.08060	0.05641
8. NIMMO (N=633)	0.07739	0.05342
9. ACTIVATOR (N=611)	0.12295	0.09932
10. PETTIBON (N=593)	0.04841	0.02197
11. PIERCE-STILLWAGON (N=587)	0.15831	0.13468
12. TOFTNESS (N=588)	0.07941	0.05362
13. BIOMECHANICAL PRINCIPLES (N=604)	0.03133	0.00492

Table 4.9.4 Adjusted R^2 for the Full Model - Miscellaneous Practice Management Variables.

VARIABLES	R^2	ADJUSTED R^2
1. PERFORM HOME VISITS (N=673)	0.01331	-0.01076
2. TREAT BY MANIPULATION ONLY ON FIRST VISIT (N=662)	0.11810	0.09622
3. GIVE EMOTIONAL/SOCIAL COUNSELLING (N=672)	0.07709	0.05455
4. RATE AGREEMENT TO PRESCRIBE DRUGS (N=668)	0.06355	0.04054
5. TIME SPENT WITH PATIENT - FIRST VISIT (N=669)	0.10326	0.08125
6. TIME SPENT WITH PATIENT - SUBSEQUENT VISITS (N=669)	0.28547	0.26794

4.10 DIAGNOSTIC TESTS - THE LOG-TRANSFORMATION

The skewness of each dependent variable was calculated for the whole group and many of these revealed that the distributions were skewed (Tables 2.4.2 - 2.4.5). This may not be a problem in multiple regression analysis, because it could reflect the distribution across the independent x variables rather than lack of normality of the error term ε. Nevertheless, the possibility that a log-transformation might improve the models was investigated by transforming the selected highly and moderately skewed variables in adjusted models only (Appendix 6). The transformation followed this approach:

Positively skewed data -> Take log

Negatively skewed data -> Compute dependent variable (*) = 100 - dependent variable

-> Take log of (*)

The direction (+ or -) for the parameter estimates should be the same for positively skewed data after log-transformation. The direction should be reversed for negatively skewed data. The adjusted F-tests were calculated as previously described and the corresponding p-values before and after log-transformation were computed in MINITAB. Tables 4.10.1 - 4.10.4 show that the majority of p-values that were significant at the 5% level before remained so after the log-transformation. However, in a number of cases the parameter estimates neither remained nor changed direction or magnitude when expected to. It may be due to effects from other levels of the same categorical variable or the influence of other variables when using the full model.

Table 4.10.1 X-ray Variables - p-values for F-tests before and after Log-transformation.

		GET ORAL CONSENT N=499	GET X-RAYS FROM HOSPITAL VIA GP N=605	TAKE TISSUE X-RAYS N=513	ASK ABOUT MENSTRUAL CYCLE N=506
VARIABLE	CATEGORY	P-VALUES PRELOG/POSTLOG	P-VALUES PRELOG/POSTLOG	P-VALUES PRELOG/POSTLOG	P-VALUES PRELOG/POSTLOG
SEX	MALE FEMALE	0.1130/0.8066	0.6715/0.3627	0.0604/0.8232	0.8231/0.5326
COUNTRY	SCANDINAVIA CONTINENT UK/IRELAND	0.0037/0.0025	0.0000/0.0000	0.2451/0.0927	0.0034/0.0155
EMPLOYMENT STATUS	SINGLE PARTNER GROUP EMPLOYED	0.1389/0.6023	0.8398/0.7103	0.2638/0.1238	0.8613/0.6088
COLLEGE OF GRADUATION	EUROPEAN AMERICAN CANADIAN AUSTRALIAN	0.0370/0.0149	0.5895/0.8254	0.6551/0.6284	0.4723/0.0062
ACADEMIC DEGREE	YES NO	0.6715/0.3302	0.6469/0.8876	0.3202/0.1890	0.6802/0.3276
PRACTICE ADDRESS	METROPOLITAN URBAN SEMI-URBAN RURAL	0.6686/0.8684	0.8181/0.7316	0.8684/0.7387	0.0257/0.1354
AGE	(YEARS)	0.1632/0.1590	0.0191/0.1333	0.2023/0.2390	0.6802/0.4506
DURATION OF PRACTICE	(MONTHS)	0.2699/0.1414	0.0129/0.0960	0.3775/0.3776	0.6172/0.5026
YEAR OF GRADUATION	(YEAR)	0.2441/0.1276	0.0053/0.0677	0.3627/0.4205	0.5779/0.5172

Table 4.10.2 Examination Variables - p-values for F-tests before and after Log-transformation.

		STATIC PALPATION N=669	DYNAMIC PALPATION N=666	TAKE TEMPERATURE N=665	MOUTH EXAMINATION N=668
VARIABLE	CATEGORY	P-VALUES PRELOG/POSTLOG	P-VALUES PRELOG/POSTLOG	P-VALUES PRELOG/POSTLOG	P-VALUES PRELOG/POSTLOG
SEX	MALE FEMALE	0.4585/0.6317	0.0074/0.0059	0.8231/0.1195	0.3326/0.4133
COUNTRY	SCANDINAVIA CONTINENT UK/IRELAND	0.3204/0.0453	0.0000/0.0000	0.1781/0.0897	0.0001/0.0020
EMPLOYMENT STATUS	SINGLE PARTNER GROUP EMPLOYED	0.9032/0.6963	0.5343/0.5111	0.5168/0.5584	0.9296/0.8542
COLLEGE OF GRADUATION	EUROPEAN AMERICAN CANADIAN AUSTRALIAN	0.5894/0.6349	0.0203/0.1043	0.1678/0.2571	0.2328/0.4408
ACADEMIC DEGREE	YES NO	0.3300/0.5969	0.3485/0.3744	0.1888/0.2457	0.0656/0.1299
PRACTICE ADDRESS	METROPOLITAN URBAN SEMI-URBAN RURAL	0.1016/0.1700	0.5768/0.7603	0.9166/0.7531	0.0086/0.1657
AGE	(YEARS)	0.4426/0.5026	0.0000/0.0002	0.2439/0.1588	0.0684/0.4505
DURATION OF PRACTICE	(MONTHS)	0.8625/0.8066	0.0000/0.0002	0.1172/0.1299	0.0262/0.1902
YEAR OF GRADUATION	(YEAR)	0.9563/0.9204	0.0000/0.0004	0.0863/0.0984	0.0218/0.1994

Table 4.10.3 Treatment Technique Variables - p-values for F-tests before and after Log-transformation.

		TOFTNESS N=588	PETTIBON N=593	HIO-TOGGLE N=624	DIVERSIFIED N=648
VARIABLE	CATEGORY	P-VALUES PRELOG/POSTLOG	P-VALUES PRELOG/POSTLOG	P-VALUES PRELOG/POSTLOG	P-VALUES PRELOG/POSTLOG
SEX	MALE FEMALE	0.0153/0.0302	0.0363/0.0875	0.0283/0.0051	0.2289/0.2196
COUNTRY	SCANDINAVIA CONTINENT UK/IRELAND	0.0000/0.0019	0.6007/0.0729	0.0158/0.1362	0.0000/0.0207
EMPLOYMENT STATUS	SINGLE PARTNER GROUP EMPLOYED	0.2943/0.4161	0.4886/0.5523	0.0762/0.2329	0.3698/0.6218
COLLEGE OF GRADUATION	EUROPEAN AMERICAN CANADIAN AUSTRALIAN	0.6550/0.3743	0.0239/0.0652	0.7458/0.4209	0.0000/0.0000
ACADEMIC DEGREE	YES NO	0.4427/0.9749	0.8875/0.9204	0.6243/0.8626	0.0723/0.0843
PRACTICE ADDRESS	METROPOLITAN URBAN SEMI-URBAN RURAL	0.7964/0.7819	0.9807/0.8613	0.2540/0.6755	0.3742/0.0814
AGE	(YEARS)	0.2306/0.1981	0.7642/0.2718	0.0044/0.3106	0.5026/0.3685
DURATION OF PRACTICE	(MONTHS)	0.0936/0.0793	0.4204/0.1527	0.0059/0.3965	0.1384/0.0869
YEAR OF GRADUATION	(YEAR)	0.0802/0.0760	0.3805/0.1404	0.0111/0.4349	0.0614/0.0361

Table 4.10.4 Miscellaneous Practice Management Variables - p-values for F-tests before and after Log-transformation.

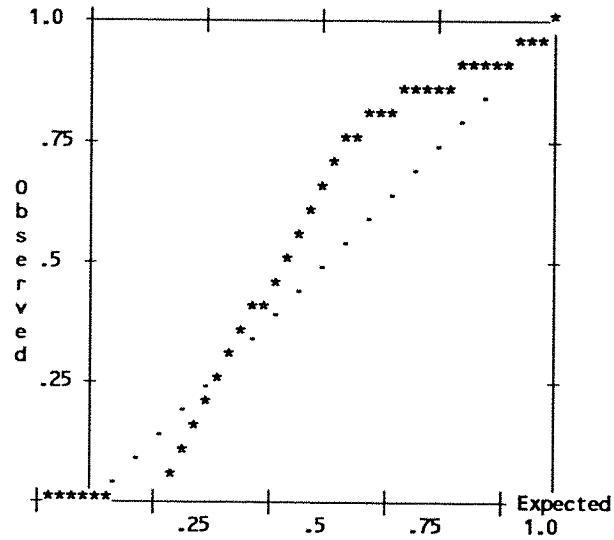
		SOCIAL/EMOTIONAL COUNSELLING N=672	PERFORM HOMEVISITS N=673	TIME SPENT ON SUBSEQUENT VISITS N=669
VARIABLE	CATEGORY	P-VALUES PRELOG/POSTLOG	P-VALUES PRELOG/POSTLOG	P-VALUES PRELOG/POSTLOG
SEX	MALE FEMALE	0.8876/0.5222	0.7291/0.5969	0.0000/0.0000
COUNTRY	SCANDINAVIA CONTINENT UK/IRELAND	0.0010/0.0035	0.3720/0.0728	0.0000/0.0000
EMPLOYMENT STATUS	SINGLE PARTNER GROUP EMPLOYED	0.6086/0.5284	0.9360/0.7459	0.0012/0.0042
COLLEGE OF GRADUATION	EUROPEAN AMERICAN CANADIAN AUSTRALIAN	0.0824/0.1595	0.5831/0.5523	0.0000/0.0000
ACADEMIC DEGREE	YES NO	0.0019/0.0817	0.3868/0.7292	0.0763/0.2602
PRACTICE ADDRESS	METROPOLITAN URBAN SEMI-URBAN RURAL	0.5583/0.4017	0.7891/0.6755	0.0200/0.0732
AGE	(YEARS)	0.1114/0.0971	0.8876/0.9203	0.2211/0.7914
DURATION OF PRACTICE	(MONTHS)	0.5222/0.4351	0.9203/0.6987	0.4276/0.2258
YEAR OF GRADUATION	(YEAR)	0.7185/0.5326	0.9913/0.7292	0.4886/0.2546

The P-P plots for the residuals were only produced for the full model due to the many variables in the study. The plots showed little change and in some cases an improvement of the model (Figures 4.10.1 - 4.10.4). For practical purposes the full models were considered reasonably robust.

Figure 4.10.1 Normal Probability Plots of Residuals before and after Log-transformation of the X-ray Variable "Get x-rays from hospital via GP".

Before log-transformation:

Normal Probability (P-P) Plot - Standardised Residual



After log-transformation:

Normal Probability (P-P) Plot - Standardised Residual

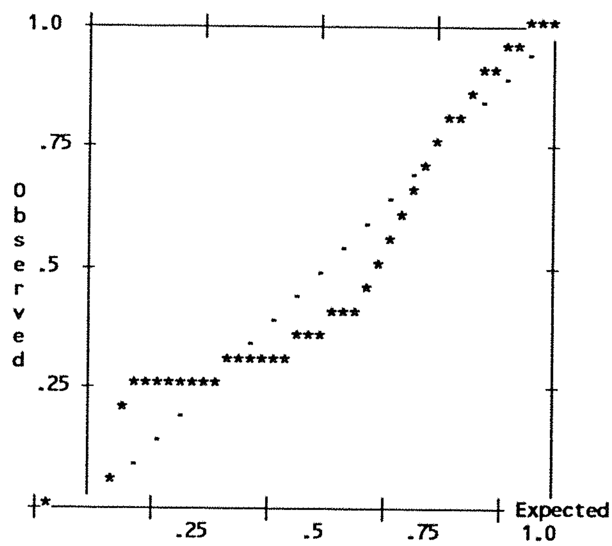
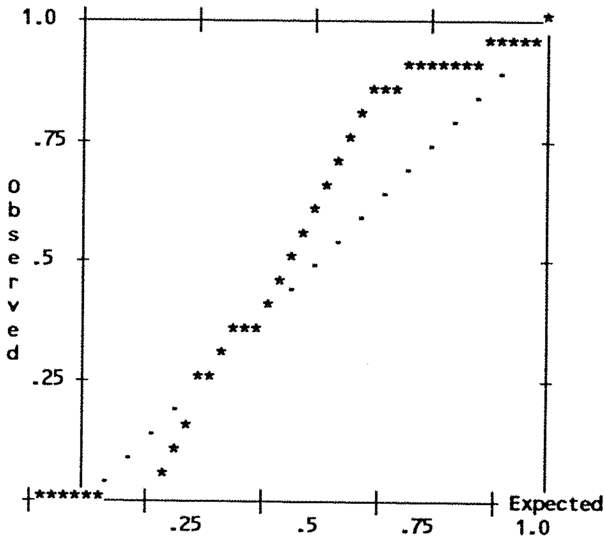


Figure 4.10.2 Normal Probability Plots of Residuals before and after Log-transformation of the Examination Variable "Take temperature".

Before log-transformation:

Normal Probability (P-P) Plot - Standardised Residual



After log-transformation:

Normal Probability (P-P) Plot - Standardised Residual

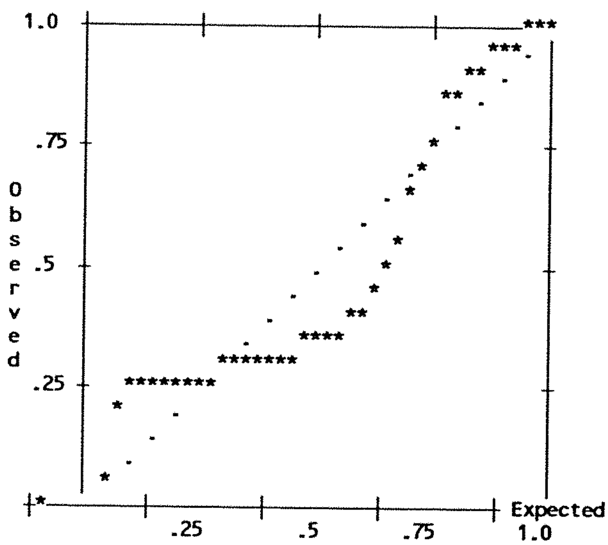
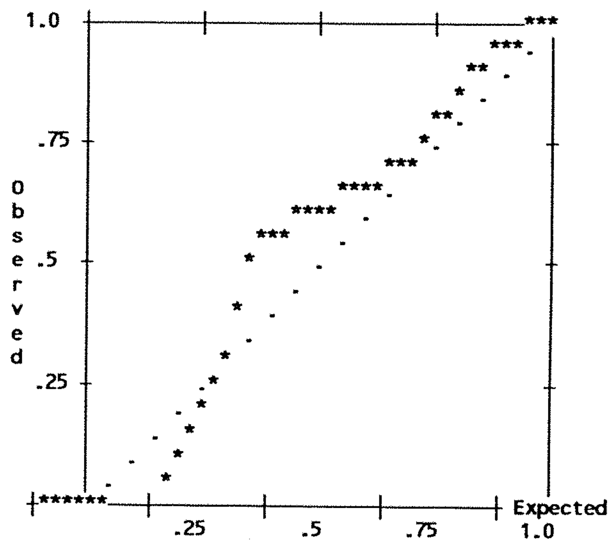


Figure 4.10.3 Normal Probability Plots of Residuals before and after Log-transformation of the Treatment Technique Variable "Pettibon".

Before log-transformation:

Normal Probability (P-P) Plot - Standardised Residual



After log-transformation:

Normal Probability (P-P) Plot - Standardised Residual

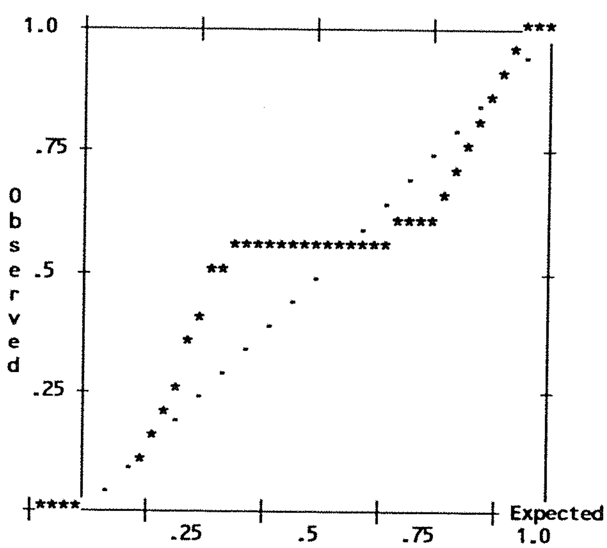
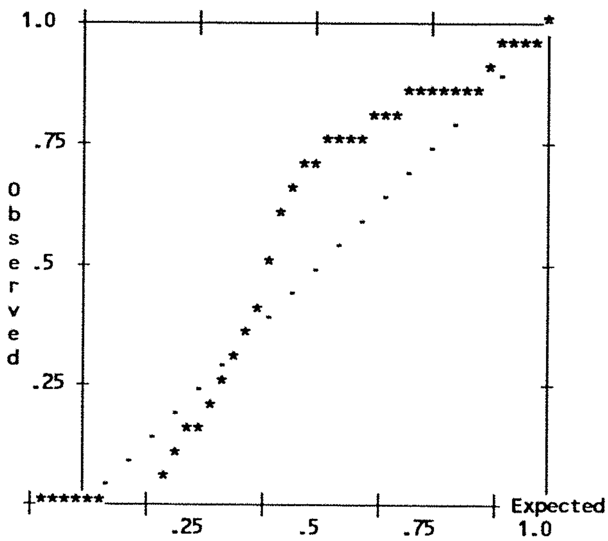


Figure 4.10.4 Normal Probability Plots of Residuals before and after Log-transformation of the Miscellaneous Practice Management Variable "Perform home visits".

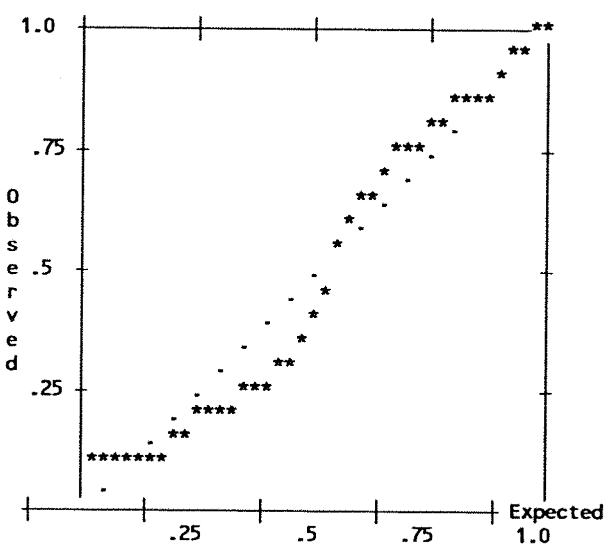
Before log-transformation:

Normal Probability (P-P) Plot - Standardised Residual



After log-transformation:

Normal Probability (P-P) Plot - Standardised Residual



CHAPTER 5

RESULTS - CLUSTER ANALYSIS

5.1 INTRODUCTION

The objective of this part of the study was to be able to describe the chiropractors in terms of all the usage variables simultaneously using a multivariate approach. This was done with each of the four groups of variables separately. It was felt that interpretation of the clusters would be easier than if all variables were combined in a single analysis.

Several approaches were applied to see whether the resulting clusters varied greatly with the initial clustering method. The same approaches were applied to all four groups of usage variables. All the analyses reported here used iterative relocation and hierarchical fusion to optimise coefficients, 1, 24, 29 & 30 in programme RELOCATE in CLUSTAN.

This chapter presents the results from the cluster analyses. In section 5.6 the resultant clusters for each of the four groups of usage variables are cross-classified with demographic variables.

5.2 THE X-RAY PROCEDURES

Some countries do not permit the use of x-rays hence, there are fewer cases available for these analyses than for the other usage variables. Starting from 20 random clusters of the whole sample cases were reallocated on the basis of the x-ray variables using programme RELOCATE. Tables 5.2.1 and 5.2.2 show the cluster sizes for 6 or fewer clusters with the 4 coefficients used in the study

Table 5.2.1 **Frequency of Clusters - X-ray Variables**

Coefficient 1 = Squared Euclidean Distance (SEUCLID)
Coefficient 24 = Euclidean sum of squares
Coefficient 29 = Size difference
Coefficient 30 = Shape difference

Start randon size 20, Maxit = 0, N = 434

CLUSTERS		COEFF 1	COEFF 24	COEFF 29	COEFF 30
1	1	434	434	434	434
2	1	412	412	412	390
	2	22	22	22	44
3	1	390	152	217	369
	2	22	260	195	44
	3	22	22	22	21
4	1	369	152	65	369
	2	22	174	152	22
	3	22	22	195	22
	4	21	86	22	21
5	1	326	152	65	347
	2	22	130	152	22
	3	22	44	109	22
	4	43	22	86	22
	5	21	86	22	21
6	1	304	152	65	325
	2	22	87	43	22
	3	22	44	109	22
	4	43	22	109	22
	5	22	43	86	22
	6	21	86	22	21

Table 5.2.2 **Frequency of Clusters - X-ray Variables**

Coefficient 1 = Squared Euclidean Distance (SEUCLID)
Coefficient 24 = Euclidean sum of squares
Coefficient 29 = Size difference
Coefficient 30 = Shape difference

Start random size 20, Maxit = 10, N = 434

CLUSTERS		COEFF 1	COEFF 24	COEFF 29	COEFF 30
1	1	434	434	434	434
2	1	428	428	407	428
	2	6	6	27	6
3	1	425	93	229	425
	2	6	335	13	6
	3	3	6	192	3
4	1	404	87	229	419
	2	6	63	5	6
	3	3	278	34	3
	4	21	6	166	6
5	1	360	75	204	321
	2	6	49	5	6
	3	44	250	113	98
	4	3	54	18	3
	5	21	6	94	6
6	1	337	52	209	353
	2	6	48	3	6
	3	39	244	21	14
	4	44	48	121	57
	5	3	6	4	3
	6	5	36	76	1

with MAXIT=0 & 10, respectively. Coefficients 24 and 29 can be seen to have produced 3 and 4 cluster solutions with sensible cluster size particularly in Table 5.2.1 with MAXIT=0. With MAXIT=0 coefficient 1 and 30 produced mainly clusters of size about 20 with one big cluster covering most of the population. With MAXIT=10 the results were worse for these coefficients since the small clusters generally contained less than 10 cases. For these reasons we focus only on results for coefficients 24 and 29. Tables 5.2.3 and 5.2.4 give the minimum distances between any two of the clusters produced using MAXIT 0 and 10, respectively, for coefficients 24 and 29 with 20 down to 2 clusters. With MAXIT=0 (Table 5.2.3) both coefficients display an initial gradual increase in these distances. For coefficient 29 one might say that a sharp increase occurred at 4 clusters, but perhaps for coefficient 24 it is more noticeable at 2 clusters. With MAXIT=10 (Table 5.2.4) there was a sharp increase at 2 and 3 clusters for coefficient 24, but coefficient 29 only shows an increase at 2 clusters.

The cluster means for several solutions are presented in Appendix 7. Table 5.2.5 shows the one selected which gave the most interpretable clusters, it is the 3 cluster solution obtained using coefficient 29 and MAXIT=10. The distances in tables 5.2.3 and 5.2.4 indicate that the 2 cluster solution is better, but this was difficult to interpret and one cluster had only 27 cases, which was not considered a useful proportional distribution. Unfortunately the reallocations in the chosen 3 cluster solution lead to one group being quite small in size, so essentially it is a two cluster solution. Although a number of interesting clusters emerged from

Table 5.2.3 Minimum distance between clusters with coefficients 24 and 29 (Maxit=0) for chiropractors using x-ray procedures.

Maxit = 0 No. of clusters	Coeff. 24 (Distance)	Coeff. 29 (Distance)
20	0.289	0.000
19	0.289	0.000
18	0.327	0.000
17	0.549	0.000
16	0.673	0.000
15	0.683	0.000
14	0.781	0.000
13	0.859	0.000
12	0.946	0.000
11	1.202	0.000
10	1.216	0.000
9	1.347	0.001
8	1.442	0.001
7	1.937	0.001
6	2.378	0.003
5	3.134	0.003
4	4.641	0.010
3	5.961	0.017
2	9.515	0.084

Table 5.2.4 Minimum distance between clusters with coefficients 24 and 29 (Maxit=10) for chiropractors using x-ray procedures.

Maxit = 10	No. of clusters	Coeff. 24 (Distance)	Coeff. 29 (Distance)
	20	5.566	0.000
	19	7.053	0.001
	18	8.965	0.003
	17	9.981	0.004
	16	9.975	0.006
	15	11.068	0.008
	14	13.011	0.012
	13	13.743	0.016
	12	18.405	0.020
	11	20.880	0.027
	10	22.813	0.036
	9	34.519	0.030
	8	43.347	0.055
	7	51.907	0.064
	6	54.944	0.115
	5	63.028	0.119
	4	69.433	0.181
	3	91.072	0.222
	2	125.585	1.454

other analyses, and those with MAXIT=0 were of more equal size, this solution was chosen because the resultant groups were more distinct and easily interpretable.

Chiropractors in cluster 1 (Table 5.2.5) reported very low uses of all outside x-ray facilities, but they often took skeletal x-rays themselves, they asked about the menstrual cycle and obtained oral consent. This is typical of practitioners with x-ray facilities within the clinic. In contrast, the chiropractors in cluster 2 said that they used outside facilities much more, but were also taking or ordering skeletal and soft tissue x-rays, and obtaining both written and oral consent much more frequently. This pattern of using outside facilities is common in countries where there are legal constraints on the use of x-rays. Why they also obtain more films and, in particular, a greater degree of consent is not entirely clear because, the latter would normally be the responsibility of the person actually taking the x-rays. However, there are only 13 chiropractors in this group. Practitioners in cluster 3 are less distinct but obtain films and consent to a great extent and make little use of outside facilities, probably because they are able to obtain films within the clinic.

Table 5.2.5 Three Clusters Generated for X-ray Variables.

Values are means within clusters (s.d.).
Coefficient 29, Maxit = 10, Start random size 20,
Standardisation & Relocation: Yes, N = 434.

VARIABLE	3 CLUSTERS		
	1	2	3
1. TAKE SKELETAL X-RAYS	**71.70** (25.20)	**75.62** (22.71)	**74.36** (20.59)
2. TAKE TISSUE X-RAYS	**5.97** (4.54)	**25.85** (25.39)	**10.96** (8.97)
3. ASK ABOUT MENSTRUAL CYCLE	**83.50** (28.91)	**89.62** (18.02)	**91.19** (16.44)
4. GET ORAL CONSENT	**74.32** (36.87)	**84.08** (25.15)	**88.50** (20.76)
5. GET WRITTEN CONSENT	**6.93** (14.80)	**39.15** (41.82)	**25.62** (33.93)
6. GET X-RAYS FROM ANOTHER CHIROPRACTOR	**10.32** (12.49)	**57.69** (39.84)	**21.80** (25.61)
7. GET X-RAYS FROM HOSPITAL VIA GP	**4.79** (5.46)	**49.31** (35.37)	**11.26** (9.91)
8. GET X-RAYS DIRECTLY FROM HOSPITAL	**7.73** (7.67)	**53.46** (35.13)	**15.32** (14.98)
9. GET X-RAYS FROM A PRIVATE RADIOLOGICAL CLINIC	**4.31** (4.65)	**50.00** (34.73)	**9.55** (8.65)
10. THE PATIENT BRINGS THE X-RAYS	**6.55** (7.44)	**35.54** (33.70)	**15.41** (16.22)
FREQUENCY (PER CENT)	**229** (52.76)	**13** (3.00)	**192** (44.24)

5.3 THE EXAMINATION PROCEDURES

The examination procedures comprised the largest group of variables (16) for the cluster analyses. Table 5.3.1 shows that coefficients 1, 24 and 29 gave usefully sized groups for 3 and 4 clusters when no reallocation was done. Coefficient 30 produced one big cluster while the remaining clusters had only 33 or 34 cases in them. The change in fusion distance between the clusters increased greatly for coefficient 24 when 4 clusters were merged to 3 (7.226) and again when 3 were merged to 2 (16.559) (Table 5.3.2). Analyses with MAXIT=10 also gave usefully sized 3 and 4 group solutions (Table 5.3.3) with a fairly good fusion distance between the clusters noticeably for coefficient 24 with 3 clusters (Table 5.3.4). The clusters are better in terms of size when using MAXIT=0 (Table 5.3.1) where the terminal fusion distance for coefficient 24 is doubled (Table 5.3.2). The cluster solution that was considered easiest to interpret, and which also gave acceptable fusion distances, were the 3 clusters obtained using coefficient 24 with MAXIT=10 (Table 5.3.5). The other cluster solutions are shown in Appendix 8 for comparison.

Table 5.3.1 **Frequency of Clusters - Examination Variables**

Coefficient 1 = Squared Euclidean Distance (SEUCLID)
Coefficient 24 = Euclidean sum of squares
Coefficient 29 = Size difference
Coefficient 30 = Shape difference

Start random size 20, Maxit = 0, N = 672

CLUSTERS		COEFF 1	COEFF 24	COEFF 29	COEFF 30
1	1	672	672	672	672
2	1	538	471	538	639
	2	134	201	134	33
3	1	371	337	438	605
	2	167	201	134	34
	3	134	134	100	33
4	1	371	136	371	571
	2	134	201	134	34
	3	134	201	67	34
	4	33	134	100	33
5	1	371	136	304	537
	2	101	68	134	34
	3	134	201	67	34
	4	33	133	67	34
	5	33	134	100	33
6	1	371	136	304	504
	2	68	68	68	34
	3	134	100	67	34
	4	33	133	67	34
	5	33	101	100	33
	6	33	134	66	33

Table 5.3.2 Minimum distance between clusters with coefficients 1, 24 & 29 (Maxit=0) for chiropractors using examination procedures.

Maxit = 0	No. of clusters	Coeff. 1 (Distance)	Coeff. 24 (Distance)	Coeff. 29 (Distance)
	20	0.011	0.359	0.000
	19	0.014	0.459	0.000
	18	0.015	0.526	0.000
	17	0.019	0.656	0.000
	16	0.019	0.681	0.000
	15	0.020	0.860	0.000
	14	0.021	0.950	0.000
	13	0.023	0.964	0.000
	12	0.020	0.980	0.000
	11	0.023	1.045	0.000
	10	0.022	1.064	0.000
	9	0.022	1.296	0.001
	8	0.022	1.604	0.002
	7	0.023	1.649	0.002
	6	0.026	1.745	0.004
	5	0.024	2.291	0.007
	4	0.039	2.698	0.012
	3	0.040	7.226	0.036
	2	0.069	16.559	0.059

Table 5.3.3 Frequency of Clusters - Examination Variables

Coefficient 1 = Squared Euclidean Distance (SEUCLID)
Coefficient 24 = Euclidean sum of squares
Coefficient 29 = Size difference
Coefficient 30 = Shape difference

Start random size 20, Maxit = 10, N = 672

CLUSTERS		COEFF 1	COEFF 24	COEFF 29	COEFF 30
1	1	672	672	672	672
2	1	487	483	367	493
	2	185	189	305	179
3	1	510	441	366	467
	2	119	74	83	161
	3	43	157	223	44
4	1	416	298	288	468
	2	147	46	50	136
	3	74	236	253	24
	4	35	92	81	44
5	1	405	275	210	391
	2	139	46	37	84
	3	27	222	121	21
	4	67	92	233	41
	5	34	37	71	135
6	1	373	176	208	356
	2	124	46	27	82
	3	47	188	56	140
	4	27	158	138	21
	5	67	67	191	41
	6	34	37	52	32

Table 5.3.4 Minimum distance between clusters with coefficients 24 and 29 (Maxit=10) for chiropractors using examination procedures.

Maxit =10	No. of clusters	Coeff. 24 (Distance)	Coeff. 29 (Distance)
	20	8.879	0.000
	19	11.290	0.002
	18	12.186	0.006
	17	13.804	0.006
	16	13.927	0.009
	15	18.440	0.014
	14	18.520	0.018
	13	19.293	0.029
	12	23.322	0.039
	11	26.916	0.051
	10	32.870	0.051
	9	36.582	0.060
	8	37.495	0.077
	7	40.788	0.088
	6	55.584	0.120
	5	57.589	0.158
	4	96.875	0.264
	3	182.354	0.430
	2	244.931	0.639

Table 5.3.5 Three Clusters Generated for Examination Variables.

Values are means within clusters (s.d.). Coefficient 24, Maxit = 10, Start random size 20, Standardisation & Relocation: Yes, N = 672.

VARIABLE	3 CLUSTERS		
	1	2	3
1. POSTURAL ANALYSIS	**73.28** (30.73)	**75.07** (30.45)	**62.36** (34.67)
2. STATIC PALPATION	**90.51** (17.54)	**90.03** (16.01)	**88.96** (17.52)
3. DYNAMIC PALPATION	**90.08** (16.55)	**89.77** (14.99)	**82.30** (24.63)
4. ORTHOPAEDIC TESTS - LUMBAR SPINE	**94.17** (7.36)	**93.12** (9.58)	**67.04** (27.01)
5. ORTHOPAEDIC TESTS - CERVICAL SPINE	**91.89** (10.75)	**90.78** (13.59)	**56.99** (28.85)
6. NEUROLOGICAL TESTS - REFLEXES	**88.03** (12.73)	**89.61** (12.45)	**49.01** (24.84)
7. NEUROLOGICAL TESTS - SENSATION	**69.92** (23.74)	**75.96** (25.26)	**30.99** (19.96)
8. NEUROLOGICAL TESTS - MUSCLE TESTING	**72.61** (22.78)	**80.38** (18.15)	**36.33** (24.72)
9. TAKE PULSE	**30.37** (23.88)	**76.27** (19.52)	**12.67** (11.97)
10. TAKE BLOOD PRESSURE	**41.46** (26.22)	**79.12** (18.30)	**20.11** (16.05)
11. CHECK RESPIRATION	**12.23** (11.96)	**40.32** (28.88)	**7.32** (5.67)
12. TAKE TEMPERATURE	**8.88** (9.37)	**25.38** (23.83)	**6.85** (6.08)
13. EXAMINE ABDOMEN	**19.30** (15.73)	**60.65** (25.61)	**10.74** (11.90)
14. EXAMINE HEART	**13.61** (10.83)	**53.77** (25.46)	**7.66** (6.79)
15. EXAMINE LUNGS	**13.16** (10.06)	**49.57** (26.09)	**9.04** (8.27)
16. MOUTH EXAMINATION	**10.31** (12.67)	**36.88** (31.21)	**9.04** (14.40)
FREQUENCY (PER CENT)	**441** (65.63)	**74** (11.01)	**157** (23.36)

The cluster means in Table 5.3.5 show that the first eight variables, the musculoskeletal examination procedures, were used more than any non-musculoskeletal examinations. Chiropractors in all three clusters reported high usage of postural analysis, static and dynamic palpation, whereas only those in clusters 1 and 2 state that they almost invariably use orthopaedic tests (lumbar and cervical) and neurological tests (reflexes, sensation and muscle testing). Chiropractors in group 3 used these procedures much less, and they also reported using all non-musculoskeletal examination procedures much less. The practitioners in cluster 2 differed from those in cluster 1 in that they said that they used all non-musculoskeletal examination procedures more frequently, potentially quite an important difference in the way they practised. In addition to high usage of all musculoskeletal examinations, they were much more likely to take the pulse and blood pressure, check respiration, take temperature, and examine the abdomen, heart, lungs and mouth, that is they examined very thoroughly. This was the cluster with the smallest frequency but it was still of a reasonable size of 74 (11%) to be useful. In summary, members of cluster 1 invariably use all musculoskeletal examinations, those in cluster 3 most frequently use postural analysis, static and dynamic palpation, and members of cluster 2 use all musculoskeletal examinations, examine the abdomen and take the pulse and blood pressure.

5.4 THE TREATMENT TECHNIQUES

The treatment technique variables generated useful group sizes for 3 and 4 clusters with MAXIT=0 and MAXIT=10 when using coefficients 24 and 29 (Tables 5.4.1 & 5.4.2). Coefficients 1 and

30 produced a number of clusters sized 26 or 27 (with MAXIT=0) or less than 10 (with MAXIT=10), which were not considered useful. With MAXIT=0 the fusion distances between clusters only showed an increase for coefficient 29 when 3 were merged to 2 clusters, whereas reductions were apparant merging from 4 to 3 and from 3 to 2 clusters for coefficient 24 (Table 5.4.3). When using MAXIT=10 only coefficients 24 and 29 had sufficient numbers in the clusters to be considered useful, and the fusion distance merging 3 to 2 clusters showed a sudden increase with both coefficients (Table 5.4.4). The means for the 2, 3 and 4 cluster solutions with coefficients 24 and 29 (MAXIT=0 and 10) were investigated. They showed that with the 2 cluster solution (Coefficient 24, MAXIT=0) less than half of the variables showed noticeable differences between the two groups but there was a considerable difference in the group sizes and the fusion distance was not that great. With MAXIT=10 the two groups were of equal size, the terminal fusion distance doubled and virtually all variables showed remarkable differences in the chiropractors' stated use of treatment techniques. The means for this cluster solution looked easier to interpret and hence, it was chosen for further analysis. The means for both 3 and 4 cluster solutions with coefficients 24 and 29 (MAXIT=0) did not show any easily interpreted differences between the groups. They are presented in Appendix 9 for comparison.

Table 5.4.1 **Frequency of Clusters - Treatment Technique Variables**

Coefficient 1 = Squared Euclidean Distance (SEUCLID)
Coefficient 24 = Euclidean sum of squares
Coefficient 29 = Size difference
Coefficient 30 = Shape difference

Start random size 20, Maxit = 0, N = 529

CLUSTERS		COEFF 1	COEFF 24	COEFF 29	COEFF 30
1	1	529	529	529	529
2	1	503	343	290	503
	2	26	186	239	26
3	1	476	160	290	477
	2	27	186	106	26
	3	26	183	133	26
4	1	449	160	263	424
	2	27	186	27	53
	3	27	79	106	26
	4	26	104	133	26
5	1	423	134	132	424
	2	27	186	27	27
	3	27	79	106	26
	4	26	104	131	26
	5	26	26	133	26
6	1	397	134	132	398
	2	27	105	27	27
	3	27	81	106	26
	4	26	79	131	26
	5	26	104	79	26
	6	26	26	54	26

Table 5.4.2 **Frequency of Clusters - Treatment Technique Variables**

Coefficient 1 = Squared Euclidean Distance (SEUCLID)
Coefficient 24 = Euclidean sum of squares
Coefficient 29 = Size difference
Coefficient 30 = Shape difference

Start random size 20, Maxit = 10, N = 529

CLUSTERS		COEFF 1	COEFF 24	COEFF 29	COEFF 30
1	1	529	529	529	529
2	1	528	243	528	526
	2	1	286	1	3
3	1	522	175	296	521
	2	6	134	1	5
	3	1	220	232	3
4	1	281	145	224	513
	2	243	111	214	5
	3	4	201	1	2
	4	1	72	90	9
5	1	267	153	178	411
	2	5	103	183	5
	3	4	195	122	102
	4	1	75	1	2
	5	252	3	45	9
6	1	254	147	156	268
	2	5	41	142	176
	3	4	96	73	5
	4	191	181	140	71
	5	1	61	1	2
	6	74	3	17	7

Table 5.4.3 Minimum distance between clusters with coefficients 24 and 29 (Maxit=0) for chiropractors using treatment techniques.

Maxit = 0	No. of clusters	Coeff. 24 (Distance)	Coeff. 29 (Distance)
	20	0.408	0.000
	19	0.562	0.000
	18	0.604	0.000
	17	0.669	0.000
	16	0.743	0.000
	15	0.794	0.000
	14	0.846	0.000
	13	1.118	0.000
	12	1.135	0.000
	11	1.169	0.000
	10	1.198	0.000
	9	1.221	0.000
	8	1.687	0.000
	7	1.955	0.001
	6	2.373	0.002
	5	2.497	0.002
	4	3.132	0.004
	3	4.203	0.004
	2	6.820	0.019

Table 5.4.4 Minimum distance between clusters with coefficient 24 and 29 (MAXIT=10) for chiropractors using treatment techniques.

Maxit = 10	No. of clusters	Coeff. 24 (Distance)	Coeff. 29 (Distance)
	20	10.726	0.000
	19	11.824	0.001
	18	13.192	0.001
	17	14.718	0.003
	16	16.139	0.004
	15	17.169	0.004
	14	19.314	0.008
	13	20.897	0.010
	12	24.058	0.014
	11	26.151	0.015
	10	27.604	0.027
	9	30.913	0.030
	8	32.671	0.044
	7	34.243	0.066
	6	44.164	0.102
	5	54.446	0.121
	4	57.749	0.234
	3	73.967	0.413
	2	145.204	20.943

Chiropractors in cluster 1 (Coefficient 24, MAXIT=10) reported a much higher usage of most techniques compared to those in group 2 (Table 5.4.5). Only Diversified was used slightly more by chiropractors in cluster 2, and Nimmo was used as frequently as cluster 1 members. It is noticeable that the less physically demanding techniques, such as Toggle Recoil, Logan, Sacro-Occipital Technique, Applied Kinesiology, Activator and Toftness, are used much more by practitioners in cluster 1. This would tend to be consistent with female chiropractors' choice. Additionally, graduates from Australian colleges, who tend to use many different techniques, would be expected in this group, although they are few

Table 5.4.5 Two Clusters Generated for Treatment Technique Variables.

Values are means within clusters (s.d.). Coefficient 24, Maxit = 10, Start random size 20, Standardisation & Relocation: Yes, N = 529.

VARIABLE	2 CLUSTERS	
	1	2
1. DIVERSIFIED	**63.09** (30.99)	**70.27** (30.16)
2. GONSTEAD	**41.52** (31.21)	**32.13** (33.90)
3. HIO - HOLE-IN-ONE	**23.92** (23.35)	**9.07** (12.76)
4. TOGGLE RECOIL	**27.58** (24.51)	**16.73** (18.95)
5. LOGAN	**14.73** (13.16)	**2.97** (5.02)
6. SACRO-OCCIPITAL TECHNIQUE	**25.42** (24.72)	**9.86** (17.89)
7. APPLIED KINESIOLOGY	**26.81** (26.44)	**8.98** (14.78)
8. NIMMO	**42.79** (26.27)	**42.33** (28.62)
9. ACTIVATOR	**20.57** (19.31)	**7.30** (12.00)
10. PETTIBON	**10.84** (10.59)	**1.16** (3.05)
11. PIERCE-STILLWAGON	**12.18** (12.30)	**1.55** (3.59)
12. TOFTNESS	**10.37** (10.80)	**0.97** (2.41)
13. BIOMECHANICAL PRINCIPLES	**43.66** (27.87)	**34.38** (31.12)
FREQUENCY (PER CENT)	**243** (45.94)	**286** (54.06)

in numbers.

5.5 THE MISCELLANEOUS PRACTICE MANAGEMENT VARIABLES

These variables were more difficult to characterise than the other groups. Nevertheless, they are important factors in describing the chiropractors. When using MAXIT=0 and MAXIT=10 almost all usefully sized cluster solutions produced one minor group ranging from approximately 25 to 70 cases (Tables 5.5.1 & 5.5.2) the exception being the coefficient 29 solutions with MAXIT=0. Initially 3 and 4 clusters coefficient 24 and 29 looked most useful using MAXIT=0 based on group sizes. Table 5.5.3 (MAXIT=0) only shows little change in the fusion distances for coefficient 29 for 3 clusters merging to 2 and with coefficient 24 a noticeable increase is again only found for 3 merging to 2. With MAXIT=10 gradual and increasing fusion distances are shown for 4 clusters merging to 3 and this is doubled when merging from 3 to 2 with coefficient 29 (Table 5.5.4). This change, although not doubled, is also noticeable for similar cluster solutions with coefficient 24 (MAXIT=10) and, because of its easier interpretation, the group sizes and the terminal fusion distances, this 2 cluster solution was chosen for cross-classification with the demographic variables.

Table 5.5.1 **Frequency of Clusters - Miscellaneous Practice Management Variables**

Coefficient 1 = Squared Euclidean Distance (SEUCLID)
Coefficient 24 = Euclidean sum of squares
Coefficient 29 = Size difference
Coefficient 30 = Shape difference

Start random size 20, Maxit = 0, N = 689

CLUSTERS		COEFF 1	COEFF 24	COEFF 29	COEFF 30
1	1	689	689	689	689
2	1	654	413	345	654
	2	35	276	344	35
3	1	585	413	345	482
	2	35	207	240	172
	3	69	69	104	35
4	1	413	103	104	448
	2	35	310	240	172
	3	172	207	104	35
	4	69	69	241	34
5	1	413	103	104	172
	2	35	310	240	276
	3	35	70	69	172
	4	69	69	241	35
	5	137	137	35	34
6	1	103	103	104	172
	2	310	172	137	276
	3	35	70	69	70
	4	35	138	103	35
	5	69	69	241	102
	6	137	137	35	34

Table 5.5.2 Frequency of Clusters - Miscellaneous Practice Management Variables

Coefficient 1 = Squared Euclidean Distance (SEUCLID)
Coefficient 24 = Euclidean sum of squares
Coefficient 29 = Size difference
Coefficient 30 = Shape difference

Start random size 20, Maxit = 10, N = 689

CLUSTERS		**COEFF 1**	**COEFF 24**	**COEFF 29**	**COEFF 30**
1	1	689	689	689	689
2	1	628	352	521	339
	2	61	337	168	350
3	1	623	327	307	332
	2	25	304	59	312
	3	41	58	323	45
4	1	330	214	304	280
	2	26	207	202	299
	3	28	53	40	83
	4	305	215	143	27
5	1	276	174	280	249
	2	6	230	159	185
	3	28	47	19	203
	4	96	164	52	22
	5	283	74	179	30
6	1	272	173	230	209
	2	6	228	124	50
	3	25	21	5	190
	4	95	29	35	21
	5	4	164	80	188
	6	287	74	215	31

Table 5.5.3 Minimum distance between clusters with coefficients 24 and 29 (Maxit=0) for miscellaneous practice management variables.

Maxit = 0 No. of clusters	Coeff. 24 (Distance)	Coeff. 29 (Distance)
20	0.253	0.000
19	0.330	0.000
18	0.420	0.000
17	0.459	0.000
16	0.576	0.000
15	0.710	0.000
14	0.718	0.000
13	0.745	0.000
12	0.803	0.000
11	0.837	0.000
10	0.961	0.000
9	1.114	0.000
8	1.340	0.000
7	1.542	0.000
6	2.460	0.001
5	2.907	0.001
4	3.956	0.004
3	5.564	0.007
2	12.666	0.013

Table 5.5.4 Minimum distance between clusters with coefficients 24 and 29 (Maxit=10) for miscellaneous practice management variables.

Maxit = 10	No. of clusters	Coeff. 24 (Distance)	Coeff. 29 (Distance)
	20	9.694	0.000
	19	10.228	0.001
	18	14.316	0.003
	17	15.356	0.004
	16	17.595	0.005
	15	17.785	0.010
	14	21.737	0.015
	13	22.775	0.020
	12	22.217	0.025
	11	34.642	0.034
	10	36.961	0.027
	9	50.600	0.044
	8	56.867	0.061
	7	70.417	0.079
	6	92.915	0.092
	5	96.424	0.119
	4	144.701	0.169
	3	193.936	0.249
	2	228.824	0.592

Initially, the 4 cluster solution (MAXIT=10) looked more sensible on the basis of fusion distances but it was difficult to interpret the clusters. Coefficients 24 and 29 with MAXIT=0 gave acceptable sized groups for 3 and 4 clusters (Table 5.5.1) but the means within clusters were not sufficiently dissimilar to be useful in describing the practitioners. They are presented for comparison in Appendix 10. With coefficients 24 and 29 (MAXIT=0) the 2 cluster solutions hardly showed any differences in the means between the clusters. With coefficient 29 (MAXIT=10) several differences in the cluster means were revealed but, because of the unremarkable terminal fusion distances and the large group size differences this was not the ideal choice. The solutions not chosen are shown in Appendix 10.

Chiropractors in cluster 1 of the 2 cluster solution with coefficient 24 (MAXIT=10) were much more likely to treat by manipulation only on the patient's first visit, and gave slightly more emotional/social counselling and home visits (Table 5.5.5). They were less likely to agree to prescribe drugs and also stated spending less time with the patient on the first and subsequent visits compared to practitioners from cluster 2. Treating by manipulation only is perhaps typical of older practitioners with many years of experience practising in a traditional style. Members of cluster 2 stated that they spent more time with the patient and also treated by using more than just manipulation on the patient's first visit.

Table 5.5.5 Two Clusters Generated for Miscellaneous Practice Management Variables.

Values are means within clusters (s.d.). Coefficient 24, Maxit = 10, Start random size 20, Standardisation & Relocation: Yes, N = 689.

VARIABLE	2 CLUSTERS	
	1	2
1. PERFORM HOME VISITS	**7.88** (8.30)	**5.97** (6.14)
2. TREAT BY MANIPULATION ONLY ON FIRST VISIT	**69.68** (22.23)	**18.16** (18.30)
3. GIVE EMOTIONAL/SOCIAL COUNSELLING	**12.25** (15.24)	**7.56** (9.29)
4. RATE AGREEMENT TO PRESCRIBE DRUGS	**43.40** (34.15)	**49.13** (34.79)
5. TIME SPENT WITH PATIENT - FIRST VISIT	**33.69** (9.80)	**43.58** (11.48)
6. TIME SPENT WITH PATIENT - SUBSEQUENT VISITS	**11.97** (3.68)	**15.64** (5.05)
FREQUENCY (PER CENT)	**352** (51.09)	**337** (48.91)

5.6 CHECKS FOR THE ROBUSTNESS OF CLUSTERS

In order to provide a check for the robustness of resulting clusters the cases for each of the four sets of variables, ie. x-ray, examination, treatment technique and miscellaneous practice management, were reordered at random in SPSS, to achieve random starting points for repeated analyses. Subsequently these cases were fed back into CLUSTAN and re-analysed using the same procedures (coefficients and MAXIT commands) as previously described in this chapter. Generally, the clusters generated through randomisation are identical to those presented in sections 5.1 to 5.5 and chosen for cross-classification with the demographic variables. The means within the large groups correspond to those previously found. However, for the x-ray solutions a few groups with a small number of cases gave slightly different means within clusters. Generally, the results from the randomisation are reassuring in suggesting that the clusters do not differ greatly when different starting values are used.

5.7 CROSS-CLASSIFICATION WITH THE DEMOGRAPHIC VARIABLES

5.7.1 THE X-RAYS

The 3 clusters in this cross-classification came out with very uneven proportions hence, it was essentially a 2 cluster solution. Practitioners in cluster 1 stated that they frequently take their own x-rays, while those in cluster 3 obtained films and consent somewhat more than cluster 1 chiropractors. Both groups 1 and 3 practitioners made limited use of outside facilities (Table 5.2.5). Chiropractors in cluster 2 used outside facilities much more but there were only 13 practitioners in this group so they cannot be said to represent some Continental or Scandinavian countries in which this is commonly done.

Table 5.7.1 shows that Scandinavian practitioners were most likely to be found in group 1 (62%), while Continental chiropractors were more often in group 3 (51%). In cluster 3 a greater use of tissue x-rays, and obtaining oral and written consent was reported. These chiropractors much more frequently used services from outside the clinic, such as getting x-rays from another chiropractor, obtaining them from hospital via the general medical practitioner, getting the films directly from hospital, a private radiological clinic and the patient bringing the films. Table 5.7.1 also shows a slightly higher proportion of female chiropractors in cluster 1 (55% in cluster 1 for females, 52% in cluster 1 for males). Cluster 1 differed from other clusters by showing much lower usage of tissue x-rays, obtaining written consent, getting x-rays from another chiropractor, obtaining them from hospital via the general medical practitioner, getting the films directly from hospital, a private radiological clinic and having the patient bring the films (Table 5.2.5). This is most likely influenced by the mandatory availability of x-ray facilities in Danish practices, where also a higher proportion of female chiropractors are found. In several Continental countries chiropractors are not allowed to take x-rays.

The employment status of single, partner and group/health clinic practitioners occupied similar proportions in clusters 1 and 3, respectively. A similar proportional representation was found for practitioners graduating from European, American and Canadian

Table 5.7.1 Cross-tabulation of Demographic Variables by 3 Clusters of X-ray Variables.

Coefficient 29, Maxit = 10

VARIABLE	CATEGORY	3 CLUSTERS 1	2	3	TOTAL
		N (%)	N (%)	N (%)	N
SEX	MALE	**167** (51.9)	**10** (3.1)	**145** (45.0)	**322**
	FEMALE	**62** (55.4)	**3** (2.7)	**47** (42.0)	**112**
COUNTRY	SCANDINAVIA	**98** (62.0)	**1** (0.6)	**59** (37.3)	**158**
	CONTINENT	**26** (40.0)	**6** (9.2)	**33** (50.8)	**65**
	UK/IRELAND	**105** (49.8)	**6** (2.8)	**100** (47.4)	**211**
EMPLOYMENT STATUS	SINGLE	**80** (55.2)	**4** (2.8)	**61** (42.1)	**145**
	PARTNER	**84** (51.2)	**4** (2.4)	**76** (46.3)	**164**
	GROUP	**48** (53.9)	**3** (3.4)	**38** (42.7)	**89**
	EMPLOYED	**15** (46.9)	**2** (6.3)	**15** (46.9)	**32**
COLLEGE OF GRADUATION	EUROPEAN	**116** (52.7)	**6** (2.7)	**98** (44.5)	**220**
	AMERICAN	**97** (52.2)	**5** (2.7)	**84** (45.2)	**186**
	CANADIAN	**13** (56.5)	**1** (4.3)	**9** (39.1)	**23**
	AUSTRALIAN	**3** (60.0)	**1** (20.0)	**1** (20.0)	**5**
ACADEMIC DEGREE	YES	**44** (44.0)	**4** (4.0)	**52** (52.0)	**100**
	NO	**179** (55.9)	**8** (2.5)	**133** (41.6)	**320**
PRACTICE ADDRESS	METROPOLITAN	**51** (49.5)	**4** (3.9)	**48** (46.6)	**103**
	URBAN	**78** (51.0)	**3** (2.0)	**72** (47.1)	**153**
	SEMI-URBAN	**95** (57.9)	**5** (3.0)	**64** (39.0)	**164**
	RURAL	**5** (55.6)	**1** (11.1)	**3** (33.3)	**9**
AGE	MEAN YEAR (SD) [N, %]	**36.5** (9.3) [228, 52.5]	**35.4** (7.9) [13, 3.0]	**36.4** (8.1) [192, 44.2]	**433**
DURATION OF PRACTICE	MEAN MONTHS (SD) [N, %]	**115.5** (99.5) [228, 52.5]	**116.5** (91.6) [13, 3.0]	**113.6** (90.0) [192, 44.2]	**433**
YEAR OF GRADUATION	MEAN YEAR (SD) [N, %]	**80.6** (8.4) [229, 52.8]	**80.8** (7.5) [13, 3.0]	**80.8** (7.7) [192, 44.2]	**434**

Missing cases on demographic variables:

	N (%)
EMPLOYMENT STATUS	4 (0.9)
ACADEMIC DEGREE	14 (3.2)
PRACTICE ADDRESS	5 (1.2)
AGE	1 (0.2)
DURATION OF PRACTICE	1 (0.2)

colleges, respectively. A larger proportion of the chiropractors who did not possess additional academic qualifications were in cluster 1 but this was by no means a startling difference. The semi-urban practices were also seen somewhat more often in this group than metropolitan and urban clinics. There was little difference between the 3 clusters in terms of the chiropractors' age, duration of practice and year of graduation.

5.7.2 THE EXAMINATIONS

The 3 group solution with coefficient 24 (MAXIT=10) was chosen because they showed acceptable terminal fusion distances and could easily be interpreted although, there were uneven numbers in the clusters. The 74 chiropractors in cluster 2 was considered acceptable for inclusion in a separate group (Table 5.7.2).

Chiropractors in group 1 had high rates on the eight musculoskeletal examinations but typically reported low means in taking the pulse and blood pressure, checking respiration, temperature and examining the abdomen, heart, lungs and mouth, that is they did not perform a comprehensive examination. Compared to the other clusters the practitioners in group 3 reported the lowest usage of all musculoskeletal and non-musculoskeletal examination procedures. In contrast, cluster 2 members had the highest rates for taking the blood pressures and pulse, checked respiration, temperature, and examined the abdomen, heart, lungs and mouth much more frequently.

Table 5.7.2 Cross-tabulation of Demographic Variables by 3 Clusters of Examination Variables.

Coefficient 24, Maxit = 10

VARIABLE	CATEGORY	3 CLUSTERS 1 N (%)	2 N (%)	3 N (%)	TOTAL N
SEX	MALE	**314** (63.4)	**59** (11.9)	**122** (24.6)	**495**
	FEMALE	**127** (71.8)	**15** (8.5)	**35** (19.8)	**177**
COUNTRY	SCANDINAVIA	**129** (59.4)	**5** (2.3)	**83** (38.2)	**217**
	CONTINENT	**89** (60.1)	**19** (12.8)	**40** (27.0)	**148**
	UK/IRELAND	**223** (72.6)	**50** (16.3)	**34** (11.1)	**307**
EMPLOYMENT STATUS	SINGLE	**162** (58.7)	**31** (11.2)	**83** (30.1)	**276**
	PARTNER	**152** (67.3)	**20** (8.8)	**54** (23.9)	**226**
	GROUP	**90** (72.6)	**18** (14.5)	**16** (12.9)	**124**
	EMPLOYED	**32** (80.0)	**5** (12.5)	**3** (7.5)	**40**
COLLEGE OF GRADUATION	EUROPEAN	**245** (73.6)	**46** (13.8)	**42** (12.6)	**333**
	AMERICAN	**163** (55.8)	**22** (7.5)	**107** (36.6)	**292**
	CANADIAN	**24** (68.6)	**4** (11.4)	**7** (20.2)	**35**
	AUSTRALIAN	**8** (72.7)	**2** (18.2)	**1** (9.1)	**11**
ACADEMIC DEGREE	YES	**111** (57.5)	**39** (20.2)	**43** (22.3)	**193**
	NO	**310** (68.3)	**32** (7.0)	**112** (24.7)	**454**
PRACTICE ADDRESS	METROPOLITAN	**118** (70.2)	**26** (15.5)	**24** (14.3)	**168**
	URBAN	**165** (67.9)	**19** (7.8)	**59** (24.3)	**243**
	SEMI-URBAN	**147** (61.8)	**25** (10.5)	**66** (27.7)	**238**
	RURAL	**8** (50.0)	**3** (18.8)	**5** (31.3)	**16**
AGE	MEAN YEAR (SD) [N, %]	**35.3** (8.1) [439, 65.3]	**38.9** (10.3) [73, 10.9]	**40.6** (9.3) [156, 23.2]	**668**
DURATION OF PRACTICE	MEAN MONTHS (SD) [N, %]	**100.4** (85.4) [440, 65.5]	**116.4** (103.6) [74, 11.0]	**154.2** (99.9) [157, 23.4]	**671**
YEAR OF GRADUATION	MEAN YEAR (SD) [N, %]	**81.9** (7.38) [441, 65.6]	**80.5** (8.8) [74, 11.0]	**77.3** (8.5) [157, 23.4]	**672**

Missing cases on demographic variables:

	N (%)
EMPLOYMENT STATUS	6 (0.9)
COLLEGE OF GRADUATION	1 (0.1)
ACADEMIC DEGREE	25 (3.7)
PRACTICE ADDRESS	7 (1.0)
AGE	4 (0.6)
DURATION OF PRACTICE	1 (0.1)

Table 5.7.2 shows that more female than male chiropractors were in cluster 1, that is that females were more likely to perform orthopaedic (lumbar and cervical) and neurological tests. Additionally, of the three geographical regions UK/Ireland had the highest proportions in this cluster. More chiropractors without academic qualifications were in cluster 1 (68%) than practitioners with an academic degree (58%). The metropolitan clinics had most chiropractors (70%) in cluster 1 and least in cluster 3 (14%). Higher proportions of chiropractors in urban and semi-urban clinics were in cluster 3 although most of them were found in cluster 1. Thus, there was a trend for metropolitan chiropractors to perform musculoskeletal examinations more and for rural practitioners to examine less. The European college graduates had a higher proportion (74%) in cluster 1, many of whom were young UK/Irish practitioners in metropolitan/urban areas.

The 3 clusters were most informative when cross-classified with the continuous demographic variables (Table 5.7.2). It was clear that cluster 1 comprised younger chiropractors and cluster 3 the older ones. This was also confirmed by cross-classification with the duration of practice and year of graduation variables. It is not surprising that the older practitioners were found in cluster 3 reporting the lowest usage of any examination procedures. This is in agreement with reports from the literature, that recent graduates examine more comprehensively. One might imagine that cluster 2 comprised a lot of these practitioners. However, one would have expected the difference in usage of examination procedures to show up more clearly in cluster 1.

5.7.3 THE TREATMENT

The means for 2 clusters were split into high (cluster 1) and low (cluster 2) usage for most variables (Table 5.4.5). Cluster 1 showed that these chiropractors used the techniques Toggle Recoil, Logan, Sacro-Occipital Technique, Applied Kinesiology, Activator and Toftness much more than other practitioners. This would be expected from female chiropractors who tend to chose less physically demanding methods of treatment. Table 5.7.3 shows that they are well represented in this group. Cluster 1 also comprises a higher number of practitioners from Continental countries in which many of these techniques are frequently promoted and extensively used. Graduates from American and Canadian colleges tend to be in cluster 1, whereas European graduates are found in cluster 2. Additional academic qualifications and practice address seemed to make little difference to the cluster frequencies. The continuous demographic variables did not show any differences between the members of the two clusters.

5.7.4 THE PRACTICE MANAGEMENT

The 2 cluster solution (Coefficient 24, MAXIT=10, Table 5.5.5) showed that chiropractors in cluster 1 much more frequently reported treating by manipulation only on the patient's first visit and gave slightly more emotional/social counselling and home visits. Compared to practitioners in cluster 2 they said that they spent less time with the patient on the first and subsequent visits and were also less likely to agree to prescribe drugs. It was decided to cross-classify this 2 cluster solution with the demographic

Table 5.7.3 Cross-tabulation of Demographic Variables by 2 Clusters of Treatment Technique Variables.

Coefficient 24, Maxit = 10

VARIABLE	CATEGORY	2 CLUSTERS 1 N (%)	2 N (%)	TOTAL N
SEX	MALE FEMALE	159 (41.4) 84 (57.9)	225 (58.6) 61 (42.1)	384 145
COUNTRY	SCANDINAVIA CONTINENT UK/IRELAND	86 (48.0) 60 (56.6) 97 (39.8)	93 (52.0) 46 (43.4) 147 (60.2)	179 106 244
EMPLOYMENT STATUS	SINGLE PARTNER GROUP EMPLOYED	101 (47.6) 82 (46.1) 40 (39.6) 16 (48.5)	111 (52.4) 96 (53.9) 61 (60.4) 17 (51.5)	212 178 101 33
COLLEGE OF GRADUATION	EUROPEAN AMERICAN CANADIAN AUSTRALIAN	97 (36.7) 120 (53.1) 19 (63.3) 7 (77.8)	167 (63.3) 106 (46.9) 11 (36.7) 2 (22.2)	264 226 30 9
ACADEMIC DEGREE	YES NO	67 (47.2) 166 (45.0)	75 (52.8) 203 (55.0)	142 369
PRACTICE ADDRESS	METROPOLITAN URBAN SEMI-URBAN RURAL	57 (46.0) 81 (42.4) 94 (48.0) 5 (45.5)	67 (54.0) 110 (57.6) 102 (52.0) 6 (54.5)	124 191 196 11
AGE	MEAN YEAR (SD) [N, %]	35.9 (7.9) [241, 45.6]	36.7 (8.5) [285, 53.9]	526
DURATION OF PRACTICE	MEAN MONTHS (SD) [N, %]	106.9 (83.7) [243, 45.9]	111.0 (91.0) [285, 53.9]	528
YEAR OF GRADUATION	MEAN YEAR (SD) [N, %]	81.3 (7.2) [243, 45.9]	81.0 (7.7) [286, 54.1]	529

Missing cases on demographic variables:

	N (%)
EMPLOYMENT STATUS	5 (0.9)
ACADEMIC DEGREE	18 (3.4)
PRACTICE ADDRESS	7 (1.3)
AGE	3 (0.6)
DURATION OF PRACTICE	1 (0.2)

variables (Table 5.7.4). This showed that cluster 2 comprised proportionately more females, employed and group/health clinic practitioners from the UK/Ireland. The cluster 2 chiropractors were generally younger, graduated within the past decade from a European college and had been in practice for approximately 7.6 years. In section 5.5 (Table 5.5.5) it was shown that these cluster members, compared to those in group 1 who had a more traditional practice style, differed by being much less likely to treat by manipulation only on the patient's first visit and said that they spent somewhat more time on patient visits.

Table 5.7.4 shows that in cluster 1 the chiropractors tended to be older, male, American or Canadian college graduates in single practices or partnerships, and located in Scandinavia and the Continent. There was little difference between the clusters in terms of academic qualifications and practice address.

Table 5.7.4 Cross-tabulation of Demographic Variables by 2 Clusters of Miscellaneous Practice Management Variables.

Coefficient 24, Maxit = 10

VARIABLE	CATEGORY	2 CLUSTERS 1 N (%)	2 N (%)	TOTAL N
SEX	MALE	**286** (56.0)	**225** (44.0)	**511**
	FEMALE	**66** (37.1)	**112** (62.9)	**178**
COUNTRY	SCANDINAVIA	**136** (59.6)	**92** (40.4)	**228**
	CONTINENT	**103** (67.3)	**50** (32.7)	**153**
	UK/IRELAND	**113** (36.7)	**195** (63.3)	**308**
EMPLOYMENT STATUS	SINGLE	**158** (55.8)	**125** (44.2)	**283**
	PARTNER	**129** (54.9)	**106** (45.1)	**235**
	GROUP	**48** (38.7)	**76** (61.3)	**124**
	EMPLOYED	**14** (34.1)	**27** (65.9)	**41**
COLLEGE OF GRADUATION	EUROPEAN	**122** (35.9)	**218** (64.1)	**340**
	AMERICAN	**201** (66.8)	**100** (33.2)	**301**
	CANADIAN	**24** (66.7)	**12** (33.3)	**36**
	AUSTRALIAN	**4** (36.4)	**7** (63.6)	**11**
ACADEMIC DEGREE	YES	**102** (53.1)	**90** (46.9)	**192**
	NO	**238** (50.3)	**235** (49.7)	**473**
PRACTICE ADDRESS	METROPOLITAN	**82** (46.9)	**93** (53.1)	**175**
	URBAN	**129** (52.0)	**119** (48.0)	**248**
	SEMI-URBAN	**131** (53.5)	**114** (46.5)	**245**
	RURAL	**7** (46.7)	**8** (53.3)	**15**
AGE	MEAN YEAR (SD) [N, %]	**39.0** (8.9) [350, 50.8]	**35.1** (8.8) [335, 48.6]	**685**
DURATION OF PRACTICE	MEAN MONTHS (SD) [N, %]	**141.2** (99.0) [351, 50.9]	**91.9** (85.4) [337, 48.9]	**688**
YEAR OF GRADUATION	MEAN YEAR (SD) [N, %]	**78.4** (8.4) [352, 51.1]	**82.6** (7.4) [337, 48.9]	**689**

Missing cases on demographic variables:

	N	(%)
EMPLOYMENT STATUS	6	(0.9)
COLLEGE OF GRADUATION	1	(0.1)
ACADEMIC DEGREE	24	(3.5)
PRACTICE ADDRESS	6	(0.9)
AGE	4	(0.6)
DURATION OF PRACTICE	1	(0.1)

CHAPTER 6

DISCUSSION AND CONCLUSION

6.1 INTRODUCTION

The key objective of the study was to investigate chiropractors' estimated usage of x-ray, examination and practice management procedures, and treatment techniques, as well as the importance of demographic variables in explaining the differences in the use of such procedures. This study is the first and most comprehensive European survey of chiropractic practice. The lack of standardised procedures and the diversity of practice results in limitations to the conclusions that can be drawn from the survey. No attempt was made to quantify the success of chiropractic management, assess the efficacy of treatments or to compare it with any other form of treatment for musculoskeletal disorders.

6.2 DATA COLLECTION AND RESPONSE RATES

The approach chosen to examine these issues was that of a postal questionnaire of all 1290 members of the European Chiropractors' Union (ECU 1990 register, 15 countries). Although prior agreement to participate had been obtained from all the National Associations in each country no information was returned from Germany and Spain, and the response rate was low for countries such as Belgium, Holland, France and Finland (Table 2.3.1). Overall the response rate was 55%, poor for a postal questionnaire. Some demographic information was available on non-responders and it suggests that they may not differ greatly from the responders, but caution is needed here in that not all non-responders had registration information (Tables 2.3.2 & 2.3.3). Nevertheless, one can still get an impression of the chiropractors' demographic profile and this generally corroborates findings from other studies.

An improvement of the response rates might have been achieved from considerably shortening the questionnaire, for example by leaving out some more technical aspects on x-ray equipment, laboratory and clinic management procedures. Additionally, the questionnaires might have been more useful if constructed as hypothetical, though realistic, standardised cases where the practitioners could be asked to comment on examination and treatment procedures for patients with specific symptoms. However, for reasons to be discussed later in this chapter the latter option was considered impossible to carry out in practice following information obtained from the pilot study and the requirements set out by the main funding body, the European Chiropractors' Union.

6.3 THE DEMOGRAPHIC PROFILE OF THE CHIROPRACTORS

The nine demographic variables were chosen because, they provided a basic description of the chiropractors, and covered important aspects of their employment conditions, they were likely to be completed without difficulty by the chiropractors, and they were easy to compare with other studies. Demographic information on non-responders, to the extent this was available, could later be obtained from files by the national contact persons. The non-responders were slightly older (40.7 years), mainly from the Continent, had practised for 14.2 years and were graduates from predominantly American colleges (Tables 2.3.2 & 2.3.3).

The mean age (37.2 years) and sex distributions of responding chiropractors were similar to findings from studies in other continents (20,21,23). It has recently been reported that 50% of the chiropractic profession graduated since 1980 (25). The current study shows that, compared to only a few decades ago, there has been a change in the chiropractors' demographic profile. They are now younger and the number of female practitioners has increased from 9% in 1974 to 26% (23,24) (Table 2.3.2). A similar trend was predicted from one Australian study on the basis of the number of undergraduate students enrolled in chiropractic education in 1986 (20). However, this did not lead to an increase in the number of registered female practitioners in Australia possibly because it is common for female Australian chiropractors to work on a part time basis, or not at all, whilst raising a family. In Denmark, which had the largest proportion (40%) of female chiropractors in our survey, it is much more common for female chiropractors to be in full time practice and use locum chiropractors during the latter stages of pregnancy, and shortly afterwards. The substantial change in the European profession is noticeable because, chiropractic is traditionally a male dominated profession, and the public's perception may be that considerable physical strength is necessary. There may also be an element of popularity involved during recent times, and the prospect of becoming an independent health care practitioner is likely to be an important consideration in a student's choice of occupation. In contrast, physiotherapy remains a female dominated occupation although, amongst professionals, this would probably be regarded as much more physically demanding (60). When using spinal manipulation, it is usually a question of applying the most appropriate techniques adapted to the size and physical strength of the chiropractor. Because, special mechanized treatment couches are normally used, the size of the patient becomes less important as the features of such couches are used to apply various treatment techniques.

6.4 REGRESSION RESULTS AND THE IMPLICATIONS OF DEMOGRAPHIC FEATURES AND TRAINING ON CHIROPRACTORS' ESTIMATED USE OF X-RAY, EXAMINATION AND MANAGEMENT PROCEDURES, AND TREATMENT TECHNIQUES

The change to more female chiropractors allows patients greater choice of practitioner. Although, one might imagine this to be more important when dealing with strictly female conditions, such as back pain associated with dysmenorrhoea, no great gender differences emerged with respect to the use of x-ray and examination (except cervical orthopaedic tests and taking the blood pressure) procedures (Tables 4.2.1 & 4.2.2). However, when looking at the way practitioners said they treated and managed patients then there were significant differences between the sexes. Female chiropractors were much more likely to use less physically demanding techniques (Table 4.2.3), less likely to agree to prescribe drugs and, although gender differences were not great here, spent significantly more time with patients on their first and subsequent visits (Table 4.2.4). The implications of the greater number of female practitioners have not been established. They are most likely to be in relation to patient management but, hardly any research has been reported in this field.

The profession has traditionally been trained in North America and older generations in the study mainly graduated from American colleges hence the need for controlled analyses. Recent graduates are mainly European trained (Table 2.3.2). These changes have come about because of improvements in training, which is better organised and of higher quality. The financial burden from the fees to be paid in these mostly private colleges and the geographical distances from home, make students more likely to chose a European college. These trends have implications for processes which may lead to the full integration of chiropractors into the health care system because, graduates need less retraining in order to adapt to European health care practices, and Government bodies are better able to assess the quality of the education. The chiropractic profession's relationship with such institutions is also likely to be eased through the uniformity of training and management of mainly, but not only, neuro-musculoskeletal conditions. The importance of college of graduation in describing differences between the chiropractors in their use of examination procedures were seen in relation to musculoskeletal examinations (Table 4.5.2), but much more so in the use of treatment techniques (Table 4.5.3) and management procedures (Table 4.5.4).

Chiropractors are now awarded BSc degrees when graduating from accredited colleges after 5-6 years of training. A small but growing number of practitioners are currently studying for postgraduate qualifications. One might imagine that a more comprehensive educational background would be reflected in their way of practising. Practitioners who possessed additional academic qualifications were more likely to perform non-musculoskeletal examinations, such as taking the pulse, blood pressure, and examining the abdomen, heart and lungs, but did not otherwise appear any different in the way they practised.

The countries involved in the survey were grouped into three broad regions: Scandinavia, Continent and United Kingdom/Ireland. Countries with common cultural background and similar legal practices were thus grouped together. It was not possible to asses variation between individual countries within regions in the usage of procedures and treatment techniques because of the few members in some National Associations. It was anticipated that the country of practice would influence the use of x- rays due to legal restrictions in some countries (6,16). The regression analyses confirmed significant differencies between regions with respect to the use of almost all x-ray procedures (Table 4.3.1). In those regions where the chiropractors were permitted to take x-rays they tended to use outside services significantly less, and vice versa. It was also shown that there were significant differences between regions in terms of examination procedures (Table 4.3.2). United Kingdom/Irish practitioners estimated that they used almost all procedures significantly more than chiropractors from other regions. They contributed the largest number of responders in the survey (Table 2.3.1), and tended to be slightly younger and recent graduates, typical of the fastest growing associations in the European Chiropractors' Union.

The treatment techniques used also showed significant differences between regions. This was anticipated because of the diversity of techniques which are being promoted, especially in Continental regions, and differences in the curriculum between colleges (Table 4.3.3). Practitioners from some countries, notably Scandinavia, were mainly graduates of either European or American colleges. The use of treatment techniques may also to some extent be influenced by the fact that in the Continent the mean age is higher and the duration of practice longer, and these factors on their own showed significant differences in the use of some treatment techniques (Table 4.8.3). Cultural differences between countries might be expected to result in differences in practices of management, especially in relation to direct patient contact (Table 4.3.4).

In agreement with other studies (6,20,33,61) most chiropractors remain self-employed, practising solo or as partners (Table 2.3.2). The majority usually work in one clinic only (69.8%) but a large minority work in at least two clinics (25.7%). The increasing recognition of the profession and changes in the health care system towards multi-disciplinary approaches to the management of patients has probably facilitated the number of opportunities which exist in relation to health care centres.

The practices remain almost exclusively concentrated in metropolitan, urban or semi-urban areas (Table 2.3.2) with little indication of development in rural communities, in spite of the hard labour occupations found in such areas which should provide ample opportunities for interventional and preventative health care. The results of the study indicated that employment status and practice address had little impact on the way chiropractors practised.

In many professions, except where dictated by the nature of the job or contractual agreements, it appears to be a common problem that postgraduate training is not mandatory. Thus some individuals may develop practice routines which in some respects are less comprehensive than would be expected from members of a profession. Several musculoskeletal examination procedures showed highly significant associations with age, duration of practice and year of graduation (Table 4.8.2). Older chiropractors in long established practices stated that they used such procedures less, whereas recent graduates used them much more. The age, duration of practice and year of graduation were shown to be very important in explaining variation in almost all of these procedures but not to such an extent in relation to the non-musculoskeletal examinations. The more comprehensive use of examination procedures by recent graduates is in agreement with previous findings from Australia (11).

6.5 VALIDITY OF THE DATA AND MEASUREMENT SCALES

The usage variables represent the practitioners' own estimates of the extent to which they apply these procedures. This may, depending on the questions asked, be problematic due to the subjectiveness of the responses. The participation in for example a course in new treatment techniques may alter the chiropractor's perception of their frequency of use of some procedures.

The studies previously reported on chiropractic practice have shown the proportions, means and standard deviations of relevant demographic and practice variables (6). We attempted to assess usage of various x-ray, examination and management procedures, and treatment techniques, using a visual analogue scale to represent the chiropractors' perceived percentage usage. The important issue is not so much the statistical methods used, but how the questions were asked and the information gathered. In the following sections some of the problems with the study design will be discussed.

The placement of numbers on the visual analogue scales was intended to assist the practitioners in placing a mark on the scale. In practice some chiropractors tended to circle the numbers. The scores were analysed as continuous values but there was a definite tendency for the data to clump around the values on the scales. Annotating a visual analogue scale with numbers should probably be avoided because of the problems with digit preference. In order to overcome this problem we could have split the values half-way between the numbers, or split the variable at the median for the whole line and performed a logistic regression analysis. Although, this alternative might have ensured a more robust analysis, it would also have resulted in loss of information from the data. Furthermore, if using more than two categories there does not appear to be any consensus on the larger number of categories in which to divide an analogue scale although the optimal is approximately five to seven categories. The measurements were all done by the author and inter-observer variation of the visual analogue scale lines was thus not an issue.

In retrospect, the wording of the questions relating to the use of various procedures raised concerns that they might not accurately measure what they were supposed to measure. When asking in what proportion of all their patients the practitioners used procedures or techniques they could have answered the question every time although some procedures might only have been used for patients with certain condtions or symptoms. Thus, for example testing reflexes, sensation and muscle strength may only be done when radicular symptoms are present, and auscultation of the lungs only if chest problems are suspected. Hence, it might have been more meaningful if questions were asked in relation, for example to a specified number of conditions, such as neck pain or low back pain, of which a reasonable number could have been obtained. However, from the pilot study it was clear that practitioners gave different diagnoses, even for very similar conditions. This is one of the major problems with a lack of classification, or a definition of back pain, a problem which has yet to be addressed through collaborative and multidisciplinary research. The 244 cases obtained resulted in 125 not mutually exclusive diagnoses and there exists no standardisation of procedures and techniques used. On a European scale with limited funds, time and taking into account many different ways of practising, it was not considered feasable in this study to expect or test practitioners' agreement on when and for which conditions to use many of the procedures and techniques suggested. One might have overcome some of the problems by giving constructed standardised, but realistic, cases to comment on, or requested information on a set number of for example low back pain patients. The latter would have limited the number of procedures, and techniques applicable though not necessarily the diagnoses given. Obtaining information retrospectively from the practitioners' files would have been difficult due to great differences in the quality of record keeping hence, only prospective data collection was considered.

Some data from patient documents were used to provide a check for the chiropractors' estimated use of certain procedures and their actual usage (See section 2.7). Only variables which had a directly corresponding variable in both documents were chosen in order to ease interpretation of the plots obtained. These related to the time spent on the first and subsequent patient visits, the proportion of patients where x-rays were obtained directly from hospital and those x-rayed in a private radiological clinic. The differences were plotted against the means for each of the four variables in order to assess how good the chiropractors were at estimating their actual use of procedures and time spent with patients (Figures 2.7.1 - 2.7.4). There was poor agreement between the estimates and actual mean times spent with patients on their first visits (Table 2.7.1). On average chiropractors overestimated the time spent at the first visit by approximately 40 minutes, a few overestimated by 60 minutes and several underestimated by at least 30 minutes. Agreement was much better for subsequent patient visits, which are of shorter duration, mean 13.9 minutes (Figure 2.7.2). However, it must be pointed out that actual usage figures were based on only 15 patients, while the chiropractors were estimating their typical usage. The chiropractors' estimates of the proportion of patients for whom x-rays were obtained directly from hospital (14%) showed acceptable agreement with the actual proportions for low means (Figure 2.7.3). A similar trend is observed when the practitioners estimate the proportion of patients x-rayed in a private radiological clinic (13%) but there is somewhat more scatter here (Figure 2.7.4). Data obtained from the patient documents showed that of the 1014 patients in the study only 252 (25%) were actually x-rayed within the chiropractic clinics, that is mainly by those practitioners with such facilities available. Overall the results tend to indicate that the chiropractors' estimates are not very accurate. The problems are likely to arise more frequently when they are asked to estimate for example their use of examination procedures or treatment techniques over the whole year. Additionally, practitioners may, when specifically asked, feel that they ought to perform some examination procedures more often than they actually do. Despite anonymity of responses this is at least one likely cause of inflated estimates. It also raises the question of the value of self-reporting as a means of obtaining data, at least with respect to the kind of information requested in this study. It was not possible to assess to what extent such issues like recall bias played a part in the survey, but this aspect of the design could probably be improved in a future study through a change in the documents to allow more frequent recording of data over shorter periods of time.

The objectives of the following sections are to review other studies and their methodology in order to compare and contrast their methods and results with ours. The discussion and comparison with our findings will be done for each study in turn.

A review of previous studies collecting hard data relating to European chiropractic practice showed that they were generally of poor quality. They relied on questionable and selective sampling methods, had fairly poor response rates and never reported information about non-responders. In order to obtain comparative information it was necessary to include findings from North American and Australian surveys where most such studies have been carried out.

EUROPE

The studies which most closely resembled our survey were Breen's (10,23) and a follow up of his study by Huisman (24). The data about chiropractors registered with the British

Chiropractic Association (BCA) and their patients collected for the former study were obtained over a period from October 1973 to October 1974. The information was taken from questionnaires answered by practising chiropractors, and data abstracted from patient case records. The chiropractors were interviewed using a standardised schedule although no mention of what this was could be found (23). There was no indication of how the questionnaire was developed, or if a pilot study was conducted, and no information about non-responders was available. The questionnaires were completed for 49 practitioners, which represented 72% of BCA membership in 1973. Information was sought on both the diagnostic and therapeutic procedures used, and other aspects of chiropractic practice not comparable to our survey. Data from case files were abstracted retrospectively from practice records of 24 chiropractors whose practices were selected for sampling to give a proportional geographical representation in Great Britain. A 1 in 5 random sample of up to 1000 records was taken from each practice with more recently established practices contributing proportionally fewer cases. Information about patients (n=2.987) included demographic details, diagnosis, type of treatment and other data in some ways similar to our survey.

The mean age of the chiropractors was 39 years (range 24-76 years) which was close to our 37 years but in the British survey the gender distribution was highly disproportionate with only 4 (8%) females. Most practitioners were American (55%) trained, 22% from U.K. and 20% from Canadian colleges which was noticeably different from our survey (Table 2.3.2) but in accordance with trends at the time when most practitioners were trained in North America. It was not possible to compare the use of various x-ray and examination procedures directly with our survey as Breen's study based this on a sub-sample of patients with low back pain (53%,n=1.598). However, it was reported that taking x-rays, using palpation, orthopaedic, neurological and organ examinations were done in over 70% of these patients. Similarly, the use of techniques was also based on the patient sample and mainly consisted of joint manipulation and to some extent soft tissue therapy. A more detailed exposition of the variety of manipulative techniques used was reported to be difficult to abstract from the case files, and was also beyond the scope of the study. Overall, the patients' complaints were almost exclusively neuromusculoskeletal in origin, and approximately 6% were not treated by the chiropractors due to underlying disease or for other unspecified reasons. The gender distribution was 53% females and 47% males which is similar to most earlier, and current, studies of chiropractic patients. Because of the practitioners' response rate, lack of information about the non-responders, and data collected retrospectively from frequently incomplete patient files the representativeness of the samples are questionnable but overall tend to support the findings from other studies.

Huisman (24) conducted a survey in 1989 as a follow up to Breen's study (10,23), except no patient information was collected. The questionnaire was very similar to the one previously used and consisted of 102 questions divided into 3 parts. The first part related to practitioner information, the second to practice procedures, such as examination and treatment techniques, and the third part to practice organisation. A pilot study was not undertaken prior to mailing the questionnaire to all 267 registered BCA members who had graduated at least 1 year prior to the survey. The 6 page questionnaire was accompanied by a covering letter and a self-addressed stamped envelope. A total of 146 questionnaires (55% response rate) were returned. No information about the non-responders was available. Because of the structuring of the questions and reporting of the answers in terms of percentages of practitioners comparison with our survey is difficult and only general tendencies can be observed.

It was shown that a considerable change in the number of female chiropractors had occurred thus, they comprised 22.9% in 1989 as opposed to previously 8.2% of the British practitioners. In our survey the overall gender distribution was even higher for female (26%) chiropractors (Table 2.3.2). This was mainly due to the large number of recent European college graduates now comprising 81.5% of British chiropractors which was very close to the 84.4% in our survey (U.K. n=308). Only 15.8% were trained in North America and less than 1% in Australia. In Huisman's study the mean age had been reduced since 1973 by the effects of the increase in recent graduates thus, it was 36.3 years as opposed to 39.3 years previously. This was close to our overall mean age of 37 years but lower among the U.K. based practitioners as most recent graduates trained and settled here. The mean number of years in practice was 9 which was quite close to the responders in our survey (Table 2.3.3). There was an increase from 10.2% to 20.5% of practitioners holding degree level qualifications which was consistent with our findings (Table 2.4.1.1). The examinations, treatment procedures used, the conditions treated and their frequency were similar to the previous study, but there now appeared to be more patient involvement in the management. Many aspects of the survey could not be directly compared to ours. Nevertheless, many of the developments over the past 20 years tended to be consistent with our findings.

U.S.A. AND CANADA

North American surveys vary somewhat in their contents compared to European studies. This is mainly due to differences in the health care systems and the re-imbursement schemes in particular. Nevertheless, demographic features of chiropractors and specific issues such as treatment techniques were similar.

Phillips and Butler's (19) survey of chiropractors in Dade County, Florida, was conducted with a view to chiropractic care becoming integrated into the local community health system. Practitioners willing to participate in a postal questionnaire also completed information on up to 100 randomly selected new patients from the chiropractor's records beginning with the calender year of 1979. The practitioner survey was short, mainly asking for financial information. The patient questionnaire sought demographic data and clinical information, such as diagnosis, examination and treatment procedures. The documents were mailed or hand- delivered to the practitioners and returned in the same way following completion. The documents did not appear to have been piloted before carrying out the study.

Of the 170 chiropractors in Dade County, 41 (24.1%) participated in the survey. Twelve of the 41 practitioners failed to submit all the 100 cases requested (mean number of cases 98.6). No demographic information relating to the practitioners was sought and comparable data only pertained to the type of practice, that is 78% (32/41) solo practitioners and 19.5% (8/41) in a multiple practice situation. The patients' (n=3.943) complaints were similar to those found in our survey with over 90% being musculoskeletal problems, especially head and neck pain (33.8%) and low back pain (44.8%). In our survey these were 28.5% and 51.8%, respectively. The mean age (43.4 years) and sex distributions (50.5% female) closely matched findings from our survey (n=1.014, mean age 40.8 years, females 53.8%). Unfortunately, the examination and treatment procedures were categorised in a very general way so that comparison with our study was not possible. The response rate of 24.1% was well below what is anticipated for a survey, and no information was available pertaining to the non-responders which might well differ considerably from the responders. Although, the findings tend to support some of the results from our survey one must be cautious interpreting their conclusions.

Another American study more in line with our objectives was carried out in order to determine the demographic and practice characteristics of chiropractors (21). A four-part questionnaire was developed and mailed to a national stratified (by state) random sample of chiropractors. The subjects were practitioners who completed the questionnaire and were randomly selected from lists of practising chiropractors obtained from state licensing boards and state professional associations. The questionnaire used was developed in three stages. First, previous related questionnaires were reviewed. Second, based on this review, a number of questions were generated to which the authors sought answers. Third, the items generated were reviewed by a number of experts in survey development and who had an interest in chiropractic practice. Subsequently a pilot study was carried out to detect any potential problems that might arise during the conduct of the survey. After this process, the questionnaire was revised based upon suggestions from the experts and information gathered from the pilot study. The study was supported by a well known chiropractic research and educational foundation which the authors felt would increase the response rate. The document consisted of questions related to the following: personal background of the chiropractor, educational background, professional activities, and chiropractic practice. Questions dealing with patient-related activities were worded in such a manner that repeat patients would not be included in the responses, that is only information pertaining to new patients was collected. Through a compilation of lists from various licensing boards, state agencies and associations, which were screened and cleaned to eliminate duplications, the final list of chiropractors amounted to 19.000 from which a 10% stratified random sample was drawn (n=1873) based on the percentage distribution across states. Each chiropractor in the sample was mailed a questionnaire together with a stamped return-addressed envelope. Additionally, a covering letter assuring anonymity was included. A reminder postcard was mailed to each subject 3 weeks after the initial questionnaire mailing. A second reminder was sent to each subject 6 weeks after the initial mailing.

A total of only 685 questionnaires were returned completed (37% response rate). However, due to the stringent data collection methods used it was suggested that the information might after all be regarded as representative of most practising chiropractors. Additionally, the postal service was unable to deliver 152 of the questionnaires which were returned. No information about the non-responders was available. Of the 685 completed questionnaires 91% were male and the mean age was 40 years. This was a considerably higher proportion of males compared to our survey (Table 2.3.2) and more closely resembled the situation in Europe 20 years ago. In addition to their chiropractic diploma over 50% of the respondents held an undergraduate degree, 39% of the sample had a baccalaureate degree from schools other than chiropractic colleges, 38% reported they had some college degree, and 13% had some graduate work or held a graduate degree. In our survey only 29% (Table 2.4.1.1) had a qualification other than their chiropractic diploma. The higher number of practitioners in North America with additional qualifications is not surprising as some college or university education has long been required prior to entering chiropractic college. Additionally, a number of people chose chiropractic as their second career after having worked or studied in other possibly related fields, such as physical education or biology. Approximately 53% reported that they practised in an urban area, 33% in a small town and 10% in a rural area although it was not clear from the paper where the population size limits between these were. Respondents reported that on average they had been in practice for 19 years which was somewhat longer compared to our 10 years (14 years non-responders) with a mean age of 37 years (40 years non-responders) (Table 2.3.3). This might suggest that the number of new graduates has had less effect on the mean age for American chiropractors compared to European ones. Approximately 53% were graduates from 3 of the longest established American colleges and the remaining were graduates from other non-specified colleges. The conditions treated were reported as 77% neuromusculoskeletal problems, 10% viscerosomatic and 4% vascular-related conditions. This represents a slightly more diverse spectrum compared to our 95% musculoskeletal problems. However, it was not specified exactly which conditions were treated in the American study hence, there is likely to be a considerable overlap. Thus, one might anticipate more than 80% of the conditions treated to have at least a major musculoskeletal component as part of the symptom complex. The remaining information was not relevant for comparison with our survey as it related to particular American features of practice and financial information.

In Canada Kelner, Hall and Coulter (61) performed the largest independent study of chiropractic which was published in 1980. The authors interviewed one fifth of the Canadian chiropractors (n=349) and a large random sample of their patients (every fifth patient, n=658), observed field practitioners treat patients and participated for one year in the daily routine of the only Canadian chiropractic college at the time. The authors came from a sociological/behavioural science background and were based at the Behavioural Science Department of the Faculty of Medicine, University of Toronto. The research methods used included observation of the patients and chiropractors during clinic practice, and data were collected through the use of interviews and questionnaires. Only the questionnaire type data collection will be mentioned here as this part was comparable to our survey in terms of the information collected.

Information about the chiropractors was obtained by conducting a survey of all practising chiropractors in Canada. The original list of practitioners was compiled from registration lists of the national association and other unnamed sources, which among other things established the practitioners' location, age and college of graduation. The response rate to the survey was exceptionally high, 90%, and the information thus gathered became the authors' data base for various parts of their research. A random sample of 349 practitioners was drawn from a group of 1.806 practising chiropractors and thus represented approximately 20% of the total population. Several samples were drawn using various (unspecified) ways of stratifying the chiropractors in order to take into account the differences in the distribution of practitioners per province and community size. It was shown that stratifying according to the variables province and community size also provided a representative sample of type of practice (solo/group practice) and college of graduation. Thus, the total population of chiropractors was randomly distributed through the various community sizes irrespective of what college the practitioner attended or whether he/she practised in solo or group practice.

All practitioners included in the sample were asked to take part in a two-hour interview. The structured interview focused on many things and those comparable to our survey included the demographic characteristics of the practitioner, educational background, the nature of the clinic, and the nature of the patients, The response rate from the practitioners was extremely high. Eighty-seven per cent of the original sample agreed to take part, and those who refused or were unavailable were replaced with other randomly selected chiropractors. The size of the sample of practitioners was limited by the travel costs of interviewing selected chiropractors across Canada. No comparable listing was available for devising the patient sample. Instead, it was derived from the appointment books of a sub-sample of practitioners. The researchers aimed at obtaining a large random sample of patients whilst still restricted by the costs hence, a scheme was devised using the practitioners as the basis of generating a sample of patients. A sub-sample of 70 of the 349 practitioners being interviewed was randomly chosen for this purpose.

Each of the 70 chiropractors was contacted and asked if he would co- operate in three ways: To be interviewed as a practitioner; to allow the researchers to select and interview a random sample of patients; and to allow them to observe the operation of the clinic, including (with permission and signed consent) the actual treatment of the patients they would be interviewing. Eighty per cent of the chiropractors asked agreed to participate. Those who refused or were unavailable were replaced by other randomly chosen practitioners. Information about patients was obtained from selecting patients (approximately 10) at random throughout the working day of the practitioner. The selection process took into account the number of patients consulting the clinic on the day. If a practitioner saw 100 patients that day, every tenth was observed; if he saw 20 they interviewed every second; and so on. All patients were interviewed in private and this was based on a structured questionnaire and lasted approximately 30 minutes. It focused on the demographic characteristics of the patients, their use of chiropractic (past and present) care, the manner in which they came to the chiropractor, their satisfaction with the treatment received, and their views on other kinds of health care. The total patient sample consisted of 658 patients. The researchers' priority had been to ensure that a random selection of patients was obtained. The strategy used made it virtually impossible for anyone to influence the sampling procedures. The practitioners did not know ahead of time on which day observations would take place. Even if they had, they could not determine which patients would be selected. Although, most practitioners schedule their appointments ahead, there are always new appointments and cancellations, so it was not possible to predict in advance which particular patients would be chosen as respondents. Furthermore, much of the information gathered which was comparable to our survey was extracted from patient interviews following examination and treatment. This had the advantage of minimising recall bias to virtually zero and, perhaps most important of all, it eliminated practitioners' inaccurate estimates regarding the use of procedures and examinations. Unfortunately, this also meant that the information was collected under a broader category and thus lacked the many details of examination procedures, techniques, etc. which was the advantage of our survey.

The mean age of the patients was not given but 82.5% of the sample (n=658) was between 18 and 65 years of age. In our survey 70% of the patients were between 21 and 55 years of age (n=1.014). Females comprised 54% of the sample in the Canadian study and this was equal to our findings. The referral patterns showed that 45% of patients were recommended by another patient and 30% from a patient's relative. Their health complaints were reported in a number of sub-categories which were not directly comparable to our survey but overall the vast majority of complaints were of musculoskeletal origin. In our survey the time for the first and subsequent visits were first estimated and later the actual time used was recorded by the chiropractor. In the Canadian study patients reported the duration of visits and this was given as follows:

Length of Time	Percentage of Patients (n=658)	
	First Visit	Subsequent Visits
< 5 minutes	9.6	11.9
6 - 10 -	6.5	28.0
11 - 20 -	22.9	35.3
21 - 30 -	26.0	12.2
31 - 40 -	2.3	1.8
> 40 -	23.4	5.5
Don't Know/Not Available	9.2	5.5

Thus, 67% and 75% of patients were in the ranges 1-40 and 1-20 minutes for the first and subsequent visits, respectively. In our survey the estimated mean duration of the first and subsequent visits were 38.5 (S.D. 11.8, range 5-90, n=709) minutes and 13.9 (S.D. 4.9, range 2-45, n=708) minutes, respectively (Table 2.4.5). This suggests that, although the chiropractors' estimates in our survey were not particularly accurate, the average time spent with patients is similar for different continents reflecting more time spent on the initial examination and treatment and less when a routine of treatment is likely to be established. In the Canadian study the history taking (80.1%), physical examination (5.7%), therapy (66.1%) and x-ray taking (49.2%) were merely recorded as the percentage of patients who had this done on their first visit and thus were not directly comparable to our survey. However, taking x-rays in the chiropractic clinics was in our survey limited to 25% (252/1.014) of the patient population and films were frequently borrowed from hospitals, which avoided unnecessary exposure. Additional chiropractor and patient information related to for example income and other features which were not comparable to our survey.

The main advantages of the Canadian study were in the rigorous sampling procedures and the lengths to which the authors went in order to maintain representativenes at all levels of their study of both patients and chiropractors. The disadvantages were, at a time when little information was avaiable about many of the demographic and clinical features of practice, that so wide categories were set up which excluded much interesting information, This was one of the things we attempted to address in our much more detailed survey.

AUSTRALIA

The first survey of Australian chiropractors appears to be from 1975 (17). However, the studies which most closely resemble our survey have been conducted by Leboeuf and Webb (11,20,22,26,n=131). The papers published deal with various aspects of the same survey, such as demographic information about chiropractors, diagnostic and therapeutic procedures used. In another survey (31), which was carried out almost simultaneously, questionnaires were mailed to 1.100 randomly selected chiropractors in order to assess their use of various therapies. In the following the findings of the studies are presented in the chronological order of the years in which they were carried out.

Winter's study (17) aimed at surveying chiropractic practice in Australia because information to be submitted to federally initiated enquiries was lacking. Furthermore, the study set out to use the survey for exploratory purposes in developing more sophisticated investigations of particular aspects of chiropractic practice. Questionnaires were prepared by the author and finalised with the help of a firm of marketing and data processing consultants who conducted the survey and analysed the results. Survey forms were sent to all members of the Australian Chiropractors Association from all states and territories. Besides answering the practitioner section each chiropractor asked 10 patients selected according to a mathematical formula (randomly?) to complete the patients' section. The practitioner section comprised 23 questions and the patients completed 16 questions by ticking boxes against the appropriate answer(s). The response rate was 66% (n=133) for the practitioners and 62% (n=1.250) for the patients but no information about non-responding chiropractors was available. Much of the information collected was not directly comparable to our survey and the reporting of percentages of the respondents made it difficult to assess more than an overall tendency.

The gender distribution followed previous patterns with 91% of practitioners being males and thus considerably different from our findings (Table 2.3.2). The mean age of the chiropractors was not given but 16% were under 30 years, 55% between 31 and 40 years, and 29% were over 40 years of age. This would probably be fairly similar to our findings with the mean age of 37 years. It was suggested that there had been a peak in the number of graduates trained overseas during the previous decade and that a decline in new graduates was in evidence. However, the studies by Leboeuf and Webb a few years later (see below) suggested that the reverse was much more likely, and it is now well established that approximately 50% of the profession graduated since 1980 (25). Of the respondents 19% of chiropractors had been in practice for less than 3 years and 45% between 3 and 9 years so one might expect some effect on the mean age from the number of recent graduates, though this was more obvious in later studies. The practices were mainly located in small or larger towns thus, 32% of chiropractors practised in areas with a population centre of 5.001-20.000, 21% in areas sized 20.001-50.000, 11% of practitioners in areas with a population size of 50.001-100.000, 11% in towns with a population of 100.001-500.000, and 21% in areas with over 500.000 people. The population sizes were not directly comparable to our survey (Table 2.3.2) due to the differences in geography and consequent categorisation but it is evident that practitioners mainly based their clinics in well populated areas with hardly any in the rural communities. Over 75% of the chiropractors had a university entrance qualification before studying chiropractic but postgraduate qualifications were not in evidence from this sample. The pre-college qualifications were similar to those required in other continents. The patients' complaints were mainly musculoskeletal in origin with 45% low back and 26% neck and shoulder problems. This compared well to our findings of 51% low back and 28% neck and shoulder pains, and those of other studies (19,22). The gender distributions were also in accord with our survey and previous studies with 55% being females and 45% males. Because Winter's survey was probably one of the first major studies of this kind there was little information at hand which could have helped developing better questions and allowed easier comparison with other surveys. Nevertheless, much of the information collected is consistent with findings from other continents.

In 1984 Leboeuf et al. (31) conducted a postal questionnaire survey of registered chiropractors practising in Australia. Their aim was to identify the treatment techniques used as well as establish which adjunctive therapies, for example nutrition and exercise therapy, were suggested. Due to the development of the profession and legislation in various states the practitioners had a very diverse educational background. They included those practising chiropractic, osteopathy, and similar methods without any formal training at one extreme to those with degree course qualifications at the other. The latter were more typical of recent graduates. A questionnaire was mailed to 1.100 randomly selected registered chiropractors in Australia out of an estimated total of 1.500, with pre-stamped self-addressed envelopes supplied. Respondents could choose from various techniques, but the questionnaire also allowed the practitioners to add other techniques to these lists. The questionnaire asked the practitioners to identify which techniques they used primarily (major core techniques) and which techniques they employed less frequently (minor core techniques). No attempt was made to identify the frequency of use for each individual respondent. The response rate was 34.5%, much lower than another similar study on recently graduated chiropractors which was carried out around the same time (20). No information was available about the non-responders. Because the techniques used were reported as a percentage of the respondents the results were not directly comparable to our survey which listed the estimated percentage of patients for whom the techniques were used. However, their findings did give an indication of which techniques were used very frequently and a comparison with figures for recently graduated chiropractors (26) showed the following:

Total usage of technique

Technique	% of respondents	% of Recent Graduates
Diversified	73.4	87.0
Sacro-Occipital Technique (S.O.T.)	59.2	53.0
Gonstead	56.8	82.0
Nimmo	54.7	79.0
Applied Kinesiology (A.K.)	54.0	53.0
Thompson	33.2	39.0
Toggle Recoil	27.9	32.0
Logan Basic	18.2	36.0
Pierce-Stillwagon	18.2	21.0
Pettibon	3.4	N/A
Toftness	3.2	N/A

When compared to our survey (Table 2.4.4) Diversified technique clearly comes out as the most commonly used. Gonstead, Nimmo and Toggle Recoil are also widely used in all three studies but the Australian graduates tend to use Sacro-Occipital Technique, Applied Kinesiology, Thompson (negligible in our survey), Logan Basic and Pierce-Stillwagon techniques considerably more than their European colleagues. Gonstead has traditionally been taught in American colleges but is less frequently used by the increasing number of European graduates although it is part of the curriculum. More recent Australian graduates appeared to use this technique but it is not possible to asses if this was due to a large number of American trained chiropractors in the sample. Furthermore, it was not possible to ascertain why S.O.T. and A.K., which are non-forceful techniques, are so widely used in Australia, except that they are known to be popular. Thus, a number of things such as exposure at college, from other field practitioners, or availability of courses may together with other unknown factors explain the more frequent use of these techniques. In our survey female practitioners were shown to estimate using non-forceful techniques much more frequently but a direct comparison with the Australian female chiropractors is not possible here. Adjunctive therapies were not specifically analysed in our survey and the practitioners tended to integrate exercise prescription and ergonomic advice rather than treat them as separate issues. However, both European and Australian graduates tend to use exercise prescription very frequently. Furthermore, the Australian graduates also appear to put more emphasis on nutritional advice.

The other survey which was referred to above (11,20,22,26) comprised 131 recently graduated chiropractors in Australia. A questionnare was designed, annonymity ensured, and mailed in early 1985 to 150 Phillip Institute of Technology (PIT, Australia) graduate chiropractors, 70% of their total number. The same questionnaire was also mailed to 50 non-PIT graduates identified through a mailing list from the federal Australian Chiropractors' Association. This sample did not include any graduates of the second Australian chiropractic training institution, the Sydney College of Chiropractic. In order to increase the response rate the survey was advertised in the PIT newsletter, a personalised covering letter was included with the questionnaire, a pre-paid self-addressed envelope was provided, and a second mail-out was sent 2 months after the first with an explanatory letter urging non-responding practitioners to complete and return the questionnaire. In the original papers no pilot study appeared to have been conducted and the questionnaire was not included in the publications. However, the summary paper (22) of this survey stated that the questionnaire containing predominantly closed-style questions was tested, revised and retested but made no reference as to how this was done.

Of the 150 PIT graduates 108 (72%) responded, and of the non-PIT graduates 23 (46%) took part in the survey. The overall response rate was 65.5% but no information about the non-responders was available. Most non- PIT practitioners were trained in North America and the total (n=131) sample was analysed except where the non-PIT graduates differed considerably from the rest of the sample. The ages ranged from 21-58, with the median and mean ages being 39.5 and 26.9, years, respectively, for all respondents; 45.6% of these were aged from 23-25 years, whereas only 3% were over the age of 40. In our survey the mean age was 37.2 years (non- responders 40.7 years, Table 2.3.3) but the large group of young graduates from the Australian survey probably had a much greater influence on the mean age. The respondents in the study all graduated from 1978 to 1984 (23.0 % in 1983 and 16.7% in 1984) whereas our survey included graduates from 1959 to 1990 with the mean year of graduation being 1980 (Table 2.3.3). The majority of Australian practitioners were males (87.8%), a gender distribution somewhat different from our 74% males (Table 2.3.2) and thus more reminiscent of the European scene 20 years ago. As mentioned in chapter 6.3 it is common for Australian female chiropractors to work on a part time basis, or not at all, whilst raising a family thus, a large number of female undergraduates (27.5% at PIT in 1986, 38% of students in their first year) might not lead to a proportionately large numbers of registered female practitioners. Solo practice is the classical chiropractic set-up which the recently graduated chiropractors seemed to strive toward but initially they worked as associates (53%), locums (26%) or as partners (10%), and only 9% were in solo practice. At the time of the survey 56.9% were in solo practice, 18.5% associates, 18.5% partners, and 3.8% locums. Overall this was similar to findings from other studies but slightly different from our survey (Table 2.3.2) where the chiropractors tended to be longer established and the difference is perhaps a reflection of the larger number of very young, recent graduates in the Australian study. Unfortunately, the descriptions of practice location (population size) were very diffuse so no direct comparison with our findings were possible, but most practitioners were located in the Capital city suburbs (44.2%), small (24.8%) or large (15.5%) country towns. Only 23.7% of all respondents had other academic qualifications and these were 60.9% of the non-PIT graduates (n=23) compared with 15.7% of PIT graduates (n=108). This may reflect differences in the American and Australian educational systems but the overall figure compares well to our 28.7% holding other qualifications (Table 2.3.2). The examination and treatment procedures used by the chiropractors were recorded as a percentage of the respondents, and the examination procedures were categorised as used often; rarely; or never. The examination procedures listed were more extensive in our survey but due to differences in the reporting only some of the Australian findings are comparable to our study. Vital signs, such as blood pressure, heart rate, respiration rate and temperature, were generally examined much more frequently than by practitioners in our survey (Table 2.4.3), which may reflect the larger number of young, recent graduates who are known to examine more comprehensively. The neurological procedures (reflexes, sensation and muscle tests, Table 2.4.3), orthopaedic examinations and palpation were done very frequently in both studies but slightly more so by the Australian graduates. They also appeared to use x- rays more but the differences were not great here and it was not specified which particular forms of x-rays although, one must assume they were mainly skeletal films. The majority (74%) of the respondents reported spending between 16 and 30 minutes (excluding time to take x-rays) with the patients during the first visit but no information was recorded on subsequent visits. Furthermore, it was not specified if the time spent also included treatment although by implication one must assume that only examination was carried out. The findings regarding time spent on the first visit are fairly similar to those from our survey (mean 38.5 minutes, Table 2.4.5) except we included taking x-rays and treating the patient on this visit. The techniques used by the chiropractors were reported as a percentage of the respondents (n=131) and were highlighted in previous sections. There appeared to be a tendency for techniques to be related to size and gender based on the anthropometric data (height and weight) of practitioners which were also recorded. Smaller practitioners tended to use diversified techniques more frequently with the patient sitting or resting on his/her back (supine position) compared to large practitioners. The latter group appeared to show a preference for Gonstead techniques with the patient sitting. Females were somewhat more inclined to use manipulative procedures for the neck with the patient supine, whereas males chose seated techniques. Females (few in numbers) appeared more likely to choose less forcefull or stretch techniques. None of these apparant tendencies reached statistically significant levels. However, it is interesting to note from the regression analyses in our survey that female chiropractors here also tended to choose less forceful techniques but these results were based on the practitioners' own estimates and not anthropometric data (Table 4.2.3).

In a follow up paper based on the same survey of 131 recently graduated chiropractors Leboeuf and Webb (22) summarised the findings published in five previous papers and highlighted possible future developments for the profession but no new data were presented.

The review of previous studies and their methodologies showed that no superior survey has been conducted. Despite attemps to improve the study design the problems with a lack of standardisation and classification of methods, procedures and patients' conditions remain, and these could not be resolved in our survey either.

6.6 ASSUMPTIONS IN THE REGRESSION ANALYSES

The techniques employed to check the assumptions of the multiple regression analyses are briefly discussed in this section.

The skewness of all dependent variables were calculated and those which were highly and moderately skewed were log-transformed and regression analyses were compared with untransformed results (Tables 4.10.1 - 4.10.4 & Figures 4.10.1 - 4.10.4). The aim was to check how robust analyses were to changes of scale, and generally the results were reassuring. Taking the log improved the skewness of the chiropractors' estimates but it did not alter the influence of clumping. Most variables which were significant at the 5% level in untransformed analyses remained so after the transformation and hence, the conclusions are probably reasonably robust to changes in scale of measurement. Deletion of outliers was not considered as this might result in an under-estimation of the variance, tending to increase the significance of the results.

6.7 THE CLUSTER ANALYSES

The cluster analyses were used for data exploration purposes and to complement the regression analyses. The cross-classifications produced useful groups for some key demographic and usage variables, but the subjectivity of these methods must be taken into account in the evaluation and interpretation of such groups.

The cluster interpretations were difficult and clusters did not seem clearly different. There were several similarity/dissimilarity coefficients and distance measures available in CLUSTAN. The choice of which to use is essentially arbitrary with few guidelines as to which ones might be appropriate, the only clear restriction being that they should be applicable to continuous variables. We tried several approaches to see how robust resulting clusters were to variations in methods, in summary the clusters varied enormously.

The cross-classifications of clusters with the demographic variables gave similar results for some key groups and thus, complemented the regression analyses well (section 5.7). However, the subjectivity of cluster analysis compared to regression methods, and the fact that so many analyses produced uninformative clusters made it an unrewarding and time consuming exercise. It may be that this data set simply cannot be described by distinct clusters. We tried looking for clusters for the x-ray variables, the examination procedures, treatment techniques and the miscellaneous practice management variables separately. An alternative was to group all 45 usage variables together, initial attempts to do this were not fully explored, but were not promising.

6.8 CONCLUSION

The main aim was to get an overview of the data by investigating chiropractors' estimated usage of the 45 x-ray, examination and practice management procedures, and treatment techniques, and which demographic factors could be used to explain the differences in the use of such procedures. For this purpose multiple regression and cluster analysis techniques were used. In general, most effects found were small and a main conclusion is that the demographic variables did not explain much variability in self-reported practice. This leads us back to the design of the survey which, in retrospect, could have been improved if the questions asked had been more specific and possibly the data collection limited to fewer questions. In the following sections the demographic variables and their main effects are briefly listed.

The **COUNTRY**, **SEX**, **COLLEGE OF GRADUATION**, **AGE**, **DURATION OF PRACTICE** and **YEAR OF GRADUATION** are the most useful demographic features in describing the chiropractors' estimated use of x-ray, examination and practice management procedures, and treatment techniques.

COUNTRY has the greatest impact on all the explanatory variables (Table 6.8.1). This tends to support the suggestion that legal and political cultural issues influence the way chiropractors practise.

SEX is most helpful in describing differences in the use of treatment techniques and management procedures. We were able to demonstrate differences in the use of these techniques and procedures between male and female practitioners (Table 6.8.2). This has not previously been documented.

COLLEGE OF GRADUATION mainly explains differences in the use of treatment techniques, but also influences the application of musculoskeletal examinations and practice management procedures (Table 6.8.3). Although, this might have been expected in relation to treatment techniques, it has not previously been shown to affect examination and management procedures.

ACADEMIC DEGREE, the variable describing the possession of additional non-chiropractic qualifications, showed interesting features. In contrast to COLLEGE OF GRADUATION, the comparisons showed significant differences in the use of non-musculoskeletal examinations for practitioners with additional qualifications (Table 6.8.4). This might have been expected, but has not previously been established.

AGE, **DURATION OF PRACTICE** and **YEAR OF GRADUATION** (Tables 6.8.5 - 6.8.7), which were highly correlated, mainly explain the chiropractors' estimated usage of examination procedures and thus, corroborate the evidence from previous studies, that younger practitioners, usually recent graduates, examine more thoroughly. Additionally, DURATION OF PRACTICE and YEAR OF GRADUATION are also useful in explaining the time spent with patients on their first visit.

EMPLOYMENT STATUS (Table 6.8.8) and **PRACTICE ADDRESS** (Table 6.8.9) were generally not helpful in explaining the usage of the x-ray, examination and management procedures, and treatment techniques.

The cluster analyses were extremely time consuming and gave few useful results from this data set. The clusters in many cases had no compelling interpretation. When they were cross-classified with the demographic variables little of interest emerged, and what did transpire from some of the classifications confirmed the findings from the regression analyses. In general, the time spent on this part of the study was not rewarded by useful clusters.

Obtaining information from a postal questionnaire of chiropractors registered by their National Associations was considered the most feasable approach to a European survey. However, the data collected suffered from the lack of standardisation and poor record keeping in individual countries. This was further hampered by low response rates from some associations.

The requirements of this first European survey extended beyond the limits of well defined research questions. The study did provide the answers requested by the major funding organisation (The European Chiropractors' Union) in establishing a useful body of knowledge about chiropractors in Europe. The profile of chiropractors and the conditions they treat are similar to those seen in other continents.

Although enjoying popular support from patients with musculoskeletal disorders, it is only with the social, legal and scientific developments during the past decade that the chiropractic profession has seen its most dramatic changes towards becoming a fully recognised independent health care profession. It is hoped that the experiences and results from this study will help such progress through the development of succinct research questions for more detailed analysis.

Table 6.8.1 **Overview of usage variables where COUNTRY explains significant differences in unadjusted and adjusted comparisons.**

	USAGE VARIABLES EXPLAINED
X-RAY PROCEDURES	Take skeletal x-rays
	Take soft tissue x-rays
	Ask about menstrual cycle
	Get oral consent
	Get written consent
	Get x-rays from another chiropractor
	Get x-rays from hospital via the GP
	Get x-rays directly from hospital
	Obtain x-rays from a private radiological clinic
	The patient brings the x-rays
EXAMINATION PROCEDURES	Postural spinal analysis
	Dynamic spinal palpation
	Orthopaedic tests - Lumbar
	Orthopaedic tests - Cervical
	Neurological - reflexes
	Neurological - sensation
	Neurological - muscle tests
	Take the pulse
	Check the respiration rate
	Abdomen examination
	Heart auscultation
	Lung auscultation
	Mouth examination
TREATMENT TECHNIQUES	Diversified
	Gonstead
	HIO
	Toggle Recoil
	Logan
	SOT
	AK
	Nimmo
	Activator
	Toftness
PRACTICE MANAGEMENT	Give emotional/social counselling
	Time spent on the patient's first visit
	Time spent on subsequent patient visits

Table 6.8.2 Overview of usage variables where SEX explains significant differences in unadjusted and adjusted comparisons.

(*) - Denotes that significant differences were found in the adjusted models only.

	USAGE VARIABLES EXPLAINED
X-RAY PROCEDURES	Obtain x-rays from a private radiological clinic (*)
EXAMINATION PROCEDURES	Take the blood pressure Perform dynamic palpation (*)
TREATMENT TECHNIQUES	Logan SOT Nimmo Activator Toftness HIO (*) Toggle Recoil (*) Pettibon (*)
PRACTICE MANAGEMENT	Treat by manipulation only on the patient's first visit Rate agreement to prescribe drugs Time spent on the patient's first visit Time spent on subsequent patient visits

Table 6.8.3 Overview of usage variables where COLLEGE OF GRADUATION explains significant differences in unadjusted and adjusted comparisons.

(*) - Denotes that significant differences were found in the adjusted models only.

	USAGE VARIABLES EXPLAINED
X-RAY PROCEDURES	Get oral consent
EXAMINATION PROCEDURES	Postural spinal analysis Dynamic spinal palpation Orthopaedic tests - Lumbar Neurological - reflexes
TREATMENT TECHNIQUES	Diversified Gonstead Toggle Recoil SOT AK Activator Pettibon Pierce-Stillwagon Nimmo (*)
PRACTICE MANAGEMENT	Treat by manipulation only on the patient's first visit Rate agreement to prescribe drugs Time spent on subsequent patient visits

Table 6.8.4 Overview of usage variables where ACADEMIC DEGREE explains significant differences in unadjusted and adjusted comparisons.

(*) - Denotes that significant differences were found in the adjusted models only.

	USAGE VARIABLES EXPLAINED
X-RAY PROCEDURES	Get x-rays directly from hospital The patient brings the x-rays
EXAMINATION PROCEDURES	Postural spinal analysis (*) Take the pulse Take the blood pressure Abdomen examination Heart auscultation Lung auscultation
TREATMENT TECHNIQUES	None
PRACTICE MANAGEMENT	Give emotional/social counselling

Table 6.8.5 Overview of usage variables where AGE explains significant differences in unadjusted and adjusted comparisons.

(*) - Denotes that significant differences were found in the adjusted models only.

	USAGE VARIABLES EXPLAINED
X-RAY PROCEDURES	Get x-rays from hospital via the GP (*)
EXAMINATION PROCEDURES	Dynamic spinal palpation Orthopaedic tests - Lumbar Orthopaedic tests - Cervical Neurological - reflexes Neurological - sensation Neurological - muscle tests Heart auscultation (*)
TREATMENT TECHNIQUES	Gonstead HIO Toggle Recoil (*) Pierce-Stillwagon (*)
PRACTICE MANAGEMENT	None

Table 6.8.6 Overview of usage variables where DURATION OF PRACTICE explains significant differences in unadjusted and adjusted comparisons.

(*) - Denotes that significant differences were found in the adjusted models only.

	USAGE VARIABLES EXPLAINED
X-RAY PROCEDURES	Get x-rays from hospital via the GP (*)
EXAMINATION PROCEDURES	Dynamic spinal palpation Orthopaedic tests - Lumbar Orthopaedic tests - Cervical Neurological - reflexes Neurological - sensation Neurological - muscle tests Heart auscultation (*)
TREATMENT TECHNIQUES	Gonstead (*) HIO Toggle Recoil (*) Pierce-Stillwagon (*)
PRACTICE MANAGEMENT	Treat by manipulation only on the patient's first visit Time spent on the patient's first visit

Table 6.8.7 Overview of usage variables where YEAR OF GRADUATION explains significant differences in unadjusted and adjusted comparisons.

(*) - Denotes that significant differences were found in the adjusted models only.

	USAGE VARIABLES EXPLAINED
X-RAY PROCEDURES	Get x-rays from hospital via the GP (*)
EXAMINATION PROCEDURES	Dynamic spinal palpation Orthopaedic tests - Lumbar Orthopaedic tests - Cervical Neurological - reflexes Neurological - sensation Neurological - muscle tests Heart auscultation (*) Mouth examination
TREATMENT TECHNIQUES	Gonstead (*) HIO Toggle Recoil (*) Pierce-Stillwagon (*)
PRACTICE MANAGEMENT	Treat by manipulation only on the patient's first visit Time spent on the patient's first visit

Table 6.8.8 **Overview of usage variables where EMPLOYMENT STATUS explains significant differences in unadjusted and adjusted comparisons.**

	USAGE VARIABLES EXPLAINED
X-RAY PROCEDURES	None
EXAMINATION PROCEDURES	Neurological - reflexes Neurological - sensation Heart auscultation
TREATMENT TECHNIQUES	None
PRACTICE MANAGEMENT	Time spent on subsequent patient visits

Table 6.8.9 Overview of usage variables where PRACTICE ADDRESS explains significant differences in unadjusted and adjusted comparisons.

(*) - Denotes that significant differences were found in the adjusted models only.

	USAGE VARIABLES EXPLAINED
X-RAY PROCEDURES	Ask about menstrual cycle Get x-rays from another chiropractor (*) The patient brings the x-rays
EXAMINATION PROCEDURES	Neurological - sensation Check the respiration rate Heart auscultation Mouth examination
TREATMENT TECHNIQUES	Toggle Recoil Logan Pierce-Stillwagon
PRACTICE MANAGEMENT	Time spent on subsequent patient visits (*)

6.9 IMPLICATIONS OF THE STUDY

This is the first and most comprehensive study of members of the European Chiropractors' Union and thus, the largest survey of the profession in Europe. Apart from limited information about demographic and practice characteristics little documentation was available to describe the chiropractors and the way they practised.

The developments in basic and clinical science relevant to chiropractic, which have emerged since the late 1970s, and more recent changes in the European Community made it necessary for the profession to look carefully at where it is going and how these changes are likely to affect its future development. The descriptive parts of this survey (Chapter 2) were required to get an overview of European practice for comparison with other continents and for factual documentation in negotiations with Government officials and other health professions.

This survey establishes the foundation for European National Associations to document what they are doing in society, particularly, when the pressures of accountability and consumer satisfaction are ever increasing.

In the discussion suggestions on how to improve the design and methodology of the survey were put forward. Further studies might include the analysis of patient data with an assessment of how specific conditions are examined and treated by the practitioners, and how differencies between male and female chiropractors may appear in the management of patients. This might be done for a large group of patients with very similar complaints, for example low back or neck pain, and with pre-arranged examination/treatment protocols established. It would also be interesting to do this in different countries and investigate how legal and political cultural aspects may affect the management of patients. In the data from our survey it is most likely that further analysis of the data along these lines may only indicate potential associations but with the suggested improvements in the design a new follow up study would be required. The identification of the specific components of the management which may be most effective could be the subject of a future clinical trial.

REFERENCES

1. Meade, T.W., Dyer, S., Browne, W., Townsend, J. & Frank, A.O. (1990) Low back pain of mechanical origin: Randomised comparison of chiropractic and hospital outpatient treatment. British Medical Journal **300**, 1431-1437.

2. Brønfort G. (1986) Chiropractic treatment of low back pain: A prospective survey. Journal of Manipulative and Physiological Therapeutics June **9**, (2), 99-113.

3. Koes, B.W., Bouter, L.M., van Mameren, H., Essers, A.H.M., Verstegen, G.M.J.R., Hofhuizen, D.M., Houben, J.P. & Knipschild, P.G. (1992) Randomised clinical trial of manipulative therapy and physiotherapy for persistent back and neck complaints: Results of one year follow up. British Medical Journal **304**, 601-605.

4. Frymoyer, J.W. (1989) Epidemiology. In: Frymoyer, J.W. & Gordon, S.L. (Editors) New Perspectives on Low Back Pain. Symposium, American Academy of Orthopaedic Surgeons, 222 South Prospect Avenue, Park Ridge, Illinois 60068, U.S.A., Chapter 3.

5. Kelsey, J.L. & Golden, A.L. (1990) Epidemiology of low back pain. In: Floman, Y. (Editor) Disorders of the Lumbar Spine. Aspen Publishers Inc., Rockville, Maryland, U.S.A., Chapter 4.

6. Pedersen, P. (1990) The identity of chiropractic practice with special reference to Western Europe. European Journal of Chiropractic **38**, (2), 41-55.

7. Wardwell, W.I. (1992) Chiropractic: History and Evolution of a New Profession. Mosby Year Book, St. Louis, U.S.A., Chapter 4.

8. European Journal of Chiropractic (1990), **38**, (2), (The definition of chiropractic appears on the last page).

9. Gaucher-Peslherbe, P.-L. (1992) Chiropractic Early Concepts in their Historical Setting. Quoted in: Wardwell, W.I. (1992) Chiropractic: History and Evolution of a New Profession. Mosby Year Book, St. Louis, U.S.A., p15.

10. Breen, A.C. (1976) Chiropractic in Britain. Annals of the Swiss Chiropractors' Association **6**, 207-218.

11. Leboeuf, C. & Webb, M.N. (1988) Recently graduated chiropractors in Australia. Part 4 - Diagnostic procedures. Journal of the Australian Chiropractors' Association June **18**, (2), 60-62.

12. Burton, K. (1977) A work study of the Osteopathic Association of Great Britain. **Part 1.** The structure of practice. pp 1-6.

13. Burton, K. (1977) A work study of the Osteopathic Association of Great Britain. **Part 2.** The characteristics of patients. pp 1-6.

14. Plaugher, G. (1992) The role of plain film radiography in chiropractic clinical practice. Chiropractic Journal of Australia, **22**, (4), 153-161.

15. Wardwell, W.I. (1980) The present and future role of the chiropractor. In: Haldeman, S. (Editor) Modern Developments in the Principles and Practice of Chiropractic. Appleton-Century-Crofts, New York, Chapter 2.

16. Tamulaitis, C.M., Auerbach, G.A., Chance, M.A., Gaucher-Peslherbe, L., Engelbrecht, R.V. & Takeyachi, K. (1992) Chiropractic growth outside North America. In: Haldeman, S. (Editor) Principles and Practice of Chiropractic. Appleton & Lange, Norwalk, Connecticut, 2nd edition, Appendix, pp 599-619.

17. Winter, D.O. (1975) A chiropractic survey. Journal of the Australian Chiropractors' Association **October-December**, 7-13.

18. New Zealand Report. (1979) Chiropractic in New Zealand. Report of the Commission of Inquiry into chiropractic. The Government Printing Office, Wellington, New Zealand.

19. Phillips, R.B. & Butler, Jr., R. (1982) Survey of chiropractic in Dade County, Florida. Journal of Manipulative and Physiological Therapeutics June **5**, (2), 83-89.

20. Leboeuf, C. & Webb, M.N. (1987) Recently graduated chiropractors in Australia. Part 1 - Personal and professional demographic profile. Journal of Manipulative and Physiological Therapeutics **17**, (3), 99-102.

21. Baffi, C.R., Redican, K.J., Morris, L., Schroeder, K.K. & Olsen, L.K. (1988) Demographic and practice characteristics of chiropractors. Journal of Manipulative and Physiological Therapeutics April **11**, (2), 85-88.

22. Leboeuf, C. & Webb, M.N. (1990) A survey of recently graduated chiropractors in Australia. Journal of Manipulative and Physiological Therapeutics **13**, (4), 152-156.

23. Breen, A.C. (1977) Chiropractors and the treatment of back pain. Rheumatology and Rehabilitation **16**, 46-53.

24. Huisman, M. (1989) Chiropractic practice in Britain. Undergraduate Project, Anglo-European College of Chiropractic, Bournemouth, England.

25. Chapman-Smith, D. (1993) The chiropractic profession. The Chiropractic Report, Toronto, Fumia Publications Inc., **7**, p1.

26. Webb, M.N. & Leboeuf, C. (1988) Recently graduated chiropractors in Australia. Part 5: Therapeutic procedures. Journal of the Australian Chiropractors' Association December **18**, (4), 128-130.

27. Hennigan, T.W., Franks, P.J., Hocken, D.B. & Allen-Mersh, T.G. (1990) Rectal examination in general practice. British Medical Journal **301**, 478-480.

28. Lamm, L.C & Wegner, E. (1989) Chiropractic scope of practice: What the law allows. American Journal of Chiropractic Medicine December **2**, (4), 155-159.

29. Wardwell, W.I. (1992) Chiropractic: History and Evolution of a New Profession. Mosby Year Book, St. Louis, U.S.A., Chapter 13.

30. Haldeman, S. & Hammerich K. (1973) The evolution of neurology and the concept of chiropractic. ACA Journal of Chiropractic August **7**, pp. S-57 - S-63.

31. Leboeuf, C. Kent, J.P. & Swatland, J. (1987) The use of major and minor therapy forms in Australian chiropractic practices. Journal of the Australian Chiropractors' Association **17**, (3), 109-111.

32. Wardwell, W.I. (1989) The Connecticut survey of public attitudes toward chiropractic. Journal of Manipulative and Physiological Therapeutics June **12**, (3), 167-173.

33. Pedersen, P., Kleberg, P. & Walker, K. (1993) A pilot survey of patients and chiropractors in European chiropractic practices: Sociodemographic, anamnestic and management procedures. European Journal of Chiropractic **41**, (1), 5-19.

34. Norusis, M.J. (1988) SPSS/PC+ V2.0 Base Manual. SPSS Inc., Chicago, U.S.A.

35. Lamberts, H. & Wood, M. (Editors) (1987) ICPC - International Classification of Primary Care. Oxford University Press, New York.

36. Bland, J.M. & Altman, D.G. (1986) Statistical methods for assessing agreement between two methods of clinical measurement. The Lancet 8 February, 307-310.

37. Kleinbaum, D.G., Kupper, L.L. & Muller, K.E. (1988) Applied Regression Analysis and Other Multivariable Methods. PWS-KENT Publishing Company, Boston, U.S.A., 2nd edition.

38. Minitab: Data Analysis Software. (1989) Release 7.2 - Standard version, Minitab Inc., Canyon Lake, Texas.

39. Minitab (1991). Reference Manual. Release 8, PC version, November, Minitab Statistical Software, Minitab Inc., Canyon Lake, Texas.

40. Paykel, E.S & Rassaby, E. (1978) Classification of suicide attempters by cluster analysis. British Journal of Psychiatry **133**, 45-52.

41. Matussek, P., Soldner, M. & Nagel, D. (1981) Identification of endogenous depressive syndrome based on the symptoms and the characteristics of the course. British Journal of Psychiatry **138**, 361-372.

42. Heinrich, I., O'Hare, H., Sweetman, B. & Anderson, J.A.D. (1985) Validation aspects of an empirically derived classification for non-specific low back pain. The Statistician **34**, 215-230.

43. Fairbank, J.C.T. & Pynsent, P.B. (Editors) (1990) Back Pain: Classification of Syndromes. Manchester University Press, Manchester.

44. Tryon, R.C. (1939) Cluster Analysis. Edward Brothers, Ann Arbor, U.S.A.

45. Tryon, R.C. (1958) General dimensions of individual differencies: Cluster analysis versus multiple factor analysis. Educ. Psychol. Measurements **18**, 477-495.

46. Cattell, R.B. (1944) A note of correlation clusters and cluster search methods. Psychometrika **9**, 169-184.

47. Bromley, D.B. (1966) Rank order cluster analysis. Br. J. Math. Stat. Psychol. **19**, 105-123.

48. Wishart, D. (1987) Clustan User Manual (Clustan 3). Computing Laboratory, University of St. Andrews, 4th edition, Clustan Limited, 16 Kingsburgh Road, Edinburgh.

49. Sokal, R.R. & Michener, C.D. (1958) A statistical method for evaluating systematic relationships. Univ. Kansas Sci. Bull. **38**, 1409-1438.

50. Lance, G.N. & Williams, W.T. (1966) Computer programs for hierarchical polythetic classification. Comp. J. **9**, 60-64.

51. King, B.F. (1966) Market and industry factors in stock price behaviour. Journal of Business **39**, 139-190.

52. King, B.F. (1967) Step wise clustering procedures. J. Am. Stat. Assoc. **62**, 86-101.

53. Gower, J.C. (1967) A comparison of some methods of cluster analysis. Biometrics **23**, 623-628.

54. Ward, J.H. (1963) Hierarchical grouping to optimize an objective function. J. Am. Stat. Assoc. **58**, 236-244.

55. MacQueen, J.B. (1967) Some methods for classification and analysis of multivariate observations. In: Proceedings of 5th Berkeley Symposium on Mathematical Statistics and Probability, Berkeley, California, University of California Press, Vol. **1**, 281-297.

56. Everitt, B.S. (1993) Cluster Analysis. Edward Arnold, London, 3rd edition, Chapter 3.

57. Fleiss, J.L. & Zubin, J. (1969) On the methods and theory of clustering. Multivariate Behaviour Res. **4**, 235-250.

58. SAS (1990). SAS/STAT User's Guide. Version 6, 4th edition, Vol. **1**, Chapter 6.

59. Dixon, W.J. (Chief Editor) (1985) BMDP Manual. University of California Press, Berkeley, California, U.S.A.

60. Wardwell, W.I. (1992) Chiropractic: History and Evolution of a New Profession. Mosby Year Book, St. Louis, U.S.A., Chapter 14.

61. Kelner, M., Hall, O. & Coulter I. (1980) Chiropractors: Do they help? A study of their education and practice. Fitzhenry & Whiteside, Toronto.

APPENDIX 1

THE PRACTITIONER QUESTIONNAIRE

CHIROPRACTIC PRACTITIONER QUESTIONNAIRE.
EUROPEAN SURVEY OF CHIROPRACTIC PRACTICE - MAIN SURVEY

Principal investigator - Palle Pedersen, D.C.
A.E.C.C. Research Department

Date for filling in the questionnaire:	For office use only
---- day ---- month ---- year	Research code: --------
	Country code: --------

PART 1: **PRACTITIONER INFORMATION**

Please complete ALL of the following questions.

1. **ARE YOU** male or female?
(Please tick)

Male __ [1] Female __ [2]

2. **WHAT IS** your date of birth?

____ Day ___ Month ___ Year [Age]

3. **WHAT IS** your nationality?

________________________ [Nation]

4. **WHAT IS** your present legal marital status?
(Please tick ONLY ONE)

Single ___ [1]

Not married (single) but living together ___ [2]

Married ___ [3] Divorced ___ [4]

Separated/estranged ___ [5] Widdowed ___ [6]

5. **WHAT BEST DESCRIBES** the area in which your practice address(es) is/are located?
(Indicate the first established satellite clinic if more than one)

(Please tick)

Main clinic:

Metropolitan (population > 250,000): ___ [1]
Urban (population 50,000-250,000): ___ [2]
Semi-urban (population 2,000-49,999): ___ [3]
Rural (population < 2000): ___ [4]

Satellite clinic:

Does not apply: ___ [7]
Metropolitan (population > 250,000): ___ [1]
Urban (population 50,000-250,000): ___ [2]
Semi-urban (population 2,000-49,999): ___ [3]
Rural (population < 2,000): ___ [4]

FOR GUIDELINES WITH REGARDS TO WHAT CONSTITUTES MAIN AND SATELLITE CLINICS RESPECTIVELY, PLEASE SEE THE BLUE SHEET AT THE END OF THE QUESTIONNAIRE

---

6. **FROM WHICH** College did you graduate?

Name of the College: ________________ [College]

7. **IN WHICH** year did you graduate? 19 _____ [Year]

8. **HOW LONG** in all have you practised as a graduate chiropractor?

Years: _____ Months: _____ [Months]

9. WHAT IS your CURRENT status in the clinic(s) in which you work?
(Please tick as appropriate both main and satellite clinic)

	Main clinic	Satellite clinic
Does not apply		___ [7]
Self-employed - independent (solo practice, 1 chiropractor only)	___ [1]	___ [1]
Self-employed chiropractor - partnership (group practice, > 1 chiropractor)	___ [2]	___ [2]
Self-employed chiropractor (group practice, > 1 chiropractor/other Clinician, eg. health centre; EXCL. partnership	___ [3]	___ [3]
Employed chiropractor (group practice, > 1 chiropractor/other clinician, eg. health centre)	___ [4]	___ [4]

10. HOW LONG have you worked in the current practice(s) as a graduate chiropractor?

(First established satellite clinic, if more than one; <u>same</u> practice may have had a different address in the past)

(Please tick)

<u>Main clinic</u>

<u>Satellite clinic</u>

Does not apply ___ [97]

Years ___ Months ___ [Months]

Years ___ Months ___ [Months]

11. IN HOW many clinics do you CURRENTLY work as a chiropractor?

(Please circle)

1 2 3 4 5 > 5 [ ]

12. DO YOU hold a secondary school* leaving certificate?
(* Grammar/High school)

(Please tick)

Yes _____ [1] No _____ [2]

13. DO YOU hold any (non-chiropractic) academic qualifications?

(Please tick)

None _____ [9]

*BSc (Physical Education) ___ [1]

*BSc (Other) ___ [2] MSc ___ [3] PhD ___ [4]

MD ___ [5] BA ___ [6] MA ___ [7]

Physiotherapist ___ [8]

Other (please specify) ________________________

____

________________________________ ___ [10]

* National qualifications comparable to the British Bachelor of Science degree:

Denmark	:	Cand. Scient.
France	:	Licence
Italy	:	Laurea
Norway	:	Cand. Mag.
Spain	:	Licenciado
Sweden	:	Fil. Kand./FK
Switzerland	:	Diploma/Staatsdiplom/Lizentiat/ Diplom d'etat

PART 2: PRACTICE PROCEDURES - RADIOGRAPHY

14. IN THE country where you work, what is CURRENTLY the legal situation for chiropractors with respect to taking x-rays IN THEIR OWN CLINIC?

(Please tick)

(a) Prohibited by law (Go to Question 16) ___ [1]

(b) Prohibited by law but can order directly from hospital (Go to Question 16) ___ [2]

(c) Not prohibited by law ___ [3]

(d) Don't know ___ [8]

15. DO YOU have x-ray facilities available to you in the clinic(s) in which you work?

(First established satellite clinic if more than one).

(Please tick)

Main clinic	Satellite clinic
	Does not apply ___ [7]
Yes ___ [1]	Yes ___ [1]
No ___ [2]	No ___ [2]

(Answer Questions 16 & 17 and then go directly to Part 3, Question 30).

16. IN WHAT proportion of ALL your patients would you estimate that you obtain x-rays/the results of radiological investigations from other sources, such as the ones mentioned below?

(Please answer ALL sections a-e (f), marking with X on the line).

(a) X-rays are obtained from another chiropractic clinic (eg. main clinic, if working in more than one, or from a colleague's clinic).

0 20 40 60 80 100 %
/____/____/____/____/____/ [ ]

(b) X-rays are obtained from hospital via the patient's general medical practitioner.

0 20 40 60 80 100 %
/____/____/____/____/____/ [ ]

(c) X-rays are obtained directly from hospital.

0 20 40 60 80 100 %
/____/____/____/____/____/ [ ]

(d) X-rays are obtained from a private clinic (eg. radiologist).

0 20 40 60 80 100 %
/____/____/____/____/____/ [ ]

(e) The patients usually bring the results (x-rays, MRI, CT-scan, etc) from radiological investigations performed elsewhere.

0 20 40 60 80 100 %
/____/____/____/____/____/ [ ]

(f) Other (please specify):

____

______________________________ [ ]

17. HOW IMPORTANT do you generally consider the below listed reasons/indications for taking skeletal x-rays of the cervical and lumbar spine for any given patient?

(Rate by INCREASING order of priority, ie 1,2,3,4,5. 1 = least important; 5 = most important reason. Rate EACH section a-e. Please answer even if you are not allowed to take x-rays in a chiropractic clinic).

(DJD = Degenerative Joint Disease)

Cervical Spine:

(a) Visually evaluate overall posture: ___ [ ]

(b) Evaluate the extent of DJD: ___ [ ]

(c) Exclude pathology (inflammatory, infectious and malignant conditions): ___ [ ]

(d) Draw lines to determine listings for adjusting ONLY: ___ [ ]

(e) Draw lines to determine postural changes ONLY: ___ [ ]

(f) Other (please specify):

____

____

_______________ [ ]

<u>Lumbar Spine:</u>

(a) Visually evaluate overall posture: ___ [ ]

(b) Evaluate the extent of DJD: ___ [ ]

(c) Exclude pathology (inflammatory, infectious and malignant conditions: ___ [ ]

(d) Draw lines to determine listings for adjusting ONLY: ___ [ ]

(e) Draw lines to determine postural changes ONLY: ___ [ ]

(f) Other (please specify):

____

____

_______________ [ ]

PRACTITIONERS WHO HAVE TICKED "NO" IN QUESTION 15, PLEASE GO STRAIGHT TO PART 3 AND COMPLETE THE REST OF THE QUESTIONNAIRE, STARTING WITH QUESTION 30.

PRACTITIONERS WHO HAVE TICKED "YES" IN QUESTION 15, PLEASE READ THE INSTRUCTIONS BELOW AND COMPLETE THE REST OF THE QUESTIONNAIRE STARTING WITH QUESTION 18.

<u>For practitioners answering Questions 18-29, please complete the questions as if you take or order x-rays yourself in the clinic(s) in which you practice.</u>

18. **IN WHAT** proportion of your patients with low back pain would you estimate that you take or order skeletal x-rays?

(Please use X on the line).

0 20 40 60 80 100 %
/____/____/____/____/____/ [ ]

19. **IN WHAT** proportion of ALL your patients would you estimate that you take or order soft tissue x-rays, such as, for example, chest and abdominal films?

(Please use X on the line)

0 20 40 60 80 100 %
/____/____/____/____/____/ [ ]

20. **FOR <u>MALE</u>** patients, below which age do you normally (ie. in most cases) use gonadal shields when x-raying?

(Please tick the most inclusive age category ONLY)

Below age 30 ___ [1] Below age 40 ___ [2]

Below age 50 ___ [3] Below age 60 ___ [4]

Below age 70 ___ [5] Never use shields ___ [6]

21. **FOR <u>FEMALE</u>** patients, below which age do you normally (ie. in most cases) use gonadal shields when x-raying?

(Please tick the most inclusive age category ONLY)

Below age 30 ___ [1] Below age 40 ___ [2]

Below age 50 ___ [3] Below age 60 ___ [4]

Below age 70 ___ [5] Never use shields ___ [6]

22. **FOR ALL** female patients of child-bearing age, what best describes the proportion whom you ask for the stage of her menstrual cycle before taking or ordering x-rays?

(Please use X on the line)

0 20 40 60 80 100 %
/____/____/____/____/____/ [ ]

23. **IN WHAT** proportion of all your patients would you estimate that you obtain oral and/or written consent before taking or ordering x-rays?

(Please answer **BOTH** sections (a) and (b), marking with X on the line)

(a) Oral consent:

0 20 40 60 80 100 %
/____/____/____/____/____/ [ ]

(b) Written consent:

0 20 40 60 80 100 %
/____/____/____/____/____/ [ ]

24. **IN WHAT** estimated proportion of ALL the radiographs taken do you, by the use of collimation, see an unexposed area around the edge of the film?

(Please use X on the line)

0 20 40 60 80 100 %
/____/____/____/____/____/ [ ]

Machine has no collimator ___

25. **WHICH TYPE** of film identification is currently used in the clinic(s) in which you work?

(Please tick as appropriate)

Main clinic:
- None ___ [8]
- Actimic (light) marker ___ [1]
- Lead lettering ___ [2]
- Adhesive labelling ___ [3]
- X-ray pencil marking ___ [4]
- Other (please specify):

________________________ [5]

Satellite clinic
- Does not apply ___ [7]
- None ___ [8]
- Actimic (light) marker ___ [1]
- Lead lettering ___ [2]
- Adhesive labelling ___ [3]
- X-ray pencil marking ___ [4]
- Other (please specify):

________________________ [5]

26. **IN THE** clinic(s) in which you practice, who normally (ie. in most cases) takes the x-rays of your patients?

(First established satellite clinic if more than one).

(Please tick as appropriate)

	Main clinic	Satellite clinic
	Does not apply	___ [7]
Yourself	___ [1]	___ [1]
Another chiropractor - within the practice	___ [2]	___ [2]
A radiographer	___ [3]	___ [3]
A nurse	___ [4]	___ [4]
The receptionist/ secretary	___ [5]	___ [5]
Chiropractic assistant (not qualified chiropractor)	___ [6]	___ [6]
Other (please specify): ____________	___ [8]	___ [8]

27. **WHAT KIND** of x-ray development procedure is used in the clinic(s) in which you practice?

(First established satellite clinic if more than one).

(Please tick as appropriate)

	Main clinic	Satellite clinic
	Does not apply	___ [7]
Automatic film processor	___ [1]	___ [1]
The time/temperature method (manual processing)	___ [2]	___ [2]

28. WHO MOST frequently develops the x-rays in the clinic(s) in which you practice?

(Please tick as appropriate)

	Main clinic	Satellite clinic
Does not apply		___ [7]
Yourself	___ [1]	___ [1]
Another chiropractor - within the practice	___ [2]	___ [2]
A radiographer	___ [3]	___ [3]
A nurse	___ [4]	___ [4]
The receptionist/ secretary	___ [5]	___ [5]
Chiropractic assistant (not qualified chiropractor)	___ [6]	___ [6]
Other (please specify): ______________	___ [8]	___ [8]

29. IN THE clinic(s) in which you practice most of the time, how do you charge for the x-rays which are taken on the first visit only?

(Please tick ONLY ONE in BOTH (A) and (B))

Do you charge:	A Main clinic	B Satellite clinic
Does not apply		___ [7]
(a) Per single x-ray (adding proportionally with the number of x-rays taken)?	___ [1]	___ [1]
(b) For a number of x-rays (lump sum payment, eg. for more than seven x-rays)?	___ [2]	___ [2]
(c) For a radiographic examination only (irrespective of area and number of x-rays taken)?	___ [3]	___ [3]
(d) For a combined radiographic and physical examination/ consultation (irrespective of area and number of x-rays taken)?	___ [4]	___ [4]
(e) Other (please specify): ______________	___ [5]	___ [5]

PART 3: PRACTICE PROCEDURES - LABORATORY INVESTIGATION

30. In the clinič(s) in which you practice, do you have any facillties available to you for doing laboratory testing?

(Please tick as appropriate)

	Main clinic	Satellite clinic
Does not apply		___ [7]
Yes	___ [1]	___ [1]
No	___ [2]	___ [2]
	(Go to Question 32)	(Go to Question 32)
Don't know	___ [8]	___ [8]
	(Go to Question 32)	(Go to Question 32)

31. IN THE clinic(s) in which you practice, do you have facilities for doing:

(Please tick as appropriate)

		Main clinic	Satellite clinic
	Does not apply		___ [97]
(a)	All tests listed below (b-o)?	___ [1]	___ [1]
(b)	Venous blood withdrawal?	___ [2]	___ [2]
(c)	Haemoglobin estimation?	___ [3]	___ [3]
(d)	Dipstick urinalysis?	___ [4]	___ [4]
(e)	Dipstick <u>and</u> micro-scopic urine examination?	___ [5]	___ [5]
(f)	Erythrocyte sedimentation rate (ESR): Micro?	___ [6]	___ [6]
(g)	Erythrocyte sedimentation rate (ESR): Macro?	___ [7]	___ [7]
(h)	Rheumatoid factor (RF)?	___ [8]	___ [8]
(i)	White blood cell determination?	___ [9]	___ [9]
(j)	Blood smears/microscopy?	___ [10]	___ [10]
(k)	Serum uric acid?	___ [11]	___ [11]
(l)	Serum alkaline phosphatase?	___ [12]	___ [12]
(m)	Serum acid phosphatase?	___ [13]	___ [13]
(n)	Bacteriological sample collection?	___ [14]	___ [14]
(o)	Bacteriological staining <u>and</u> microscopy?	___ [15]	___ [15]

PART 4: PRACTICE PROCEDURES - EXAMINATION PROCEDURES

32. IN WHAT proportion of all your patients would you estimate that you perform an overall postural analysis as part of your physical examination <u>by observation ONLY</u>?

(Please use X on the line)

0 20 40 60 80 100 %
/____/____/____/____/____/ [ ]

33. IN WHAT proportion of all your patients would you estimate that you use palpation in your musculoskeletal examination?

(Please use X on the line in both [a] and [b])

(a) Static palpation:

0 20 40 60 80 100 %
/____/____/____/____/____/ [ ]

(b) Dynamic/motion palpation:

0 20 40 60 80 100 %
/____/____/____/____/____/ [ ]

34. IN WHAT proportion of all your patients with low back pain would you estimate that you use orthopaedic testing procedures for the lumbar spine and lower extremity, such as, for example, straight leg raise/Lasegue and Fabere-Patrick's (Jansen's) test?

(Please use X on the line)

0 20 40 60 80 100 %
/____/____/____/____/____/ [ ]

35. IN WHAT proportion of all your patients with neck pain would you estimate that you use orthopaedic testing procedures for the cervical spine and upper extremity, such as, for example, Bradford Spurling's (foraminal compression test) and Adson's test?

(Please use X on the line)

0 20 40 60 80 100 %
/____/____/____/____/____/ [ ]

36. IN WHAT proportion of all your patients would you estimate that you use neurological examination procedures, such as testing reflexes, sensation and muscle strength?

(Please use X on the line in EACH section a-c)

(a) Reflexes:

0 20 40 60 80 100 %
/____/____/____/____/____/ [ ]

(b) Sensation:

0 20 40 60 80 100 %
/____/____/____/____/____/ [ ]

(c) Muscle strength:

0 20 40 60 80 100 %
/____/____/____/____/____/ [ ]

37. IN WHAT proportion of all your patients would you estimate that you check the vital signs?

(Please use X on the line in EACH section a-d)

(a) Pulse:

0 20 40 60 80 100 %
/____/____/____/____/____/ [ ]

(b) Blood pressure:

0 20 40 60 80 100 %
/____/____/____/____/____/ [ ]

(c) Respiratory rate:

0 20 40 60 80 100 %
/____/____/____/____/____/ [ ]

(d) Temperature:

0 20 40 60 80 100 %
/____/____/____/____/____/ [ ]

38. IN WHAT proportion of all your patients would you estimate that you perform physical examination of organ systems and body cavities?

(Please use X on the line in EACH section a-g)

(a) Abdominal examination:

0 20 40 60 80 100 %
/____/____/____/____/____/ [ ]

(b) Auscultation of the heart:

0 20 40 60 80 100 %
/____/____/____/____/____/ [ ]

(c) Auscultation of the lungs:

0 20 40 60 80 100 %
/____/____/____/____/____/ [ ]

(d) Mouth/oral cavity examination:

0 20 40 60 80 100 %
/____/____/____/____/____/ [ ]

(e) Rectal examination - males:

0 20 40 60 80 100 %
/____/____/____/____/____/ [ ]

(f) Rectal examination - females:

0 20 40 60 80 100 %
/____/____/____/____/____/ [ ]

(g) Breast examination - females:

0 20 40 60 80 100 %
/____/____/____/____/____/ [ ]

PART 5: PRACTICE PROCEDURES - TREATMENT & COUNSELLING

39. IN WHAT proportion of all your patients would you estimate that your physical treatment is done by giving joint/articular adjustments ONLY?

(Please use X on the line)

0 20 40 60 80 100 %
/____/____/____/____/____/ [ ]

40. **IN WHAT** proportion of all your patients would you estimate that you make use of a treatment table, which is especially made for chiropractic practice?

(First established satellite clinic, if more than one).

(Please use X on the line)

<u>Main clinic:</u>

0 20 40 60 80 100 %
/____/____/____/____/____/ [ ]

<u>Satellite clinic:</u>

0 20 40 60 80 100 %
/____/____/____/____/____/ [ ]

41. **IN WHAT** estimated proportion of all your patients do you make use of more than one special chiropractic treatment table on the same visit (such as, for example, the one in Question 40)?

(First established satellite clinic, if more than one).

(Please use X on the line)

<u>Main clinic:</u>

(a) Two special tables:

0 20 40 60 80 100 %
/____/____/____/____/____/ [ ]

(b) More than two special tables:

0 20 40 60 80 100 %
/____/____/____/____/____/ [ ]

<u>Satellite clinic:</u>

Does not apply ___ [97]

(a) Two special tables:

0 20 40 60 80 100 %
/____/____/____/____/____/ [ ]

(b) More than two special tables:

0 20 40 60 80 100 %
/____/____/____/____/____/ [ ]

42. **WHICH FEATURE** of a treatment table do you generally consider most useful when treating the majority of your patients with spinal and pelvic problems?

(Please rate EACH section a-k by INCREASING order of priority, ie. 1, 2, 3, 4, 5, even if some of these items are not currently available to you.
1 = of very little use; 5 = extremely useful).

(a) Horizontal tilt of the treatment table ___ [1]

(b) Vertical tilt of the treatment table ___ [2]

(c) Flat thoracic section/deck ___ [3]

(d) Angle elevation of pelvic section/deck ___ [4]

(e) Drop - head piece

- simple - downward drop ___ [5]
- combination drop ___ [6]

(f) Drop - thoracic piece ___ [7]
- pelvic piece ___ [8]

(g) Thoracic springing section ___ [9]

(h) Lumbo-pelvic - flexion/distraction ___ [10]

(i) Lumbo-pelvic - lateral bending ___ [11]

(j) Lumbo-pelvic - rotation ___ [12]

(k) Other (please specify):

____

____

______________________________ ___ [13]

43. IN WHAT proportion of all your patients would you estimate that you use the following <u>chiropractic</u> techniques for <u>any region of the spine?</u>

(Various techniques may be used when treating the same patient in different regions).

(Please use X on the line in EACH section a-m [n])

(a) Diversified:

0 20 40 60 80 100 %
/____/____/____/____/____/ [ ]

(b) Gonstead:

0 20 40 60 80 100 %
/____/____/____/____/____/ [ ]

(c) Toggle Recoil (HIO - upper cervical only):

0 20 40 60 80 100 %
/____/____/____/____/____/

(d) Toggle Recoil (any region of the skeleton):

0 20 40 60 80 100 %
/____/____/____/____/____/ [ ]

(e) Logan Basic:

0 20 40 60 80 100 %
/____/____/____/____/____/ [ ]

(f) Sacro-Occipital-Technique (SOT):

0 20 40 60 80 100 %
/____/____/____/____/____/ [ ]

(g) Applied Kinesiology (AK):

0 20 40 60 80 100 %
/____/____/____/____/____/ [ ]

(h) Nimmo Technique:

0 20 40 60 80 100%
/____/____/____/____/____/ [ ]

(i) Activator:

0 20 40 60 80 100 %
/____/____/____/____/____/ [ ]

(j) Pettibon (excl. activator):

0 20 40 60 80 100 %
/____/____/____/____/____/ [ ]

(k) Pierce-Stillwagon:

0 20 40 60 80 100 %
/____/____/____/____/____/ [ ]

(l) Toftness:

0 20 40 60 80 100 %
/____/____/____/____/____/ [ ]

(m) Techniques derived individually from biomechanical principles:

0 20 40 60 80 100 %
/____/____/____/____/____ [ ]

(n) Other (please specify):

____

____

________________________________ [ ]

44. IN WHAT proportion of all your patients with low back pain would you estimate that you apply flexion/distraction using a specialised flexion-distraction table?

(Please use X on the line)

0 20 40 60 80 100 %
/____/____/____/____/____/ [ ]

Name the table used
(eg. Cox, Atlas, McManis, etc)

________________________________ [ ]

45. PLEASE RATE your agreement (in percentage) with the following statement:

"It would be beneficial to the management of patients if chiropractors were allowed to prescribe medication* on a restricted basis, such as dentists".

(* mild analgesics, NSAIDS [non-steroidal anti-inflammatory drugs] and muscle relaxants).

(Please use X on the line)

Strongly disagree   Strongly agree

0 20 40 60 80 100 %
/____/____/____/____/____/   [   ]

46. IN WHAT proportion of all your patients would you estimate that there are occasions when you give them emotional or social counselling ONLY?

(Please use X on the line)

0 10 20 40 60 80 100 %
/____/____/________/________/________/________/

[   ]

47. IN WHAT proportion of all your patients would you estimate that you give physical treatments outside the clinic, such as, for example, home visits and sports tournaments?

(Please use X on the line)

0 10 20 40 60 80 100 %
/____/____/________/________/________/________/

[   ]

48. IN WHAT proportion of all your patients where physical treatments are given outside your clinic, such as, for example, home visits and sports tournaments, do you make use of the following devices?

(Please use X on the line in both [a] and [b])

(a) Portable treatment table?

0 10 20 40 60 80 100 %
/____/____/________/________/________/________/

[   ]

(b) Portable treatment table with flexion-distraction?

0 10 20 40 60 80 100
/____/____/________/________/________/________/

[   ]

49. IN THE clinic in which you work, does this practice currently employ any clinic staff*?

(* Staff needed to run the practice, such as, for example, secretaries/receptionists, chiropractic assistants - EXCL. cleaning staff).

(Please tick as appropriate)

	Main clinic	Satellite clinic
Does not apply		___ [97]
(a) One full-time receptionist/secretary:	___ [1]	___ [1]
(b) One part-time receptionist/secretary:	___ [2]	___ [2]
(c) A combination of part-time receptionists/secretaries:	___ [3]	___ [3]
(d) A combination of part-time and full-time receptionists/secretaries:	___ [4]	___ [4]
(e) A chiropractic assistant - part-time (not performing traditional secretarial work):	___ [5]	___ [5]
(f) A chiropractic assistant - full-time (not performing traditional secretarial work):	___ [6]	___ [6]
(g) A combination of part-time and full-time chiropractic assistants (not performing traditional secretarial work:	___ [7]	___ [7]

continued .

(h) None: ___ [8] ___ [8]

(i) Other (please specify):

____

____

___ [9] ___ [9]

50. IN YOUR current practice situation, approximately how many hours in all do you usually work within a 7 day period (1 calender week) treating patients ONLY?

_______ hours [ ]

51. IN YOUR current practice situation, approximately how many hours in all* do you usually work within a 7 day period (1 calender week)?

(* Incl. treating patients, writing reports, preparing next day's work and reading professional journals/books).

_______ hours [ ]

52. DURING THE past 12 months, approximately how much time have you spent on postgraduate courses and meetings to update and/or expand your knowledge base related to chiropractic ONLY?

(EXCLUDING organisational work for your profession, courses on how to run a business, accounting, computing, etc).

_______ hours [ ]

53. HOW SOON would you say that a new patient could get an appointment to see you?

(7 days = 1 week: 4 weeks = 1 month)

Within: ___ day(s) ___ week(s) ___ month(s)

[ ]

54. APPROXIMATELY HOW long do you spend with the patient?

(Please answer BOTH [a] and [b])

(a) First Visit (incl. case history taking, physical examination, x-raying [if done at all] and treatment):

_____ minutes [ ]

(b) Subsequent visits (treatment only):

_____ minutes [ ]

55. APPROXIMATELY HOW many patients (INCL. new patients) do you CURRENTLY see per full-time working day*?

(* 1 full-time working day standardised to be 7 hours (excl. breaks, lunches, etc). Please calculate an average of the most recent 5 full-time working days for each clinic).

Main clinic:	Satellite clinic:
	Does not apply ___ [97]
_____ patients [ ]	_____ patients [ ]

PART 6: PRACTICE PROCEDURES - PROFESSIONAL ISSUES

56. IN THE clinic(s) in which you practice, do you share room facilities, such as, for example, waiting-room area, with another professional, who is not a qualified chiropractor?

(Please tick as appropriate)

	Main clinic	Satellite clinic
Does not apply		___ [97]
(a) No	___ [1]	___ [1]
(b) A medical doctor - General Practitioner	___ [2]	___ [2]
(c) A medical doctor - Orthopaedic Surgeon	___ [3]	___ [3]

(d) A medical doctor - Neurosurgeon ___ [4] ___ [4]

(e) A medical doctor - Rheumatologist ___ [5] ___ [5]

(f) A medical doctor - Specialty (please specify):

____

_______________ ___ [6] ___ [6]

(g) A Physiotherapist ___ [7] ___ [7]

(h) Other (please specify):

____

_______________ ___ [8] ___ [8]

57. PLEASE INDICATE the statement(s) which best represent your perception of your role as a chiropractor in your community*.

(* Irrespective of any current national statutory limitations. The options given below can be ticked as appropriate and/or added to (g), depending on your point of view).

(a) I consider myself a primary contact practitioner, treating primarily neuro-musculoskeletal disorders by giving adjustments ONLY. ___ [1]

(b) I consider myself a primary contact practitioner treating primarily neuro-musculoskeletal and, to some degree, organic or visceral disorders. ___ [2]

(c) I consider myself a primary contact practitioner, treating primarily neuro-musculoskeletal disorders by giving adjustments by hand and using other therapies. ___ [3]

(d) I consider myself a primary contact practitioner, treating primarily neuro-musculoskeletal and to some degree organic or visceral disorders by giving adjustments by hand and using complementary therapy. ___ [4]

(e) I see my role as an educator of patients in a preventative health care setting. ___ [5]

(f) I see myself as a business person in a health care setting. ___ [6]

(g) Other (please specify):

____

____

____

_______________ ___ [7]

58. ARE YOU CURRENTLY practising any non-chiropractic therapies or disciplines?

(Please tick <u>each</u> section a-g [h])

	Yes [1]	No [2]
(a) Acupuncture	___	___
(b) Homeopathy	___	___
(c) Medical herbalism	___	___
(d) Naturopathy	___	___
(e) Osteopathy	___	___
(f) Physiotherapy	___	___
(g) Reflexology	___	___

(h) Other (please specify):

____

____

_______________ ___ [3]

THANK YOU VERY MUCH FOR TAKING THE TIME TO COMPLETE THIS QUESTIONNAIRE. YOUR HELP IS GREATLY APPRECIATED.

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

FOR OFFICE USE ONLY

PDI (Patient Density Index) = ______

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

VERY IMPORTANT!!!

NO SECTIONS SHOULD BE LEFT WITHOUT AN ANSWER UNLESS SPECIFICALLY STATED.

Some practitioners may have dual employment status, eg. both principal clinician (owner) and partnership in a satellite clinic, or employee in two clinics with different owners. The following guidelines should be used when determining what constitutes the main and satellite clinics respectively. (a, b, c, d, e) indicate the DECREASING order of priority used; a = 1st/highest priority; b = 2nd priority, etc).

GUIDELINES

MAIN CLINIC

(a) Owner/partnership/principal clinician.
(b) The clinic you are working in most of the time.
(c) The first clinic of employement (if employee).
(d) The first established clinic (if owner).
(e) The clinic with the greatest turnover within the past 12 months.

SATELLITE CLINIC

(a) The first established satellite clinic (if owner).
(b) The (satellite) clinic you are working in most of the time (if employee working in two "satellite" clinics).
(c) The clinic with the greatest turnover within the past 12 months.

IF ONLY ONE CLINIC IS REFERRED TO IN THE QUESTION, THIS WILL ALWAYS BE THE MAIN CLINIC UNLESS OTHERWISE SPECIFIED

FIGURES IN [ ] ARE FOR OFFICE USE ONLY

VERY IMPORTANT!!!

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

APPENDIX 2

SPSS COMMANDS FOR UNIVARIATE MODEL USING A CATEGORICAL DEMOGRAPHIC VARIABLE

APPENDIX 2

SPSS Commands for Univariate Model using the Categorical Demographic Variable COUNTRY and the Dependent Variable DYNAPALP.

```
RECODE DYNAPALP (997,998=-1)/ COUNTRY (1,3,9,11,15=20)
(7,14=30) (2,5,6,8,12,13=40).

COMPUTE SCANDINA = 0.
COMPUTE GREATBRI = 0.
COMPUTE CONTINEN = 0.
IF (COUNTRY EQ 20) SCANDINA = 1.
IF (COUNTRY EQ 30) GREATBRI = 1.
IF (COUNTRY EQ 40) CONTINEN = 1.
COMPUTE MALE = 0.
COMPUTE FEMALE = 0.
IF (SEX EQ 0) FEMALE = 1.
IF (SEX EQ 1) MALE = 1.
COMPUTE EUROPEAN = 0.
COMPUTE AMERICAN = 0.
COMPUTE CANADIAN = 0.
COMPUTE AUSTRALI = 0.
IF (COLLGRAD EQ 1) EUROPEAN = 1.
IF (COLLGRAD EQ 2) AMERICAN = 1.
IF (COLLGRAD EQ 3) CANADIAN = 1.
IF (COLLGRAD EQ 4) AUSTRALI = 1.
COMPUTE INDEPEND = 0.
COMPUTE PARTNER = 0.
COMPUTE GROUP = 0.
COMPUTE EMPLOYED = 0.
IF (EMPLSTAM EQ 1) INDEPEND = 1.
IF (EMPLSTAM EQ 2) PARTNER = 1.
IF (EMPLSTAM EQ 3) GROUP = 1.
IF (EMPLSTAM EQ 4) EMPLOYED = 1.
COMPUTE ACADEMN = 0.
COMPUTE ACADEMY = 0.
IF (ACADDGRE EQ 0) ACADEMN = 1.
IF (ACADDGRE EQ 1) ACADEMY = 1.
COMPUTE METROPOL = 0.
COMPUTE URBAN = 0.
COMPUTE SEMURBAN = 0.
COMPUTE RURAL = 0.
IF (PRACADRM EQ 1) METROPOL = 1.
IF (PRACADRM EQ 2) URBAN = 1.
IF (PRACADRM EQ 3) SEMURBAN = 1.
IF (PRACADRM EQ 4) RURAL = 1.
SELECT IF (COUNTRY GT -1).
SELECT IF (SEX GT -1).
SELECT IF (PRACADRM GT -1).
SELECT IF (COLLGRAD GT -1).
SELECT IF (EMPLSTAM GT -1).
```

```
SELECT IF (ACADDGRE GT -1).
SELECT IF (AGE GT -1).
SELECT IF (PRACGRAD GT -1).
SELECT IF (YEARGRAD GT -1).
SELECT IF (DYNAPALP GT -1).
REGRESSION /VARIABLES GREATBRI CONTINEN FEMALE AMERICAN
CANADIAN AUSTRALI PARTNER GROUP EMPLOYED ACADEMN URBAN
SEMURBAN RURAL AGE YEARGRAD PRACGRAD DYNAPALP
/DESCRIPTIVES
/DEPENDENT DYNAPALP /METHOD ENTER GREATBRI CONTINEN
/METHOD ENTER /METHOD REMOVE GREATBRI CONTINEN
/RESIDUALS.
```

The SELECT IF commands ensure that there are no missing cases on any variables. The REGRESSION command determines which variables and categories to include in the analysis. Those dummy variables not stated in the command line are automatically used as baselines for comparison. The DESCRIPTIVES command gives mean and standard deviations of all variables in the analysis and the number of cases. The DEPENDENT command specifies the dependent variable. The METHOD ENTER GREATBRI CONTINEN command enters the 2 categories in the univariate model. This is followed by METHOD ENTER which enters all remaining variables (full model). Subsequently GREATBRI and CONTINEN are removed from the model. The RESIDUALS command produces information about any outliers, the residuals, a histogram and a normal probability (P-P) plot of the standardised residuals.

APPENDIX 3

SPSS COMMANDS FOR UNIVARIATE AND FULL MODELS USING THE CONTINUOUS DEMOGRAPHIC VARIABLES

APPENDIX 3

SPSS Commands for Univariate and Full Models using the Continuous Demographic Variables AGE, DURATION OF PRACTICE and YEAR OF GRADUATION, and the Dependent Variable DYNAPALP.

Explanations of commands as Appendix 2.

*1-6 = Explanations below

```
RECODE DYNAPALP (997,998=-1)/ COUNTRY (1,3,9,11,15=20)
(7,14=30) (2,5,6,8,12,13=40).

COMPUTE SCANDINA = 0.
COMPUTE GREATBRI = 0.
COMPUTE CONTINEN = 0.
IF (COUNTRY EQ 20) SCANDINA = 1.
IF (COUNTRY EQ 30) GREATBRI = 1.
IF (COUNTRY EQ 40) CONTINEN = 1.
COMPUTE MALE = 0.
COMPUTE FEMALE = 0.
IF (SEX EQ 0) FEMALE = 1.
IF (SEX EQ 1) MALE = 1.
COMPUTE EUROPEAN = 0.
COMPUTE AMERICAN = 0.
COMPUTE CANADIAN = 0.
COMPUTE AUSTRALI = 0.
IF (COLLGRAD EQ 1) EUROPEAN = 1.
IF (COLLGRAD EQ 2) AMERICAN = 1.
IF (COLLGRAD EQ 3) CANADIAN = 1.
IF (COLLGRAD EQ 4) AUSTRALI = 1.
COMPUTE INDEPEND = 0.
COMPUTE PARTNER = 0.
COMPUTE GROUP = 0.
COMPUTE EMPLOYED = 0.
IF (EMPLSTAM EQ 1) INDEPEND = 1.
IF (EMPLSTAM EQ 2) PARTNER = 1.
IF (EMPLSTAM EQ 3) GROUP = 1.
IF (EMPLSTAM EQ 4) EMPLOYED = 1.
COMPUTE ACADEMN = 0.
COMPUTE ACADEMY = 0.
IF (ACADDGRE EQ 0) ACADEMN = 1.
IF (ACADDGRE EQ 1) ACADEMY = 1.
COMPUTE METROPOL = 0.
COMPUTE URBAN = 0.
COMPUTE SEMURBAN = 0.
COMPUTE RURAL = 0.
IF (PRACADRM EQ 1) METROPOL = 1.
IF (PRACADRM EQ 2) URBAN = 1.
```

```
IF (PRACADRM EQ 3) SEMURBAN = 1.
IF (PRACADRM EQ 4) RURAL = 1.
SELECT IF (COUNTRY GT -1).
SELECT IF (SEX GT -1).
SELECT IF (PRACADRM GT -1).
SELECT IF (COLLGRAD GT -1).
SELECT IF (EMPLSTAM GT -1).
SELECT IF (ACADDGRE GT -1).
SELECT IF (AGE GT -1).
SELECT IF (PRACGRAD GT -1).
SELECT IF (YEARGRAD GT -1).
SELECT IF (DYNAPALP GT -1).
REGRESSION /VARIABLES GREATBRI CONTINEN FEMALE AMERICAN
CANADIAN AUSTRALI PARTNER GROUP EMPLOYED ACADEMN URBAN
SEMURBAN RURAL AGE YEARGRAD PRACGRAD DYNAPALP
/DESCRIPTIVES
/DEPENDENT DYNAPALP
/METHOD ENTER                          *1 full model
/METHOD REMOVE PRACGRAD YEARGRAD       *2 control for age
/METHOD REMOVE AGE                     *3 full model -
age,pracgrad & yeargrad
/METHOD ENTER PRACGRAD                 *4 control for pracgrad
/METHOD REMOVE PRACGRAD                *5 full model -
age,pracgrad & yeargrad
/METHOD ENTER YEARGRAD                 *6 control for yeargrad
/RESIDUALS.
```

APPENDIX 4

SUMMARY OF SPSS OUTPUT FOR THE CALCULATION OF F-TESTS CATEGORICAL DEMOGRAPHIC VARIABLES

APPENDIX 4

Summary of SPSS Output for the Calculation of F-tests - Categorical Demographic Variable COUNTRY and Dependent Variable DYNAPALP.

---

* = values used for calculating adjusted F-test.

Variables entered on step number

1, CONTINEN
2, GREATBRI

ANOVA

	DF	Sum of Squares	Mean Square
Regression	2	29354.13346	14677.06673
Residual	663	227266.24492	342.78468

Variables entered on step number

3, URBAN
4, EMPLOYED
5, AUSTRALI
6, RURAL
7, CANADIAN
8, FEMALE
9, ACADEMN
10, PARTNER
11, PRACGRAD
12, GROUP
13, SEMURBAN
14, AMERICAN
15, AGE
16, YEARGRAD

ANOVA

	DF	Sum of Squares	Mean Square
Regression	16*	50279.99469*	3142.49967
Residual	649	206340.38369	317.93588*

Variables removed on step number

17, GREATBRI
18, CONTINEN

ANOVA

	DF	Sum of Squares	Mean Square
Regression	14*	36040.43492*	2574.31678
Residual	651	220579.94346	338.83248

Unadjusted (from SPSS output): F = 42.82 p = 0.0000

Adjusted: $F = \dfrac{(50279.99469 - 36040.43492)/\ (16-14)}{317.93588} = 22.39$

From MINITAB p = 0.0000

APPENDIX 5

SUMMARY OF SPSS OUTPUT FOR THE CALCULATION OF ADJUSTED F-TESTS - CONTINUOUS DEMOGRAPHIC VARIABLES

APPENDIX 5

Summary of SPSS Output for the Calculation of Adjusted F-tests - Continuous Demographic Variables AGE, DURATION OF PRACTICE and YEAR OF GRADUATION, and the Dependent variable DYNAPALP.

---

* = values used for calculating F-tests.
The mean square for the residual of the full model is used throughout.

Variables entered on step number

1, PRACGRAD
2, ACADEMN
3, RURAL
4, CANADIAN
5, AUSTRALI
6, PARTNER
7, SEMURBAN
8, EMPLOYED
9, FEMALE
10, GREATBRI
11, GROUP
12, CONTINEN
13, URBAN
14, AMERICAN
15, AGE
16, YEARGRAD

ANOVA

	DF	Sum of Squares	Mean Square
Regression	16	50279.99469	3142.49967
Residual	649	206340.38369	317.93588*

Variables removed on step number

17, YEARGRAD
18, PRACGRAD

ANOVA

	DF	Sum of Squares	Mean Square
Regression	14*	49340.52201*	3524.32300
Residual	651	207279.85637	318.40224

Variable removed on step number

19, AGE

ANOVA

	DF	Sum of Squares	Mean Square
Regression	13*	37966.78763*	2920.52213
Residual	652	218653.59075	335.35827

Variable entered on step number

20, PRACGRAD

ANOVA

	DF	Sum of Squares	Mean Square
Regression	14*	49306.04202*	3521.86014
Residual	651	207314.33636	318.45520

Variable removed on step number

21, PRACGRAD

ANOVA

	DF	Sum of Squares	Mean Square
Regression	13*	37966.78763*	2920.52213
Residual	652	218653.59075	335.35827

Variable entered on step number

22, YEARGRAD

ANOVA

	DF	Sum of Squares	Mean Square
Regression	14*	49164.14095*	3511.72435
Residual	651	207456.23743	318.67318

AGE Adjusted: $F = \frac{(49340.52201-37966.78763)/(14-13)}{317.93588} = 35.77$

PRACGRAD Adjusted: $F = \frac{(49306.04202-37966.78763)/(14-13)}{317.93588} = 35.67$

YEARGRAD Adjusted: $F=\frac{(49164.14095-37966.78763)/(14-13)}{317.93588}=35.22$

The unadjusted F-tests and p-values were taken from the SPSS output.

APPENDIX 6

SPSS COMMANDS FOR A LOG-TRANSFORMED UNIVARIATE MODEL

APPENDIX 6

SPSS Commands for Log-transformed Univariate Model using the Categorical Demographic Variable COUNTRY and the Dependent Variable DYNAPALP.

```
RECODE DYNAPALP (997,998=-1)/ COUNTRY (1,3,9,11,15=20)
(7,14=30) (2,5,6,8,12,13=40).

COMPUTE SCANDINA = 0.
COMPUTE GREATBRI = 0.
COMPUTE CONTINEN = 0.
IF (COUNTRY EQ 20) SCANDINA = 1.
IF (COUNTRY EQ 30) GREATBRI = 1.
IF (COUNTRY EQ 40) CONTINEN = 1.
COMPUTE MALE = 0.
COMPUTE FEMALE = 0.
IF (SEX EQ 0) FEMALE = 1.
IF (SEX EQ 1) MALE = 1.
COMPUTE EUROPEAN = 0.
COMPUTE AMERICAN = 0.
COMPUTE CANADIAN = 0.
COMPUTE AUSTRALI = 0.
IF (COLLGRAD EQ 1) EUROPEAN = 1.
IF (COLLGRAD EQ 2) AMERICAN = 1.
IF (COLLGRAD EQ 3) CANADIAN = 1.
IF (COLLGRAD EQ 4) AUSTRALI = 1.
COMPUTE INDEPEND = 0.
COMPUTE PARTNER = 0.
COMPUTE GROUP = 0.
COMPUTE EMPLOYED = 0.
IF (EMPLSTAM EQ 1) INDEPEND = 1.
IF (EMPLSTAM EQ 2) PARTNER = 1.
IF (EMPLSTAM EQ 3) GROUP = 1.
IF (EMPLSTAM EQ 4) EMPLOYED = 1.
COMPUTE ACADEMN = 0.
COMPUTE ACADEMY = 0.
IF (ACADDGRE EQ 0) ACADEMN = 1.
IF (ACADDGRE EQ 1) ACADEMY = 1.
COMPUTE METROPOL = 0.
COMPUTE URBAN = 0.
COMPUTE SEMURBAN = 0.
COMPUTE RURAL = 0.
IF (PRACADRM EQ 1) METROPOL = 1.
IF (PRACADRM EQ 2) URBAN = 1.
IF (PRACADRM EQ 3) SEMURBAN = 1.
IF (PRACADRM EQ 4) RURAL = 1.
SELECT IF (COUNTRY GT -1).
SELECT IF (SEX GT -1).
SELECT IF (PRACADRM GT -1).
SELECT IF (COLLGRAD GT -1).
```

```
SELECT IF (EMPLSTAM GT -1).
SELECT IF (ACADDGRE GT -1).
SELECT IF (AGE GT -1).
SELECT IF (PRACGRAD GT -1).
SELECT IF (YEARGRAD GT -1).
SELECT IF (DYNAPALP GT -1).
COMPUTE DYNAPALP = 100 - DYNAPALP.   * +
IF (DYNAPALP EQ 0.0) DYNAPALP = 0.5. *
COMPUTE DYNAPALP = LG10 (DYNAPALP).  *
REGRESSION /VARIABLES GREATBRI CONTINEN FEMALE AMERICAN
CANADIAN AUSTRALI PARTNER GROUP EMPLOYED ACADEMN URBAN
SEMURBAN RURAL AGE YEARGRAD PRACGRAD DYNAPALP
/DESCRIPTIVES
/DEPENDENT DYNAPALP /METHOD ENTER GREATBRI CONTINEN
/METHOD ENTER /METHOD REMOVE GREATBRI CONTINEN
/RESIDUALS.
```

Key: * = Commands used for transforming negatively skewed variables.

+ = For positively skewed values this command line was excluded.

APPENDIX 7

CLUSTER ANALYSIS TABLES

THE X-RAY PROCEDURES

Table A. Three and Four Clusters Generated for X-ray Variables.

Values are means within clusters (s.d.). Coefficient 24, Maxit = 0, Start random size 20, Standardisation & Relocation: Yes, N = 434.

VARIABLE	3 CLUSTERS			4 CLUSTERS			
	1	2	3	1	2	3	4
1. TAKE SKELETAL X-RAYS	74.44 (21.80)	72.27 (23.72)	71.64 (26.50)	74.44 (21.80)	71.10 (25.16)	71.64 (26.50)	74.63 (20.45)
2. TAKE TISSUE X-RAYS	7.39 (5.31)	9.71 (10.43)	7.36 (7.90)	7.39 (5.31)	8.41 (7.93)	7.36 (7.90)	12.34 (13.89)
3. ASK ABOUT MENSTRUAL CYCLE	85.78 (26.39)	87.41 (23.03)	92.32 (20.57)	85.78 (26.39)	87.59 (22.96)	92.32 (20.57)	87.06 (23.31)
4. GET ORAL CONSENT	79.74 (30.93)	82.29 (30.27)	72.27 (41.87)	79.74 (30.93)	81.60 (30.79)	72.27 (41.87)	83.69 (29.32)
5. GET WRITTEN CONSENT	15.75 (26.93)	16.01 (27.65)	20.86 (35.49)	15.75 (26.93)	17.70 (29.45)	20.86 (35.49)	12.60 (23.37)
6. GET X-RAYS FROM ANOTHER CHIROPRACTOR	13.24 (18.27)	18.44 (23.31)	22.32 (32.09)	13.24 (18.27)	19.26 (23.78)	22.32 (32.09)	16.79 (22.38)
7. GET X-RAYS FROM HOSPITAL VIA GP	7.26 (7.45)	9.07 (12.04)	19.91 (29.07)	7.26 (7.45)	9.53 (12.76)	19.91 (29.07)	8.12 (10.41)
8. GET X-RAYS DIRECTLY FROM HOSPITAL	10.03 (12.66)	13.03 (14.54)	22.50 (28.84)	10.03 (12.66)	12.24 (13.98)	22.50 (28.84)	14.63 (15.57)
9. GET X-RAYS FROM A PRIVATE RADIOLOGICAL CLINIC	6.71 (7.72)	8.32 (11.62)	13.09 (27.03)	6.71 (7.72)	9.33 (13.43)	13.09 (27.03)	6.28 (6.18)
10. THE PATIENT BRINGS THE X-RAYS	8.07 (8.66)	12.45 (14.99)	20.73 (30.16)	8.07 (8.66)	13.28 (16.23)	20.73 (30.16)	10.77 (12.02)
FREQUENCY (PER CENT)	152 (35.02)	260 (59.91)	22 (5.07)	152 (35.02)	174 (40.09)	22 (5.07)	86 (19.82)

Table B. Three and Four Clusters Generated for X-ray Variables.

Values are means within clusters (s.d.). Coefficient 29, Maxit = 0, Start random size 20, Standardisation & Relocation: Yes, N = 434.

VARIABLE	3 CLUSTERS			4 CLUSTERS			
	1	2	3	1	2	3	4
1. TAKE SKELETAL X-RAYS	73.03 (23.10)	73.11 (23.00)	71.64 (26.50)	72.74 (23.45)	73.16 (23.03)	73.11 (23.00)	71.64 (26.50)
2. TAKE TISSUE X-RAYS	7.69 (6.40)	10.15 (11.00)	7.36 (7.90)	7.05 (4.33)	7.96 (7.09)	10.15 (11.00)	7.36 (7.90)
3. ASK ABOUT MENSTRUAL CYCLE	86.69 (25.19)	86.94 (23.35)	92.32 (20.57)	83.26 (29.19)	88.15 (23.22)	86.94 (23.35)	92.32 (20.57)
4. GET ORAL CONSENT	81.29 (30.35)	81.41 (30.76)	72.27 (41.87)	77.69 (32.74)	82.83 (29.24)	81.41 (30.96)	72.27 (41.87)
5. GET WRITTEN CONSENT	15.83 (27.23)	16.02 (27.56)	20.86 (35.49)	16.09 (27.57)	15.71 (27.17)	16.02 (27.56)	20.86 (35.49)
6. GET X-RAYS FROM ANOTHER CHIROPRACTOR	13.00 (17.58)	20.44 (25.00)	22.32 (32.09)	13.85 (19.25)	12.64 (16.88)	20.44 (25.00)	22.32 (32.09)
7. GET X-RAYS FROM HOSPITAL VIA GP	7.62 (8.77)	9.27 (12.29)	19.91 (29.07)	6.22 (6.68)	8.22 (9.48)	9.27 (12.29)	19.91 (29.07)
8. GET X-RAYS DIRECTLY FROM HOSPITAL	10.53 (12.36)	13.48 (15.39)	22.50 (28.44)	9.20 (9.51)	11.10 (13.38)	13.48 (15.39)	22.50 (28.84)
9. GET X-RAYS FROM A PRIVATE RADIOLOGICAL CLINIC	6.78 (7.47)	8.78 (12.80)	13.09 (27.03)	6.05 (6.15)	7.10 (7.97)	8.78 (12.80)	13.09 (27.03)
10. THE PATIENT BRINGS THE X-RAYS	9.60 (11.83)	12.21 (14.44)	20.73 (30.16)	7.51 (8.09)	10.49 (13.03)	12.21 (14.44)	20.72 (30.16)
FREQUENCY (PER CENT)	217 (50.00)	195 (44.93)	22 (5.07)	65 (14.98)	152 (35.02)	195 (44.93)	22 (5.07)

Table C. Four Clusters Generated for X-ray Variables.

Values are means within clusters (s.d.). Coefficient 24, Maxit = 10, Start random size 20, Standardisation & Relocation: Yes, N = 434.

VARIABLE	4 CLUSTERS			
	1	2	3	4
1. TAKE SKELETAL X-RAYS	**78.91** (21.50)	**70.57** (24.00)	**71.80** (23.25)	**68.17** (26.93)
2. TAKE TISSUE X-RAYS	**9.72** (9.96)	**9.90** (9.68)	**8.01** (8.20)	**18.50** (9.44)
3. ASK ABOUT MENSTRUAL CYCLE	**57.36** (38.82)	**93.94** (11.43)	**94.92** (7.17)	**83.33** (25.93)
4. GET ORAL CONSENT	**32.59** (38.65)	**93.22** (8.74)	**93.32** (9.66)	**75.67** (35.28)
5. GET WRITTEN CONSENT	**6.69** (12.79)	**73.79** (29.75)	**6.23** (8.63)	**8.67** (4.41)
6. GET X-RAYS FROM ANOTHER CHIROPRACTOR	**17.18** (22.52)	**23.87** (30.04)	**13.87** (17.52)	**74.17** (35.06)
7. GET X-RAYS FROM HOSPITAL VIA GP	**7.31** (7.76)	**10.90** (11.71)	**7.51** (8.25)	**81.50** (17.70)
8. GET X-RAYS DIRECTLY FROM HOSPITAL	**12.09** (10.40)	**18.73** (24.69)	**9.96** (9.51)	**68.00** (30.84)
9. GET X-RAYS FROM A PRIVATE RADIOLOGICAL CLINIC	**6.54** (7.89)	**11.25** (12.58)	**6.22** (6.62)	**77.50** (20.81)
10. THE PATIENT BRINGS THE X-RAYS	**12.05** (16.29)	**9.13** (7.33)	**10.48** (12.77)	**64.00** (28.24)
FREQUENCY (PER CENT)	**87** (20.05)	**63** (14.52)	**278** (64.06)	**6** (1.38)

Table D. Three and Four Clusters Generated for X-ray Variables.

Values are means within clusters (s.d.). Coefficient 29, Maxit = 10, Start random size 20, Standardisation & Relocation: Yes, N = 434.

VARIABLE	3 CLUSTERS			4 CLUSTERS			
	1	2	3	1	2	3	4
1. TAKE SKELETAL X-RAYS	71.70 (25.20)	75.62 (22.71)	74.36 (20.59)	74.82 (20.51)	74.80 (24.01)	73.56 (22.34)	70.31 (26.52)
2. TAKE TISSUE X-RAYS	5.97 (4.54)	25.85 (25.39)	10.96 (8.97)	9.31 (6.98)	20.00 (9.72)	20.35 (19.50)	5.33 (4.29)
3. ASK ABOUT MENSTRUAL CYCLE	83.50 (28.91)	89.62 (18.02)	91.19 (16.44)	92.08 (15.28)	81.40 (28.50)	90.12 (14.28)	79.75 (32.47)
4. GET ORAL CONSENT	74.32 (36.87)	84.08 (25.15)	88.50 (20.76)	88.52 (20.89)	72.20 (38.28)	90.47 (17.40)	68.65 (39.99)
5. GET WRITTEN CONSENT	6.93 (14.80)	39.15 (41.82)	25.62 (33.93)	19.33 (29.83)	8.20 (4.76)	43.18 (41.03)	6.51 (14.16)
6. GET X-RAYS FROM ANOTHER CHIROPRACTOR	10.32 (12.49)	57.69 (39.84)	21.80 (25.61)	18.66 (22.53)	74.80 (39.16)	36.74 (34.78)	8.45 (8.36)
7. GET X-RAYS FROM HOSPITAL VIA GP	4.79 (5.46)	49.31 (35.37)	11.26 (9.91)	8.88 (7.53)	87.20 (12.15)	20.97 (16.67)	4.32 (5.49)
8. GET X-RAYS DIRECTLY FROM HOSPITAL	7.73 (7.67)	53.46 (35.13)	15.32 (14.98)	11.82 (10.11)	79.00 (16.78)	32.94 (27.14)	7.14 (7.66)
9. GET X-RAYS FROM A PRIVATE RADIOLOGICAL CLINIC	4.31 (4.65)	50.00 (34.73)	9.55 (8.65)	8.24 (7.73)	74.40 (21.66)	17.41 (19.99)	3.74 (4.56)
10. THE PATIENT BRINGS THE X-RAYS	6.55 (7.44)	35.54 (33.70)	15.41 (16.22)	13.03 (14.42)	66.60 (30.76)	18.47 (17.99)	5.88 (6.99)
FREQUENCY (PER CENT)	229 (52.76)	13 (3.00)	192 (44.24)	229 (52.76)	5 (1.15)	34 (7.83)	166 (38.25)

APPENDIX 8

CLUSTER ANALYSIS TABLES

THE EXAMINATION PROCEDURES

Table A. Three and Four Clusters Generated for Examination Variables.

Values are means within clusters (s.d.). Coefficient 1, Maxit = 0, Start random size 20, Standardisation & Relocation: Yes, N = 672.

VARIABLE	3 CLUSTERS			4 CLUSTERS			
	1	2	3	1	2	3	4
1. POSTURAL ANALYSIS	71.11 (31.01)	72.82 (32.73)	68.05 (33.63)	71.11 (31.01)	73.69 (33.37)	68.05 (33.63)	69.27 (30.24)
2. STATIC PALPATION	89.92 (17.62)	91.13 (15.15)	89.28 (19.19)	89.92 (17.62)	92.06 (14.15)	89.28 (19.19)	87.36 (18.45)
3. DYNAMIC PALPATION	87.45 (19.66)	88.93 (17.36)	89.51 (18.45)	87.45 (19.66)	89.90 (16.83)	89.51 (18.45)	85.00 (19.14)
4. ORTHOPAEDIC TESTS - LUMBAR SPINE	87.62 (18.68)	89.86 (15.17)	85.31 (21.79)	87.62 (18.68)	91.05 (14.11)	85.31 (21.79)	85.00 (18.35)
5. ORTHOPAEDIC TESTS - CERVICAL SPINE	83.25 (22.31)	86.70 (19.74)	80.78 (25.70)	83.25 (22.31)	87.97 (18.61)	80.78 (25.70)	81.55 (23.39)
6. NEUROLOGICAL TESTS - REFLEXES	78.63 (23.08)	84.80 (18.65)	73.23 (27.35)	78.63 (23.08)	85.34 (18.81)	73.23 (27.35)	82.64 (18.08)
7. NEUROLOGICAL TESTS - SENSATION	60.39 (28.91)	67.34 (26.18)	57.25 (29.79)	60.39 (28.91)	67.96 (26.12)	57.25 (29.79)	64.85 (26.69)
8. NEUROLOGICAL TESTS - MUSCLE TESTING	64.22 (27.65)	70.56 (26.45)	60.19 (29.07)	64.22 (27.65)	72.77 (25.61)	60.19 (29.07)	61.58 (28.28)
9. TAKE PULSE	31.69 (26.41)	37.90 (31.48)	21.95 (21.90)	31.69 (26.41)	38.83 (32.07)	21.95 (21.90)	34.15 (29.14)
10. TAKE BLOOD PRESSURE	40.75 (28.07)	47.66 (30.01)	31.51 (24.96)	40.75 (28.07)	47.60 (30.05)	31.51 (24.96)	47.91 (30.28)
11. CHECK RESPIRATION	14.12 (16.05)	17.96 (21.11)	9.63 (10.29)	14.12 (16.05)	17.96 (22.21)	9.63 (10.29)	17.94 (16.18)
12. TAKE TEMPERATURE	10.10 (12.17)	13.09 (15.56)	7.02 (7.62)	10.10 (12.17)	13.05 (16.31)	7.02 (7.62)	13.24 (12.27)
13. EXAMINE ABDOMEN	21.26 (21.69)	27.03 (24.13)	17.03 (16.00)	21.26 (21.69)	26.49 (22.60)	17.03 (16.00)	29.21 (29.85)
14. EXAMINE HEART	16.34 (18.04)	20.94 (21.70)	12.13 (12.38)	16.34 (18.04)	20.99 (21.71)	12.13 (12.38)	20.73 (22.00)
15. EXAMINE LUNGS	16.00 (16.40)	19.79 (20.97)	12.33 (13.06)	16.00 (16.40)	19.43 (21.10)	12.33 (13.06)	21.24 (20.68)
16. MOUTH EXAMINATION	12.97 (17.95)	14.81 (20.50)	10.52 (15.42)	12.97 (17.95)	14.18 (19.61)	10.52 (15.42)	17.39 (23.93)
FREQUENCY (PER CENT)	371 (55.21)	167 (24.85)	134 (19.94)	371 (55.21)	134 (19.94)	134 (19.94)	33 (4.91)

Table B. Three and Four Clusters Generated for Examination Variables.

Values are means within clusters (s.d.). Coefficient 24, Maxit = 0, Start random size 20, Standardisation & Relocation: Yes, N = 672.

VARIABLE	3 CLUSTERS			4 CLUSTERS			
	1	2	3	1	2	3	4
1. POSTURAL ANALYSIS	70.37 (31.46)	73.78 (31.63)	68.05 (33.63)	65.68 (34.65)	73.78 (31.63)	73.54 (28.75)	68.05 (33.63)
2. STATIC PALPATION	89.65 (17.72)	91.38 (15.36)	89.28 (19.19)	92.99 (12.47)	91.38 (15.36)	87.39 (20.25)	89.28 (19.19)
3. DYNAMIC PALPATION	87.66 (19.58)	88.33 (17.95)	89.51 (18.45)	87.62 (20.66)	88.33 (17.95)	87.69 (18.87)	89.51 (18.45)
4. ORTHOPAEDIC TESTS - LUMBAR SPINE	87.30 (19.32)	90.02 (14.40)	85.31 (21.79)	86.11 (22.92)	90.02 (14.40)	88.10 (16.46)	85.31 (21.79)
5. ORTHOPAEDIC TESTS - CERVICAL SPINE	83.23 (22.32)	86.15 (20.22)	80.78 (25.70)	82.31 (25.45)	86.15 (20.22)	83.86 (19.97)	80.78 (25.70)
6. NEUROLOGICAL TESTS - REFLEXES	78.18 (23.36)	84.52 (18.80)	73.23 (27.35)	75.90 (25.37)	84.52 (18.80)	79.72 (21.83)	73.23 (27.35)
7. NEUROLOGICAL TESTS - SENSATION	59.76 (28.65)	67.21 (27.00)	57.25 (29.79)	58.36 (28.62)	67.21 (27.00)	60.71 (28.71)	57.25 (29.79)
8. NEUROLOGICAL TESTS - MUSCLE TESTING	64.51 (27.14)	69.00 (27.71)	60.19 (29.07)	63.14 (26.68)	69.00 (27.71)	65.44 (27.48)	60.19 (29.07)
9. TAKE PULSE	31.38 (26.26)	37.38 (30.90)	21.95 (21.90)	32.47 (26.97)	37.38 (30.90)	30.64 (25.80)	21.95 (21.90)
10. TAKE BLOOD PRESSURE	40.60 (27.88)	46.74 (30.05)	31.51 (24.96)	42.18 (28.62)	46.74 (30.05)	39.53 (27.38)	31.51 (24.96)
11. CHECK RESPIRATION	13.99 (16.03)	17.51 (20.39)	9.63 (10.29)	14.38 (17.54)	17.51 (20.39)	13.73 (14.96)	9.63 (10.29)
12. TAKE TEMPERATURE	9.95 (11.48)	12.83 (15.92)	7.02 (7.62)	9.90 (12.20)	12.83 (15.92)	9.99 (11.00)	7.02 (7.62)
13. EXAMINE ABDOMEN	21.37 (22.06)	25.87 (23.29)	17.03 (16.00)	22.40 (23.92)	25.87 (23.29)	20.67 (20.75)	17.03 (16.00)
14. EXAMINE HEART	15.95 (17.55)	20.82 (21.74)	12.13 (12.38)	16.99 (20.02)	20.82 (21.74)	15.24 (15.69)	12.13 (12.38)
15. EXAMINE LUNGS	15.85 (16.31)	19.40 (20.40)	12.33 (13.06)	17.10 (17.67)	19.40 (20.40)	15.00 (15.30)	12.33 (13.06)
16. MOUTH EXAMINATION	13.03 (18.46)	14.39 (19.33)	10.52 (15.42)	12.95 (18.38)	14.39 (19.33)	13.09 (18.56)	10.52 (15.42)
FREQUENCY (PER CENT)	337 (50.15)	201 (29.91)	134 (19.94)	136 (20.24)	201 (29.91)	201 (29.91)	134 (19.94)

Table C. Three and Four Clusters Generated for Examination Variables.

Values are means within clusters (s.d.). Coefficient 29, Maxit = 0, Start random size 20, Standardisation & Relocation: Yes, N = 672.

VARIABLE	3 CLUSTERS			4 CLUSTERS			
	1	2	3	1	2	3	4
1. POSTURAL ANALYSIS	70.88 (31.05)	73.69 (33.37)	67.44 (33.97)	70.32 (31.56)	73.69 (33.37)	73.96 (28.09)	67.44 (33.97)
2. STATIC PALPATION	89.59 (18.00)	92.06 (14.15)	89.65 (18.36)	89.52 (18.10)	92.06 (14.15)	90.01 (17.58)	89.65 (18.36)
3. DYNAMIC PALPATION	87.66 (19.33)	89.90 (16.83)	88.46 (19.40)	88.11 (19.25)	89.90 (16.83)	85.18 (19.74)	88.46 (19.40)
4. ORTHOPAEDIC TESTS - LUMBAR SPINE	87.33 (18.49)	91.05 (14.11)	84.94 (23.32)	87.22 (19.08)	91.05 (14.11)	87.96 (14.88)	84.94 (23.32)
5. ORTHOPAEDIC TESTS - CERVICAL SPINE	82.93 (22.79)	87.97 (18.61)	80.78 (25.22)	83.01 (22.81)	87.97 (18.61)	82.52 (22.83)	80.78 (25.22)
6. NEUROLOGICAL TESTS - REFLEXES	78.36 (23.22)	85.34 (18.81)	73.91 (27.26)	77.54 (23.86)	85.34 (18.81)	82.88 (18.81)	73.91 (27.26)
7. NEUROLOGICAL TESTS - SENSATION	60.56 (28.70)	67.96 (26.12)	56.89 (30.29)	59.63 (28.62)	67.96 (26.12)	65.73 (28.81)	56.89 (30.29)
8. NEUROLOGICAL TESTS - MUSCLE TESTING	63.53 (28.21)	72.77 (25.61)	60.98 (27.37)	63.90 (27.84)	72.77 (25.61)	61.45 (30.31)	60.98 (27.37)
9. TAKE PULSE	31.40 (26.66)	38.83 (32.07)	20.71 (19.92)	30.85 (26.33)	38.83 (32.07)	34.48 (28.43)	20.71 (19.92)
10. TAKE BLOOD PRESSURE	40.93 (28.38)	47.60 (30.05)	29.92 (23.14)	40.19 (28.02)	47.60 (30.05)	45.01 (30.19)	29.92 (23.14)
11. CHECK RESPIRATION	14.24 (16.00)	17.96 (22.21)	8.84 (7.92)	13.81 (15.94)	17.96 (22.21)	16.61 (16.25)	8.84 (7.92)
12. TAKE TEMPERATURE	10.22 (12.10)	13.05 (16.31)	6.45 (6.00)	9.84 (11.43)	13.05 (16.31)	12.37 (15.22)	6.45 (6.00)
13. EXAMINE ABDOMEN	21.65 (22.25)	26.49 (22.60)	16.52 (15.09)	21.11 (21.76)	26.49 (22.60)	24.63 (24.74)	16.52 (15.09)
14. EXAMINE HEART	16.42 (18.20)	20.99 (21.71)	11.80 (11.23)	15.69 (17.37)	20.99 (21.71)	20.48 (21.96)	11.80 (11.23)
15. EXAMINE LUNGS	16.31 (16.83)	19.43 (21.10)	11.45 (11.33)	15.76 (16.36)	19.43 (21.10)	19.34 (19.08)	11.45 (11.33)
16. MOUTH EXAMINATION	13.25 (18.21)	14.18 (19.61)	9.89 (15.79)	12.97 (18.10)	14.18 (19.61)	14.82 (18.88)	9.89 (15.79)
FREQUENCY (PER CENT)	438 (65.18)	134 (19.94)	100 (14.88)	371 (55.21)	134 (19.94)	67 (9.97)	100 (14.88)

Table D. Three and Four Clusters Generated for Examination Variables.

Values are means within clusters (s.d.). Coefficient 29, Maxit = 10, Start random size 20, Standardisation & Relocation: Yes, N = 672.

VARIABLE	3 CLUSTERS			4 CLUSTERS			
	1	2	3	1	2	3	4
1. POSTURAL ANALYSIS	74.24 (29.91)	82.63 (25.65)	61.13 (34.78)	68.70 (32.59)	81.78 (26.17)	77.57 (27.51)	51.38 (36.64)
2. STATIC PALPATION	91.82 (13.57)	93.70 (13.02)	85.91 (22.76)	88.88 (19.01)	94.52 (7.83)	92.23 (13.30)	84.99 (24.05)
3. DYNAMIC PALPATION	91.64 (12.92)	91.90 (14.12)	81.25 (25.58)	87.99 (18.82)	90.58 (16.19)	92.08 (10.85)	75.59 (31.15)
4. ORTHOPAEDIC TESTS - LUMBAR SPINE	93.57 (8.18)	95.04 (8.84)	75.40 (26.03)	88.76 (14.55)	94.22 (10.32)	94.59 (6.09)	58.53 (30.27)
5. ORTHOPAEDIC TESTS - CERVICAL SPINE	91.42 (10.92)	93.48 (12.09)	67.15 (29.49)	84.58 (18.82)	91.94 (14.55)	92.89 (8.91)	46.10 (29.13)
6. NEUROLOGICAL TESTS - REFLEXES	87.45 (14.20)	93.49 (8.67)	60.00 (26.89)	77.37 (20.30)	92.10 (9.85)	90.30 (11.87)	42.15 (26.05)
7. NEUROLOGICAL TESTS - SENSATION	70.08 (24.14)	80.64 (23.44)	40.26 (24.57)	54.07 (24.14)	79.46 (22.38)	77.70 (22.36)	26.16 (20.07)
8. NEUROLOGICAL TESTS - MUSCLE TESTING	73.36 (22.10)	85.46 (15.69)	43.64 (26.80)	59.04 (25.28)	84.34 (17.24)	78.94 (19.79)	30.62 (24.85)
9. TAKE PULSE	32.87 (23.73)	73.75 (22.06)	12.90 (12.38)	18.44 (16.15)	81.26 (17.48)	43.23 (25.38)	8.85 (7.12)
10. TAKE BLOOD PRESSURE	44.39 (25.34)	78.35 (20.31)	20.39 (16.49)	27.86 (19.36)	84.10 (17.12)	55.07 (24.76)	14.05 (13.81)
11. CHECK RESPIRATION	13.04 (11.66)	39.07 (28.45)	6.78 (6.17)	8.42 (6.67)	46.10 (30.73)	17.33 (15.15)	5.09 (4.91)
12. TAKE TEMPERATURE	9.05 (8.13)	26.81 (23.88)	5.99 (5.71)	6.89 (5.74)	29.62 (26.33)	12.00 (11.58)	4.59 (5.93)
13. EXAMINE ABDOMEN	21.68 (16.72)	54.29 (29.10)	10.05 (10.10)	13.67 (11.84)	67.76 (24.81)	26.72 (18.64)	7.38 (9.32)
14. EXAMINE HEART	15.36 (12.01)	46.80 (28.49)	7.53 (7.08)	9.98 (7.76)	58.18 (26.81)	19.80 (14.97)	4.84 (6.15)
15. EXAMINE LUNGS	15.12 (11.56)	42.96 (27.93)	8.04 (7.34)	10.14 (7.73)	54.50 (29.41)	19.03 (12.87)	5.36 (5.74)
16. MOUTH EXAMINATION	12.06 (15.07)	32.92 (30.67)	6.94 (9.61)	8.83 (11.57)	43.58 (33.98)	14.31 (16.26)	4.35 (5.16)
FREQUENCY (PER CENT)	366 (54.46)	83 (12.35)	223 (33.18)	288 (42.86)	50 (7.44)	253 (37.65)	81 (12.05)

APPENDIX 9

CLUSTER ANALYSIS TABLES

THE TREATMENT TECHNIQUES

Table A. Two, Three and Four Clusters Generated for Treatment Technique Variables.

Values are means within clusters (s.d.). Coefficient 24, Maxit = 0, Start random size 20, Standardisation & Relocation: Yes, N = 529.

VARIABLE	2 CLUSTERS		3 CLUSTERS			4 CLUSTERS			
	1	2	1	2	3	1	2	3	4
1. DIVERSIFIED	67.08 (30.21)	66.78 (31.73)	65.89 (31.73)	66.78 (31.73)	68.12 (28.87)	65.89 (31.73)	66.78 (31.73)	69.52 (29.17)	67.06 (28.74)
2. GONSTEAD	37.71 (32.42)	34.11 (33.98)	39.57 (32.39)	34.11 (33.98)	36.08 (32.46)	39.57 (32.39)	34.11 (33.98)	33.91 (32.78)	37.72 (32.27)
3. HIO - HOLE-IN-ONE	16.96 (20.78)	13.92 (17.80)	15.71 (19.08)	13.92 (17.80)	18.05 (22.15)	15.71 (19.08)	13.92 (17.80)	16.80 (21.75)	19.00 (22.51)
4. TOGGLE RECOIL	22.13 (22.55)	20.96 (21.95)	24.03 (23.45)	20.96 (21.95)	20.47 (21.66)	24.03 (23.45)	20.96 (21.95)	20.42 (22.14)	20.51 (21.40)
5. LOGAN	9.48 (12.80)	6.33 (7.36)	11.81 (13.72)	6.33 (7.36)	7.44 (11.60)	11.81 (13.72)	6.33 (7.36)	6.75 (8.74)	7.97 (13.39)
6. SACRO-OCCIPITAL TECHNIQUE	19.83 (25.15)	11.82 (15.91)	17.11 (19.53)	11.82 (15.91)	22.20 (29.04)	17.11 (19.53)	11.82 (15.91)	22.35 (30.11)	22.08 (28.34)
7. APPLIED KINESIOLOGY	18.22 (23.36)	15.23 (21.49)	17.65 (22.57)	15.23 (21.49)	18.72 (24.09)	17.65 (22.57)	15.23 (21.49)	15.25 (19.32)	21.36 (26.95)
8. NIMMO	42.57 (27.24)	42.49 (28.16)	41.37 (26.63)	42.49 (28.16)	43.62 (27.79)	41.37 (26.63)	42.49 (28.16)	35.99 (24.66)	49.42 (28.73)
9. ACTIVATOR	14.67 (18.17)	11.05 (14.68)	15.16 (18.57)	11.05 (14.68)	14.25 (17.85)	15.16 (18.57)	11.05 (14.68)	16.11 (16.44)	12.83 (18.82)
10. PETTIBON	5.98 (9.49)	4.93 (7.76)	6.21 (8.59)	4.93 (7.76)	5.78 (10.24)	6.21 (8.59)	4.93 (7.76)	5.82 (8.04)	5.75 (11.68)
11. PIERCE-STILLWAGON	6.85 (10.58)	5.67 (9.51)	6.94 (8.59)	5.67 (9.51)	6.76 (12.07)	6.94 (8.59)	5.67 (9.51)	6.25 (8.94)	7.14 (14.02)
12. TOFTNESS	5.88 (9.77)	4.19 (6.78)	6.39 (8.61)	4.19 (6.78)	5.44 (10.68)	6.39 (8.61)	4.19 (6.78)	4.32 (5.25)	6.29 (13.38)
13. BIOMECHANICAL PRINCIPLES	38.38 (29.61)	39.12 (30.80)	35.27 (28.94)	39.12 (30.80)	41.11 (29.99)	35.27 (28.94)	39.12 (30.80)	42.34 (31.66)	40.18 (28.78)
FREQUENCY (PER CENT)	343 (64.84)	186 (35.16)	160 (30.25)	186 (35.16)	183 (34.59)	160 (30.25)	186 (35.16)	79 (14.93)	104 (19.66)

Table B. Two, Three and Four Clusters Generated for Treatment Technique Variables.

Values are means within clusters (s.d.). Coefficient 29, Maxit = 0, Start random size 20, Standardisation & Relocation: Yes, N = 529.

VARIABLE	2 CLUSTERS		3 CLUSTERS			4 CLUSTERS			
	1	2	1	2	3	1	2	3	4
1. DIVERSIFIED	68.80 (29.34)	64.77 (32.25)	68.80 (29.34)	63.75 (32.53)	65.57 (32.12)	68.27 (29.48)	73.96 (27.92)	63.75 (32.53)	65.57 (32.12)
2. GONSTEAD	38.31 (32.67)	34.18 (33.31)	38.31 (32.67)	34.69 (32.65)	33.77 (33.94)	37.94 (32.32)	41.89 (36.38)	34.69 (32.65)	33.77 (33.94)
3. HIO - HOLE-IN-ONE	17.64 (21.39)	13.77 (17.53)	17.64 (21.39)	13.92 (16.23)	13.65 (18.57)	17.59 (21.42)	18.15 (21.51)	13.92 (16.23)	13.65 (18.57)
4. TOGGLE RECOIL	22.37 (22.86)	20.92 (21.68)	22.37 (22.86)	21.68 (21.38)	20.32 (21.97)	21.91 (22.01)	26.85 (30.07)	21.68 (21.38)	20.32 (21.97)
5. LOGAN	9.83 (13.24)	6.60 (8.01)	9.83 (13.24)	6.65 (8.28)	6.56 (7.81)	9.39 (13.15)	14.11 (13.64)	6.65 (8.28)	6.56 (7.81)
6. SACRO-OCCIPITAL TECHNIQUE	19.86 (24.86)	13.55 (19.12)	19.86 (24.86)	15.06 (20.94)	12.35 (17.52)	19.53 (24.97)	23.07 (24.04)	15.06 (20.94)	12.35 (17.52)
7. APPLIED KINESIOLOGY	18.83 (23.56)	15.15 (21.60)	18.83 (23.56)	14.82 (19.62)	15.41 (23.12)	18.91 (23.64)	18.07 (23.11)	14.82 (19.62)	15.41 (23.12)
8. NIMMO	44.01 (26.99)	40.77 (28.13)	44.01 (27.00)	41.23 (28.45)	40.40 (27.98)	43.97 (27.43)	44.33 (22.79)	41.23 (28.45)	40.40 (27.98)
9. ACTIVATOR	14.25 (18.21)	12.37 (15.62)	14.25 (18.21)	14.43 (15.62)	10.72 (15.49)	14.25 (18.42)	14.19 (16.32)	14.43 (15.62)	10.72 (15.49)
10. PETTIBON	5.77 (8.71)	5.42 (9.21)	5.77 (8.71)	6.39 (10.82)	4.65 (7.65)	5.86 (9.01)	4.89 (4.85)	6.39 (10.82)	4.65 (7.65)
11. PIERCE-STILLWAGON	7.01 (11.11)	5.73 (9.00)	7.01 (11.11)	5.73 (6.64)	5.73 (10.54)	6.87 (10.65)	8.37 (15.03)	5.73 (6.64)	5.73 (10.54)
12. TOFTNESS	5.93 (10.26)	4.50 (6.73)	5.93 (10.26)	5.08 (5.70)	4.05 (7.43)	5.98 (10.66)	5.48 (4.98)	5.08 (5.70)	4.05 (7.43)
13. BIOMECHANICAL PRINCIPLES	38.83 (29.10)	38.41 (31.13)	38.83 (29.10)	41.09 (33.36)	36.28 (29.18)	39.57 (29.23)	31.67 (27.23)	41.09 (33.36)	36.28 (29.18)
FREQUENCY (PER CENT)	290 (54.82)	239 (45.18)	290 (54.82)	106 (20.04)	133 (25.14)	263 (49.72)	27 (5.10)	106 (20.04)	133 (25.14)

Table C. Two, Three and Four Clusters Generated for Treatment Technique Variables.

Values are means within clusters (s.d.). Coefficient 24, Maxit = 10, Start random size 20, Standardisation & Relocation: Yes, N = 529.

VARIABLE	2 CLUSTERS		3 CLUSTERS			4 CLUSTERS			
	1	2	1	2	3	1	2	3	4
1. DIVERSIFIED	63.09 (30.99)	70.27 (30.16)	66.67 (30.27)	46.69 (29.59)	79.57 (24.60)	64.79 (31.29)	46.35 (29.56)	80.80 (23.78)	64.57 (29.42)
2. GONSTEAD	41.52 (31.21)	32.13 (33.90)	32.90 (26.71)	78.40 (17.58)	13.70 (16.23)	37.63 (29.67)	79.90 (16.30)	13.51 (16.05)	31.06 (26.44)
3. HIO - HOLE-IN-ONE	23.92 (23.35)	9.07 (12.76)	25.18 (23.71)	15.07 (20.63)	9.00 (11.16)	25.33 (24.26)	12.96 (18.45)	9.55 (11.94)	19.10 (21.86)
4. TOGGLE RECOIL	27.58 (24.51)	16.73 (18.95)	32.13 (26.36)	11.09 (14.01)	19.91 (19.27)	30.83 (23.99)	9.95 (14.00)	21.26 (20.60)	22.79 (25.55)
5. LOGAN	14.73 (13.16)	2.97 (5.02)	15.23 (14.08)	7.23 (9.54)	3.61 (5.78)	17.61 (15.24)	4.54 (5.27)	3.54 (5.64)	9.17 (8.97)
6. SACRO-OCCIPITAL TECHNIQUE	25.42 (24.72)	9.86 (17.89)	30.94 (26.87)	8.51 (11.34)	11.11 (18.72)	18.81 (17.69)	7.16 (9.56)	8.21 (11.80)	53.12 (30.76)
7. APPLIED KINESIOLOGY	26.81 (26.44)	8.98 (14.78)	32.21 (28.62)	10.05 (11.67)	9.54 (15.61)	16.09 (14.28)	9.37 (11.80)	8.25 (12.13)	56.28 (30.50)
8. NIMMO	42.79 (26.27)	42.33 (28.62)	39.36 (26.05)	50.20 (26.39)	40.41 (28.59)	45.34 (26.11)	49.44 (26.48)	41.40 (28.24)	29.46 (25.60)
9. ACTIVATOR	20.57 (19.31)	7.30 (12.00)	24.26 (21.26)	8.28 (40.02)	7.88 (11.99)	24.17 (20.60)	7.11 (10.25)	7.63 (11.11)	17.51 (19.82)
10. PETTIBON	10.84 (10.59)	1.16 (3.05)	11.39 (12.08)	4.37 (5.31)	1.77 (4.09)	12.55 (12.59)	3.33 (4.93)	1.51 (3.74)	6.58 (6.32)
11. PIERCE-STILLWAGON	12.18 (12.30)	1.55 (3.59)	12.62 (13.88)	5.52 (6.84)	2.06 (4.50)	10.94 (9.43)	4.73 (7.12)	1.95 (4.46)	12.47 (17.94)
12. TOFTNESS	10.37 (10.80)	0.97 (2.41)	11.05 (12.46)	4.08 (4.89)	1.44 (3.02)	11.71 (12.80)	3.05 (4.45)	1.32 (2.89)	6.89 (7.61)
13. BIOMECHANICAL PRINCIPLES	43.66 (27.87)	34.38 (31.12)	43.37 (27.80)	36.97 (29.05)	35.91 (31.89)	50.77 (28.66)	31.42 (26.89)	35.52 (31.52)	34.08 (26.05)
FREQUENCY (PER CENT)	243 (45.94)	286 (54.06)	175 (33.08)	134 (25.33)	220 (41.59)	145 (27.41)	111 (20.98)	201 (38.00)	72 (13.61)

Table D. Two, Three and Four Clusters Generated for Treatment Technique Variables.

Values are means within clusters (s.d.). Coefficient 29, Maxit = 10, Start random size 20, Standardisation & Relocation: Yes, N = 529.

VARIABLE	2 CLUSTERS		3 CLUSTERS			4 CLUSTERS			
	1	2	1	2	3	1	2	3	4
1. DIVERSIFIED	66.91 (30.72)	100.0 (0.0)	66.77 (31.25)	100.0 (0.0)	67.10 (30.09)	66.47 (30.77)	65.67 (32.81)	100.0 (0.0)	70.98 (26.38)
2. GONSTEAD	36.32 (32.91)	100.0 (0.0)	31.90 (33.57)	100.0 (0.0)	41.97 (31.21)	38.99 (32.83)	29.15 (33.15)	100.0 (0.0)	46.74 (28.82)
3. HIO - HOLE-IN-ONE	15.73 (19.49)	100.0 (0.0)	9.73 (13.47)	100.0 (0.0)	23.39 (23.03)	17.29 (18.77)	8.36 (12.43)	100.0 (0.0)	29.38 (25.93)
4. TOGGLE RECOIL	21.64 (22.28)	60.0 (0.0)	14.68 (16.56)	60.0 (0.0)	30.53 (25.33)	23.86 (22.03)	13.23 (15.03)	60.0 (0.0)	36.13 (28.10)
5. LOGAN	8.20 (10.57)	99.99 (0.0)	3.45 (5.24)	99.99 (0.0)	14.26 (12.41)	10.16 (8.84)	2.21 (4.32)	99.99 (0.0)	17.58 (15.36)
6. SACRO-OCCIPITAL TECHNIQUE	16.85 (22.38)	100.0 (0.0)	9.87 (17.88)	100.0 (0.0)	25.77 (24.33)	16.26 (16.45)	8.85 (19.51)	100.0 (0.0)	37.57 (28.21)
7. APPLIED KINESIOLOGY	17.05 (22.60)	80.0 (0.0)	9.43 (15.17)	80.0 (0.0)	26.78 (26.49)	19.21 (21.14)	6.83 (13.00)	80.0 (0.0)	35.99 (29.57)
8. NIMMO	42.51 (27.55)	60.0 (0.0)	38.46 (27.92)	60.0 (0.0)	47.68 (26.23)	45.60 (26.26)	36.01 (27.44)	60.0 (0.0)	50.28 (27.90)
9. ACTIVATOR	13.23 (16.69)	100.0 (0.0)	7.34 (11.38)	100.0 (0.0)	20.75 (19.21)	15.27 (13.67)	4.91 (9.74)	100.0 (0.0)	27.96 (23.63)
10. PETTIBON	5.43 (7.94)	100.0 (0.0)	2.07 (4.67)	100.0 (0.0)	9.72 (9.10)	7.45 (5.94)	0.72 (2.37)	100.0 (0.0)	11.60 (12.99)
11. PIERCE-STILLWAGON	6.25 (9.38)	99.99 (0.0)	2.53 (5.10)	99.99 (0.0)	10.99 (11.28)	8.15 (7.08)	1.04 (2.79)	99.99 (0.0)	13.92 (15.59)
12. TOFTNESS	5.15 (8.25)	80.0 (0.0)	1.65 (3.44)	80.0 (0.0)	9.61 (10.21)	6.58 (4.85)	0.61 (1.80)	80.0 (0.0)	12.34 (15.14)
13. BIOMECHANICAL PRINCIPLES	38.53 (29.91)	100.0 (0.0)	31.70 (29.93)	100.0 (0.0)	47.24 (27.59)	42.09 (28.58)	30.48 (30.02)	100.0 (0.0)	48.80 (28.31)
FREQUENCY (PER CENT)	528 (99.8)	1 (0.20)	296 (55.95)	1 (0.19)	232 (43.86)	224 (42.34)	214 (40.45)	1 (0.19)	90 (17.01)

APPENDIX 10

CLUSTER ANALYSIS TABLES

THE MISCELLANEOUS PRACTICE MANAGEMENT PROCEDURES

Table A. Two, Three and Four Clusters Generated for Miscellaneous Practice Management Variables.

Values are means within clusters (s.d.). Coefficient 24, Maxit = 0, Start random size 20, Standardisation & Relocation: Yes, N = 689.

VARIABLE	2 CLUSTERS		3 CLUSTERS			4 CLUSTERS			
	1	2	1	2	3	1	2	3	4
1. PERFORM HOME VISITS	6.09 (5.22)	8.22 (9.63)	6.09 (5.22)	8.51 (10.15)	7.36 (7.89)	5.38 (4.43)	6.33 (5.44)	8.51 (10.15)	7.36 (7.89)
2. TREAT BY MANIPULATION ONLY ON FIRST VISIT	42.26 (32.70)	47.80 (32.88)	42.26 (32.70)	48.50 (33.08)	45.70 (32.40)	47.44 (34.36)	40.55 (32.00)	48.50 (33.08)	45.70 (32.40)
3. GIVE EMOTIONAL/SOCIAL COUNSELLING	8.54 (10.17)	12.07 (15.91)	8.54 (10.17)	11.20 (14.33)	14.68 (19.81)	7.17 (7.81)	9.00 (10.82)	11.20 (14.33)	14.68 (19.81)
4. RATE AGREEMENT TO PRESCRIBE DRUGS	46.45 (34.69)	45.85 (34.43)	46.45 (34.69)	41.81 (33.98)	57.96 (33.11)	43.88 (35.53)	47.30 (34.42)	41.81 (33.98)	57.96 (33.11)
5. TIME SPENT WITH PATIENT - FIRST VISIT	39.24 (12.07)	37.47 (11.16)	39.24 (12.07)	37.43 (11.21)	37.58 (11.06)	39.21 (12.73)	39.25 (11.86)	37.43 (11.21)	37.58 (11.06)
6. TIME SPENT WITH PATIENT - SUBSEQUENT VISITS	14.03 (4.81)	13.36 (4.69)	14.03 (4.81)	13.36 (4.53)	13.35 (5.19)	13.14 (4.31)	14.33 (4.93)	13.36 (4.53)	13.35 (5.19)
FREQUENCY (PER CENT)	413 (59.94)	276 (40.06)	413 (59.94)	207 (30.04)	69 (10.01)	103 (14.95)	310 (44.99)	207 (30.04)	69 (10.01)

Table B. Two, Three and Four Clusters Generated for Miscellaneous Practice Management Variables.

Values are means within clusters (s.d.). Coefficient 29, Maxit = 0, Start random size 20, Standardisation & Relocation: Yes, N = 689.

VARIABLE	2 CLUSTERS		3 CLUSTERS			4 CLUSTERS			
	1	2	1	2	3	1	2	3	4
1. PERFORM HOME VISITS	6.28 (5.22)	7.61 (9.00)	6.28 (5.22)	7.18 (8.22)	8.63 (10.57)	5.33 (4.33)	7.18 (8.22)	8.63 (10.57)	6.69 (5.52)
2. TREAT BY MANIPULATION ONLY ON FIRST VISIT	44.98 (33.52)	43.98 (32.22)	44.98 (33.52)	42.20 (32.16)	48.08 (32.14)	44.29 (34.26)	42.20 (32.16)	48.08 (32.14)	45.28 (33.27)
3. GIVE EMOTIONAL/SOCIAL COUNSELLING	8.90 (11.39)	11.02 (14.18)	8.90 (11.39)	9.63 (11.82)	14.21 (18.16)	6.77 (8.48)	9.63 (11.82)	14.21 (18.16)	9.82 (12.35)
4. RATE AGREEMENT TO PRESCRIBE DRUGS	43.50 (35.66)	48.92 (33.25)	43.50 (35.66)	47.01 (32.53)	53.34 (34.60)	41.91 (35.62)	47.01 (32.53)	53.34 (34.60)	44.18 (35.73)
5. TIME SPENT WITH PATIENT - FIRST VISIT	38.15 (12.11)	38.91 (11.35)	38.15 (12.11)	39.53 (11.68)	37.49 (10.47)	39.18 (12.69)	39.53 (11.68)	37.49 (10.47)	37.70 (11.85)
6. TIME SPENT WITH PATIENT - SUBSEQUENT VISITS	13.42 (4.46)	14.10 (5.04)	13.42 (4.46)	14.43 (5.15)	13.35 (4.72)	13.38 (4.76)	14.43 (5.15)	13.35 (4.72)	13.44 (4.34)
FREQUENCY (PER CENT)	345 (50.07)	344 (49.93)	345 (50.07)	240 (34.83)	104 (15.09)	104 (15.09)	240 (34.83)	104 (15.09)	241 (34.98)

Table C. Two, Three and Four Clusters Generated for Miscellaneous Practice Management Variables.

Values are means within clusters (s.d.). Coefficient 29, Maxit = 10, Start random size 20, Standardisation & Relocation: Yes, N = 689.

VARIABLE	2 CLUSTERS		3 CLUSTERS			4 CLUSTERS			
	1	2	1	2	3	1	2	3	4
1. PERFORM HOME VISITS	5.22 (4.15)	12.31 (11.51)	4.45 (3.52)	16.64 (15.39)	7.54 (6.20)	5.94 (4.51)	3.86 (2.89)	19.97 (17.11)	9.80 (7.52)
2. TREAT BY MANIPULATION ONLY ON FIRST VISIT	41.71 (32.86)	53.08 (31.43)	34.32 (32.00)	56.56 (30.90)	51.93 (31.32)	46.49 (31.62)	32.59 (32.22)	63.95 (28.15)	51.55 (32.31)
3. GIVE EMOTIONAL/SOCIAL COUNSELLING	6.72 (6.14)	19.99 (20.81)	5.23 (4.45)	35.75 (25.38)	9.73 (8.78)	7.77 (6.72)	4.97 (4.58)	38.27 (25.98)	13.73 (14.41)
4. RATE AGREEMENT TO PRESCRIBE DRUGS	41.50 (33.72)	60.80 (33.11)	33.38 (30.39)	67.46 (31.55)	54.51 (34.44)	51.04 (33.88)	26.13 (26.67)	76.40 (27.04)	55.85 (33.99)
5. TIME SPENT WITH PATIENT - FIRST VISIT	36.16 (9.84)	45.89 (13.93)	34.58 (9.60)	45.49 (15.45)	41.02 (11.57)	37.86 (9.68)	33.43 (9.40)	45.18 (17.21)	45.31 (12.81)
6. TIME SPENT WITH PATIENT - SUBSEQUENT VISITS	12.72 (3.80)	16.99 (5.91)	11.96 (3.50)	19.24 (7.30)	14.48 (4.28)	13.54 (3.69)	11.43 (3.60)	18.48 (7.18)	16.22 (5.34)
FREQUENCY (PER CENT)	521 (75.62)	168 (24.38)	307 (44.56)	59 (8.56)	323 (46.88)	304 (44.12)	202 (29.32)	40 (5.81)	143 (20.75)

Table D. Two, Three and Four Clusters Generated for Miscellaneous Practice Management Variables.

Values are means within clusters (s.d.). Coefficient 24, Maxit = 10, Start random size 20, Standardisation & Relocation: Yes, N = 689.

VARIABLE	2 CLUSTERS		3 CLUSTERS			4 CLUSTERS			
	1	2	1	2	3	1	2	3	4
1. PERFORM HOME VISITS	7.88 (8.30)	5.97 (6.14)	6.07 (4.85)	5.38 (4.24)	20.09 (15.31)	6.68 (5.93)	5.25 (4.27)	18.85 (15.66)	5.91 (4.89)
2. TREAT BY MANIPULATION ONLY ON FIRST VISIT	69.68 (22.23)	18.16 (18.30)	67.48 (24.06)	17.96 (19.00)	53.83 (30.50)	71.66 (21.40)	17.20 (19.27)	54.02 (30.31)	41.34 (30.73)
3. GIVE 8EMOTIONAL/SOCIAL COUNSELLING	12.25 (15.24)	7.56 (9.29)	7.71 (6.54)	6.40 (5.64)	41.26 (22.33)	7.68 (6.52)	5.81 (5.30)	44.74 (20.29)	7.64 (6.18)
4. RATE AGREEMENT TO PRESCRIBE DRUGS	43.40 (34.15)	49.13 (34.79)	43.31 (33.87)	46.62 (34.84)	60.36 (33.90)	19.86 (17.94)	32.45 (28.43)	63.09 (31.94)	81.51 (17.14)
5. TIME SPENT WITH PATIENT - FIRST VISIT	33.69 (9.80)	43.58 (11.48)	33.32 (9.59)	44.26 (11.33)	37.83 (11.09)	34.82 (9.91)	46.94 (11.74)	38.66 (11.73)	34.09 (8.76)
6. TIME SPENT WITH PATIENT - SUBSEQUENT VISITS	11.97 (3.68)	15.64 (5.05)	11.53 (3.52)	15.74 (4.88)	15.98 (4.78)	12.05 (3.84)	16.64 (5.37)	16.08 (4.80)	12.13 (3.19)
FREQUENCY (PER CENT)	352 (51.08)	337 (48.91)	327 (47.46)	304 (44.12)	58 (8.42)	214 (31.06)	207 (30.04)	53 (7.69)	215 (31.20)

APPENDIX 11

THE DATA SET USED FOR CHECKING CHIROPRACTORS' ESTIMATES OF PROCEDURES AGAINST PATIENT INFORMATION

The data set used for checking chiropractors' estimates against patient information (N=65).

* = Missing cases

ID	SPEN VISF	SPEN VISS	MEAN VIS1	MEAN VIS2	RAYDI HOS	RAYPR CLI	MEAN1	DIFFVI S1	MEAN2	DIFF VIS2	HOSP PT	PRICLI PT	MEADI HOS	MEAPR CLI	DIFDI HOS	DIFPR CLI
3	50	12	33.93	11.67	5	0	41.97	16.07	11.84	0.33	6.7	0.0	5.85	0.00	-1.7	0.0
4	*	*	29.64	11.23	*	*	*	*	*	*	6.7	6.7	*	*	*	*
5	50	10	32.67	11.00	0	0	41.34	17.33	10.50	-1.00	0.0	0.0	0.00	0.00	0.0	0.0
7	*	*	23.67	9.64	*	*	*	*	*	*	0.0	0.0	*	*	*	*
11	45	12	27.20	14.36	11	11	38.10	17.80	13.18	-2.36	6.7	0.0	8.85	5.50	4.3	11.0
13	40	13	33.33	13.75	11	8	36.67	6.67	13.38	-0.75	6.7	0.0	8.85	4.00	4.3	8.0
14	30	10	17.54	9.31	8	8	23.77	12.40	9.66	0.69	23.1	0.0	15.55	4.00	-15.1	8.0
20	60	12	50.71	11.50	11	6	55.36	9.29	11.75	0.50	0.0	0.0	5.50	3.00	11.0	6.0
304	30	20	30.00	20.00	*	91	30.00	0.00	20.00	0.00	6.7	86.7	*	88.85	*	4.3
505	90	15	31.27	10.38	8	8	60.64	58.73	12.69	4.62	20.0	0.0	14.00	4.00	-12.0	8.0
701	60	20	35.40	20.31	40	60	47.70	24.60	20.16	-0.31	0.0	73.3	20.00	66.65	40.0	-13.3
703	20	30	30.00	30.00	8	20	25.00	-10.00	30.00	0.00	0.0	93.3	4.00	56.65	8.0	-73.3
706	35	17	31.33	18.57	10	30	33.17	3.67	17.79	-1.57	20.0	13.3	15.00	21.65	-10.0	16.7
707	20	*	25.00	20.38	80	80	22.50	-5.00	*	*	0.0	53.8	40.00	66.90	80.0	26.2
708	45	30	47.50	39.50	*	100	46.25	-2.50	34.75	-9.50	60.0	0.0	*	50.00	*	100.0

810	60	30	53.67	31.15	20	6	56.84	6.33	30.58	-1.15	71.4	21.4	45.70	13.70	-51.4	-15.4
813	30	10	9.75	7.67	8	6	19.88	20.25	8.84	2.33	68.8	0.0	38.40	3.00	-60.8	6.0
902	30	15	28.50	15.00	4	6	29.25	1.50	15.00	0.00	53.3	0.0	28.65	3.00	-49.3	6.0
905	20	10	29.23	13.33	*	*	24.62	-9.23	11.67	-3.33	33.3	0.0	*	*	*	*
907	30	15	34.17	16.25	11	8	32.09	-4.17	15.63	-1.25	35.7	0.0	23.35	4.00	-24.7	8.0
910	45	15	43.33	15.00	11	11	44.17	1.67	15.00	0.00	33.3	0.0	22.15	5.50	-22.3	11.0
911	25	12	25.00	12.00	0	0	25.00	0.00	12.00	0.00	0.0	0.0	0.00	0.00	0.0	0.0
912	30	15	30.00	12.69	40	*	30.00	0.00	13.85	2.31	53.3	0.0	46.65	*	-13.3	*
913	30	10	26.92	12.40	*	*	28.46	3.08	11.20	-2.40	28.6	0.0	*	*	*	*
1012	60	20	57.00	19.55	13	0	58.50	3.00	19.78	0.45	80.0	0.0	46.50	0.00	-67.0	0.0
1105	45	12	41.33	12.00	11	0	43.17	3.67	12.00	0.00	6.7	33.3	8.85	16.65	4.3	-33.3
1107	20	7	17.00	10.00	20	20	18.50	3.00	8.50	-3.00	40.0	6.7	30.00	13.35	-20.0	13.3
1108	30	15	30.00	15.67	31	51	30.00	0.00	15.34	-0.67	13.3	46.7	22.15	48.85	17.7	4.3
1108	30	10	22.87	11.29	26	40	26.44	7.13	10.65	-1.29	26.7	13.3	26.35	26.65	-0.7	26.7
1113	30	11	12.31	11.45	20	20	21.16	17.69	11.23	-0.45	13.3	13.3	16.65	16.65	6.7	6.7

1116	100	0	30	10	27.00	10.83	4	15	35	28.50	3.00	10.42	-0.83	13.3	20.0	14.15	27.50	1.7	15.0
1404	*	*	40	20	31.14	13.91	11	8	11	35.57	8.86	16.96	6.09	14.3	0.0	11.15	5.50	-6.3	11.0
1407	*	*	45	20	42.86	15.42	0	11	11	43.93	2.14	17.71	4.58	15.4	15.4	13.20	13.20	-4.4	-4.4
1416	*	*	30	20	25.33	17.50	0	20	20	27.67	4.67	18.75	2.50	40.0	0.0	30.00	10.00	-20.0	20.0
1417	*	*	*	*	30.00	15.00	*	*	*	*	*	*	*	13.3	0.0	*	*	*	*
1418	*	*	40	20	40.00	20.83	0	100	0	40.00	0.00	20.42	-0.83	26.7	0.0	63.35	0.00	73.3	0.0
1601	80	31	45	15	29.29	6.83	95	91	93	37.15	15.71	10.92	8.17	21.4	14.3	56.20	53.65	69.6	78.7
1603	31	6	60	10	38.00	11.64	0	6	6	49.00	22.00	10.82	-1.64	7.1	14.3	6.55	10.15	-1.1	-8.3
1608	60	0	30	13	26.40	14.29	0	2	10	28.20	3.60	13.65	-1.29	6.7	0.0	4.35	5.00	-4.7	10.0
1607	91	11	60	7	25.00	6.73	7	8	8	42.60	35.00	6.87	0.27	0.0	0.0	4.00	4.00	8.0	8.0
1608	*	*	45	15	38.67	15.77	11	8	51	41.64	6.33	15.39	-0.77	0.0	35.7	4.00	43.35	8.0	15.3
1611	88	8	40	10	27.67	10.80	8	11	8	33.84	12.33	10.40	-0.80	0.0	13.3	5.50	10.65	11.0	-5.3
1612	31	31	25	9	18.27	8.64	13	51	31	21.64	6.73	8.82	0.36	8.3	0.0	29.65	15.50	42.7	31.0
1613	51	11	40	10	21.78	9.85	11	11	0	30.90	18.21	9.93	0.15	20.0	6.7	15.50	3.35	-9.0	-6.7
1614	48	2	38	10	31.79	10.25	8	11	11	30.90	-1.79	10.13	-0.25	0.0	38.5	5.50	24.75	11.0	-27.5

1617	28	0	30	15	28.67	16.67	26	6	60	29.34	1.33	15.84	-1.67	6.7	26.7	6.35	43.35	-0.7	33.3
1618	80	11	30	10	12.47	8.13	6	26	11	21.24	17.53	9.07	1.87	26.7	0.0	26.35	5.50	-0.7	11.0
1620	13	0	70	15	46.07	18.46	4	2	4	58.84	23.93	16.73	-3.46	0.0	23.1	1.00	13.55	2.0	-19.1
1621	•	•	30	15	30.00	15.00	11	51	6	30.00	0.00	15.00	0.00	0.0	0.0	25.50	3.00	51.0	6.0
1627	28	13	30	15	21.43	12.92	11	6	28	25.72	8.57	13.96	2.08	0.0	33.3	3.00	30.65	6.0	-5.3
1815	•	•	30	12	28.75	10.42	0	2	4	29.38	1.25	11.21	1.58	33.3	33.3	17.65	18.65	-31.3	-29.3
1901	33	13	75	20	72.00	17.50	11	15	33	73.50	3.00	18.75	2.50	40.0	0.0	27.50	16.50	-25.0	33.0
1903	77	8	45	17	34.29	16.43	11	8	4	39.65	10.71	16.72	0.57	6.7	0.0	7.35	2.00	1.3	4.0
1904	88	8	37	15	20.00	12.00	8	6	8	28.50	17.00	13.50	3.00	6.7	0.0	6.35	4.00	-0.7	8.0
1907	90	0	30	10	30.71	10.54	5	20	0	30.36	-0.71	10.27	-0.54	35.7	0.0	27.85	0.00	-15.7	0.0
1909	73	31	20	10	16.47	0.75	31	11	11	18.24	3.53	10.38	-0.75	7.1	0.0	9.05	5.50	3.9	11.0
1910	40	2	60	20	46.07	20.00	0	8	2	53.04	13.93	20.00	0.00	0.0	0.0	4.00	1.00	8.0	2.0
1912	71	11	45	15	21.79	15.00	2	28	0	33.40	23.21	15.00	0.00	6.7	0.0	17.35	0.00	21.3	0.0
1918	93	11	35	15	17.77	13.54	13	8	0	26.39	17.23	14.27	1.46	0.0	0.0	4.00	0.00	8.0	0.0
1921	•	•	45	15	38.08	15.00	37	42	6	41.54	6.92	15.00	0.00	28.6	21.4	35.30	13.70	13.4	-15.4

1922	11	11	40	20	40.67	20.50	11	8	8	40.34	-0.67	20.25	-0.50	20.0	0.0	14.00	4.00	-12.0	8.0
1923	80	4	37	15	14.67	14.27	20	0	11	25.84	22.33	14.64	0.73	13.3	0.0	6.65	5.50	-13.3	11.0
2401	*	*	45	15	44.25	15.00	0	0	0	44.63	0.75	15.00	0.00	30.0	0.0	15.00	0.00	-30.0	0.0
2402	*	*	45	12	43.10	12.00	4	0	6	44.05	1.90	12.00	0.00	20.0	5.0	10.00	5.50	-20.0	1.0
2403	*	*	35	12	14.00	10.56	0	11	0	24.50	21.00	11.28	1.44	25.0	0.0	18.00	0.00	-14.0	0.0

The variables are explained in data section 2.7. The combined variables from the practitioner and patient data were created in **MINITAB** using the following procedures:

MEAN1: (SPENVISF + MEANVIS1)/2

DIFFVIS1: (SPENVISF - MEANVIS1)

MEAN2: (SPENVISS + MEANVIS2)/2

DIFFVIS2: (SPENVISS - MEANVIS2)

MEADIHOS: (RAYDIHOS + HOSPPT)/2

DIFDIHOS: (RAYDIHOS - HOSPPT)

MEAPRCLI: (RAYPRCLI + PRICLIPT)/2

DIFPRCLI: (RAYPRCLI - PRICLIPT)