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THE NATURE, EXTENT AND FUNCTIONAL IMPACT OF FOOT PROBLEMS IN ESTABLISHED RHEUMATOID ARTHRITIS

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A dissertation submitted to the Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, in fulfillment of the requirements for the degree of Master of Science in Medicine

Johannesburg, May 2009

I, Hema Gosai declare that this thesis is my own work. It is being submitted for the degree of Master of Science in Medicine in the University of Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at this or any other university.

_____ _____

Print Signature

_____

Date

DEDICATION

To my beloved husband Bishen and my son, Veer.

ABSTRACT

Introduction

Foot involvement is common in rheumatoid arthritis (RA). Foot pain, instability and deformity affect ambulation and impacts on health-related quality of life. The aim of this study was to determine the nature, extent and functional impact of rheumatoid foot problems in established RA.

Patients and Methods

One hundred RA patients were studied. Functional status was evaluated using the modified Health Assessment Questionnaire (mHAQ) and Foot Health Status Questionnaire (FHSQ). Foot deformity and footwear suitability was assessed using the Foot Problems Survey (FP Survey) and Footwear Suitability Scale (FWS Scale).

Results

In this predominantly female group of 95%, with a mean (± SD) disease duration of 12.2 (7.9) and moderate functional disability [mHAQ: 1.3 (0.6)], the FP Survey showed all patients had one or more foot deformity. Foot function was impaired with a mean (± SD) FHSQ score of 41.3 (12.4) and the FWS Scale showed that 93% wore unsuitable footwear. A strong correlation was observed of the global FHSQ ($r=-0.5489$, $p<0.0001$), its pain domain ($r=-0.472$, $p<0.0001$) and foot function domain ($r=-0.599$, $p<0.0001$), with the global mHAQ score. Despite the high frequency of foot problems observed only 27% had visited a podiatrist.

Conclusion

In conclusion foot problems and foot function disability is common in Black South African patients with established RA. Furthermore the strong correlation between mHAQ and FHSQ showed that foot functional disability was a major driver of overall functional disability in RA.

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ABBREVIATIONS

1.	American college of Rheumatology	- ACR
2.	Chris Hani Baragwanath Hospital	- CHBH
3.	Foot Health Status Questionnaire	- FHSQ
4.	Foot Problems Survey	- FP Survey
5.	Footwear Suitability Scale	- FWS Scale
6.	Health Assessment Questionnaire	- HAQ
7.	Health-related quality of life	- HR-QOL
8.	Interphalangeal	- IP
9.	Metacarpophalangeal	- MCP
10.	Metatarsalphalangeal	- MTP
11.	Modified Health Assessment Questionnaire	- mHAQ
12.	Non-Weight Bearing	- NWB
13.	Proximal interphalangeal	- PIP
14.	Rheumatoid Arthritis	- RA
15.	Standard deviation	- ± SD

CHAPTER 1

INTRODUCTION

1. 1 Definition and classification of rheumatoid arthritis

Rheumatoid Arthritis is a chronic inflammatory autoimmune disease which results in a progressive destructive arthropathy. It is the most common potentially reversible cause of physical disability (Zvaifler, 2006). It is the second most common form of joint disorder after osteoarthritis seen by podiatrists (Roth, 1993).

There is no single sign or special investigation that is diagnostic of RA. The American College of Rheumatology (ACR) 1987 classification criteria (Appendix 2, pg. 64) (Arnett *et al.*, 1988), were developed specifically for research purposes and are appropriate in classifying patients but not necessarily appropriate for the diagnosis in the individual patient (Berkow and Fletcher, 1992).

1.2 Epidemiology of rheumatoid arthritis in Africa

Rheumatoid Arthritis occurs throughout the world and in all racial and ethnic groups. It has a prevalence of 0.3% to 1.5 % (Smyth and Janson, 1997), with the highest prevalence in Haida Indians of North America (Gofton *et al*.,1964).

Studies in South Africa from the 1970s and 1980s suggest that the prevalence in urban Black Africans is similar to that in Caucasians in Western countries (0.9%) but much lower in South African rural areas (Beighton *et al.*, 1975; Solomon *et al.*, 1975). There are no incidence studies from African countries but RA seems to be on a rise in African countries where it has emerged more recently (Calvo-Alen and Alarcon, 2006).

The peak incidence of RA is in the fifth and sixth decades, and increases in prevalence with advancing age. Women are more commonly affected in a ratio of 3:1, although a study in South Africa suggest that the ratio is higher (6.9:1) (Tikly *et al.*, 2003). The sex differential is less evident in the elderly above sixty years of age (Zvaifler, 2006).

1.3 Aetiopathogenesis

The exact aetiology of RA remains obscure. Current evidence suggests that the disease occur in a genetically susceptible individual exposed to environmental factors, which includes infectious agents, dietary factors, hormonal factors, lifestyle habits (smoking) and others (Calvo-Alen and Alarcon, 2006). The HLA class II antigens, DR4 and DR1 are the strongest known genetic factors for RA (Smyth and Janson, 1997).

The synovial membrane within the joint (Figure 1) is the initial site of inflammation. There is an immuno-inflammatory process (lymphocytes, plasma cells) that takes place at sites of articular and extra-articular lesions. This inflamed membrane causes synovial thickening and increased production of synovial fluid which leads to soft tissue swelling around the joint. This swelling stretches the articular capsule which later contributes to instability and deformity (Haslock and Burrow, 2002). The synovial proliferation that forms near the synovium-cartilage junction is referred to as pannus. This adheres to the joint margins and ‘excavates’ through the articular cartilage and into the underlying bone as an ‘erosion’ (Tak, 2006). Joint movement and physical stress are additional mechanical factors that cause distension of the joint capsule and creates joint instability (Zvaifler, 2006).

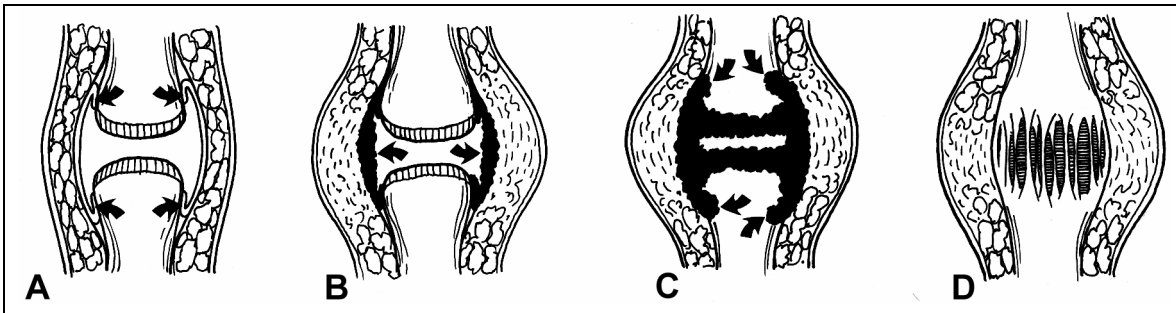

Figure 1. General pathologic process of rheumatoid arthritis (Rowe and Yochum, 1996). **A.** Normal joint **B.** Initial changes of synovial proliferation (pannus) (arrows) with periarticular oedema **C.** Bone and joint destruction **D.** Ankylosis (fibrous or bony).

1.4 Clinical manifestations

1.4.1 Articular manifestations

In the majority of patients the onset is insidious with joint pain, stiffness and symmetrical swelling of a number of peripheral joints. Initially pain may be experienced only on movement of joints, but rest pain and especially early morning stiffness are characteristic features of all kinds of active inflammatory arthritis.

Articular manifestations of RA can be classified into two categories: reversible signs and symptoms related to inflammatory synovitis and irreversible bone and cartilage damage brought on by synovitis (Haslock and Burrow, 2002). Synovitis is a potentially reversible condition and is dealt with pharmacologically and by other non-surgical means. Structural damage (cartilage loss and erosions) to the articular surface is an irreversible process.

Typical signs and deformities present in the hands are swelling of the metacarpophalangeal (MCP) and proximal interphalangeal (PIP) joints. Classic ulnar deviation and volar subluxation at the MCP joint occur in established cases. Swan neck deformity is represented by flexion of the distal interphalangeal joint with hyperextension of the PIP

joint. This deformity occurs due to spasm of the interosseous muscles and tendons. The boutonniére deformity is one of soft tissue imbalance where the MCP joint is hyper-flexed and the interphalangeal (IP) joint is hyper-extended (Harris, 2005).

In the feet one of the early changes is swelling of the Metatarsophalangeal (MTP) joint which is followed by widening of the forefoot (splayfoot). Typical deformities present includes claw or hammer toes, hallux valgus deformity and MTP joint subluxation (Haslock and Burrow, 2002). Furthermore flattening of the medial longitudinal arch (pes planus) and hindfoot valgus deformity is observed.

1.4.2 Extra-articular manifestations

Many experts consider RA to be a systemic disease where most patients in addition to the articular manifestations, experience symptoms such as malaise, fatigue, anorexia, weight loss, lethargy and myalgia (Rowe and Yochum, 1996). These manifestations occur commonly throughout the course of the disease and may precede the onset of articular symptoms by weeks or months. Significant inflammation of other organ systems is limited to those patients who are rheumatoid factor positive.

1.4.3 Functional consequences of rheumatoid arthritis

After the initial symptoms of pain and stiffness most patients with RA experience progressive loss of function (Haslock and Burrow, 2002). These disabilities vary from activities such as the ability to use a scissor to cut your toenails or the dexterity needed to tie shoelaces which are lost early in the disease. Moreover, RA is a disease of exacerbation (i.e. active inflammation) and remission (i.e. decreased active inflammation) and even during periods of disease remission, disability can be severe. This is due to joint

destruction and deformity that has previously taken place. Eventually in the late stage of the disease the pain and disability becomes constant irrespective of the disease activity. Further disability is due to structural damage in RA patients which has a greater impact on the functional status in the longer term than in the shorter term (Smolen and Aletaha,2004).

Foot involvement has been reported in greater than 85% of patients with established RA. There is an increase in the percentage of patients who experiences foot symptoms as time progresses (Michelson *et al.*, 1994). According to Costa *et al.* (2004), as the disease progresses it causes significant functional limitation and work disability and eventually most sufferers are disabled.

With time, changes in foot structure linked to impaired foot function alters gait and foot pressure. According to Van Der Leeden *et al.* (2007), impaired foot function may be related to pain, disability in activities of daily living and reduced walking speed.

According to Turner *et al.* (2006), their study showed that foot involvement occurs early in RA but the extent to which this impacts on the structure and function leading to impairment and foot related disability is unknown. Their study showed that the diseased RA foot was associated with varying levels of clinical disease activity, pain, deformity and altered function. In a further study Van Der Leeden *et al.* (2006), reported that forefoot joint damage was related to increased forefoot pressure and high forefoot pressure was associated with pain during barefoot walking. They further noted that a prolonged stance phase and delayed heel lift were related to disability in activities of daily living. Platto *et al.* (1991), have suggested that rheumatoid pain and deformity in lower extremity joints alters the gait style and impairs mobility. They further mention that the importance of pain versus structural deformity and forefoot versus hindfoot disease in RA is unknown.

1.5 Foot involvement in rheumatoid arthritis

There is evidence suggesting that individuals of the same population group may have some same morphological characteristics in the lower extremities in the general population. Benard and Stephens (1979), conducted a study to determine if significant differences exit amongst different population groups with respect to soft tissue and osseous structures of the lower limb. They looked at for example, arch morphology of the foot and found that black Africans were more prone to lower medial longitudinal and traverse arch which is consistent with a pes planus morphology.

More specifically a previous study showed some evidence of ethnic differences in foot morphology in South African females (Thompson and Zipfel, 2005). They observed a forefoot width wider then their footwear worn and found that increased body weight in Black South African female population is directly related to elongation of arch length and increased forefoot width.

Rheumatoid arthritis has a characteristic pattern of joint involvement and the small joints tend to be affected earlier than large joints and the lower extremity joints generally are affected earlier in the disease process than upper extremity joints (Michelson *et al.*, 1994). This lower extremity joint involvement leads to greater functional limitation and pain than the upper extremity joints because they are weight-bearing structures (Jones *et al.*, 1996).

Rheumatoid foot involvement account for 16% initially and then increases to 90% in patients with longstanding RA (Saag *et al.*, 1996). The prevalence of foot and ankle symptoms is related to disease duration (Michelson *et al.*, 1994). Significant foot problems were present in over 50% of RA patients of less than ten years duration. This increased to

75% in those patients with disease duration greater than twenty years. The prevalence of foot deformity varies between 52% to 92% (Balint *et al.*, 2003), but in Western countries.

A study conducted by Vaino in 1956 of nine hundred and fifty-five hospital patients reported foot problems in 89% (Shi *et al.*, 2000). Previous studies by Michelson *et al.* (1994) and Lokhamp *et al*. (2006), showed a high foot and ankle involvement of 94% and 74.1%. An overall review of all available evidence and studies relating to foot intervention in RA revealed the forefoot to be the earliest and most involved region than the hindfoot (Farrow *et al.*, 2005).

Vidigal *et al.* (1975), study reported (Table 1) MTP joint disease (forefoot) in 86%, midtarsal joint problems in 27.5% and ankle joint problems in 26%. A study which assessed specific areas for functional status, functional capacity and overall joint involvement reported 42% with ankle problems, 28% with forefoot problems and 27% with midfoot problems (Michelson *et al.*, 1994). They further reported midtarsal deformity present in 69%.

Few studies have been done reporting data about the prevalence of foot pain in different anatomical locations of the foot. However, previous studies (Table 1) have shown that hindfoot pain are worse than or just as common as forefoot symptoms (Kerry *et al.*, 1994; Michelson *et al.*, 1994). They reported forefoot pain (59%, 67.7%) and hindfoot pain (61%, 79.8%) in RA patients. Vidigal *et al.* (1975), found that 47.5% had ankle pain, 27.5% had midtarsal pains and 21.1% had subtalar region pain. In general about 74.1% of these patients reported foot pain associated with RA.

Table 1. Summary of foot involvement and foot pain in rheumatoid arthritis

		Vidigal et al. (1975)	Kerry et al. (1994)	Michelson et al. (1994)
FOOT INVOLVEMENT	Forefoot	**86%**		**28%**
	Midfoot	**27.5%**	**69%**	**27%**
	Hindfoot	**26%**		**42%**
FOOT PAIN	Forefoot		**59%**	**67.7%**
	Midfoot	**27.5%**	**10%**	
	Hindfoot	**47.5%**	**61%**	**79.8%**

Patients suffering from arthritis experience pain in their feet, disability in doing certain activities and some activities are fairly limited due to their feet. This view is supported by Smyth and Janson (1997), that there is a general agreement that the feet are a major source of pain and disability at some point in the course of the illness. The foot (76%) was found to be the most common cause of difficulty walking (Kerry *et al.*, 1994). It is documented that gait alteration (antalgic gait) and footwear fitting problems are associated with the presence of foot deformity along with pain and inflammation
(Otter *et al.*, 2004).

1.5.1 Forefoot involvement in rheumatoid arthritis

In RA, the forefoot is the first and most common site that is involved. This is probably a consequence of periarticular laxity of the intermetatarsophalangeal joint ligaments, which allows spreading of the forefoot, the development of MTP joint subluxation, claw toes or hammer toes and severe hallux valgus deformity (Smyth and Janson, 1997).

Michelson *et al.* (1994), reported 91% with hallux valgus deformity, 94% with hammer toes and Kerry *et al.* (1994), reported a lower presence of hallux valgus deformity (65%) and clawing of toes (55%).

Painful metatarsalgia (Saag *et al.*, 1996) in the forefoot can significantly impair the patient's ambulation. This is a result of the fibro fatty pad, which is located under the MTP joints, atrophies and migrates distally and no longer serve as protection for the tender eroded metatarsal heads. Secondary callosities over the metatarsal heads can result in a painful sensation of 'walking on pebbles' type experience. The skin over the flexed PIP joints becomes painful and inflamed due to the pressure from the footwear (Haslock and Burrow, 2002).

Pain and discomfort caused by dermatological conditions such as onychomycosis and metatarsal corns can cause significant morbidity. It should be noted that the elderly patient already experiences reduced mobility and therefore conditions such as metatarsal corns, hammer toes and foot deformity can contribute even further to this reduced mobility (Chan and Chong, 2002).

Chronic synovitis and ligamentous laxity causes the metatarsals to spread, which is more pronounced on weight bearing and eventually results in marked splaying of the forefoot. With progressive splaying of the forefoot and ligamentous and capsular laxity, there is a dynamic imbalance and bowstringing of the long extensor of the toe. The hallux typically drifts towards the fibula side (lateral deviation), resulting in hallux valgus deformity, and at times overrides or under-rides the lateral toes (Haslock and Burrow, 2002).

With obvious tension and muscle imbalance in the toe flexors (intrinsic muscles), the IP joints develop flexion deformity which produces typical hammer toe or claw foot deformities. With constant friction from footwear it leads to secondary callus formation (Zvaifler, 2006).

1.5.2 Midfoot and hindfoot involvement in rheumatoid arthritis

Weight-bearing accompanied with chronic synovitis produces several foot deformities (Zvaifler, 2006). The plantar aponeurosis whose function is to stabilize and maintain the longitudinal arch, when weight is placed onto the ball of the foot, becomes disrupted and non functional in RA patients and leads to a flattened arch (Mann, 1993).

Pes planus (flat foot) is a generic term that describes a foot with a depressed or an absent medial longitudinal arch, hindfoot valgus, forefoot abduction and an increased contact area with the ground (Staheli, 1999). Involvement of the midfoot and other joints in combination or in its own entity (subtalar, calcaneocuboid, and talonavicular joints) as well as involvement of the posterior tibialis tendon (disease or rupture), which causes the talus to migrate laterally, subtalar subluxation and eversion can contribute or lead to pes planus deformity (Zvaifler, 2006). A valgus hindfoot deformity is linked to progressive joint, capsular and ligament destruction. This deformity progresses as mechanical stresses is placed on this joint later in the disease (Mann and Horton, 1996).

Benard and Stephens (1979), noted that Black Africans have a high incidence of the classic pes planus foot deformity, whilst Michelson *et al.* (1994) study reported 64% with pes planus of the midfoot.

Achilles tendonitis is unique in that pain is felt most on arising and then diminishes as the tendon is used. It is related to rheumatoid disease process, chronic irritation of the heel against heel counter of the footwear, excessive pronation (whiplash effect), limb length discrepancy, tight gastrocnemius-soleus complex, overuse injury, repetitive overload injury and repetitive friction on the tendon itself (Ross, 2002).

1.6 Podiatric intervention

There are national guidelines in the United Kingdom which state that patients with rheumatic diseases should have access to podiatry services as podiatric intervention has shown to be effective in managing the rheumatoid foot. Despite this there still seems to be a lack of accessible podiatry services in this developed country (Williams and Bowden, 2004).

The question raised here, is how we effectively manage a RA patient with foot deformity in a limited resource setting. The goal of foot care in RA patients is to relieve pain, maintain function and improve quality of life. Management program should consider the cost-effectiveness of the treatment and the patient's socio-economic status (Williams and Bowden, 2004). Treatment should be implemented early and targeted more specifically.

The role of the podiatrist in the rheumatology team is essential as it ensures an optimal preventative (foot orthosis and footwear), palliative (footcare) and therapeutic care of foot disorders. The podiatrist can determine and evaluate co-morbid foot conditions, which merit their own specific treatment. Such disorders include but are not limited to ingrown toenails, painful skin lesions, local infections, ulcerations, soft tissue tumours, nerve entrapment, sprains, strains, fractures, dislocations, functional abnormalities and structural deformities (Roth, 1986).

Podiatrist can prevent reoccurrence of certain conditions such as ingrown toe nails by initial treatment, then followed by proper patient education on proper nail cutting. Other conditions such as corns and callus can be temporarily alleviated by local debridement

combined with felt padding (palliative) and strapping, and permanent relief could be obtained by fabrication of an orthotic device (Mann and Horton, 1996).

Foot orthoses are used to support a joint, prevent deformity, provide pain relief and enhance foot function by preventing or reducing disability. It may be designed to cushion the foot or alter the biomechanics of the foot (Kavlak *et al.*, 2003). A interventional study by Woodburn *et al.* (2002), showed that early intervention with custom foot orthoses reduces foot pain and plays a role in reducing the impact of foot function and disability in RA patients. Many studies, few old and more recent ones have suggested that foot orthoses proves to be effective in treating the rheumatoid foot in terms of reducing foot pain and foot function (Magalhães *et al.*, 2006). Bowen *et al.* (2005), reiterates that even though there is evidence on the positive effect of certain treatment (footwear design, foot orthoses and hosiery adaptation) there is not enough evidence to support this.

Orthotic devices are custom moulded to fit the shape of an individual's foot. These devices range form rigid, semi-rigid to soft (accommodative). A rigid orthosis alters shape of the foot by supporting, maintaining and providing minimal flexibility in a condition such as flexible pes planus deformity. A semi-rigid orthosis has supportive and cushioning properties which helps reduce pressure and shearing stress in certain regions as well as accommodates fixed deformities. A soft orthosis is mainly used to provide cushioning and reduce friction (Mann and Horton, 1996).

In the early stage of the disease, proper shoes and exercise (physical therapy) may prove to be useful and may even prevent some deformities. A proper exercise regime should be followed to keep toes flexible (Clayton, 1992). Appropriate advice on purchasing footwear,

prescription of custom made footwear and modification of footwear will benefit the patient in a therapeutic way (Lord and Pratt, 1997). Kavlak *et al.* (2003), concluded that pain relief and functional improvement could be attained by appropriate and adequate foot orthoses and appropriate or modified footwear. Patients should buy appropriate footwear that will meet their individual needs especially if they are to use an orthotic device. A systemic review on medical and surgical foot interventions concluded that foot orthoses and suitable footwear are likely to benefit the RA patient (Farrow *et al.*, 2005).

Deformity in children whose feet are still very flexible and malleable can be strongly influenced by extrinsic factors, in comparison to the older foot where it is much more difficult to achieve. To correct certain mobile deformities in children and adults one could encourage the deformity into a correct position with appropriate orthotic devices. Furthermore they mention that inadequate footwear plays a role in either having a reverse action or inhibits the action of the foot orthosis (Goel and Watt, 2002).

1.7 Footwear

Cracchiolo (1997), is of the opinion that footwear in the RA patient serves to protect the foot and also accommodate deformities, thus reducing the pain. Furthermore, footwear modifications and orthoses will not alter fixed deformities, but with proper padding reduction in pain can be achieved. Grifka (1997), further mention that RA patients with severe foot deformities find it difficult to acquire footwear off the shelf, even if in a bigger size, for their foot type. Footwear plays a role in symptomatic relief and even though they are mechanical in function they offer an alternative to surgery.

In principle footwear should be wide and have a deep toe box to accommodate the forefoot symptoms and disease. It should be supportive and comfortable, allowing for accommodation of deformity if present. It should also be large enough to accommodate orthotics and have a stable heel counter, which will provide stability to the hindfoot.
A database search on intervention in rheumatoid foot problems showed that patients who wore extra depth shoes for two months had significant improvement in physical function, walk pain and start pain compared to those who wore regular footwear (Bowen *et al.*, 2005).

Footwear should be checked for size, shape, style, abnormal wear patterns, suitability for foot and occupation. Abnormal wear patterns on the soles and heels often give a good indication on the patients gait and weight bearing patterns. Further information on pressures occurring during foot flat and take off phase can be seen on the outer sole and insole, and lastly the shape or distortion of the uppers of the shoe can indicate abnormal frontal plane motion and/or forefoot deformities (Burrow, 2002).

According to Goel and Watt (2002), the following inadequacies in footwear in any combination will deem it unsuitable for the foot:

a) Is too short or narrow.
b) Has a pointed or shallow toe box.
c) Has a soft or inadequate heel stiffener.
d) Heel height too high.
e) Narrow base to heel.
f) Having synthetic uppers and/or lining.

On ambulation pain arises from abnormal pressure under the foot on the metatarsal heads and on the dorsum of the toes from the footwear. Deformity of the forefoot causes an increase in height of the toes and makes wearing footwear difficult.
Painful calluses or small ulcerations on the prominent metatarsal heads and dorsal surface of the digits may develop due to friction from the footwear (Smyth and Janson, 1997).

Localized trauma from poorly fitted shoes is a common precursor to callus and blister formation, which can lead to infection and/or ulcers (Nancarrow, 1999). She further states that current practices of determining size of proper fitting footwear rely only upon measurement of foot length. Most measuring devices measure the foot length and width and ignore the depth requirements of the foot.

Kitaoka (1989), suggest that footwear that are uncramped and low heeled, with sufficient supportive padding are useful both from a treatment standpoint and as a modality to obviate or delay the need for surgery. Footwear adaptation whether externally or internally fitted (innersoles and orthotics) should accommodate fixed deformities, improve foot stability and relieve discomfort and not cause any footwear fitting problems or distortion to the footwear (Lord and Pratt, 1997).

According to Nancarrow (1999), even patients who had detailed education related to footwear style, quality and size had difficulty selecting appropriate footwear for their foot type. Therefore patients must keep in mind that quality and appropriate footwear is not always expensive.

Here are some points on selecting suitable footwear (Nancarrow, 1999; Ross, 2002):

1. Adequate height toe-box over the toes.
2. Adequate width (it should be possible to 'pinch' 2cm of the upper material over the balls of the foot. NB. Not too loose, causes fatigue problems).
3. Adequate length (approximately 1cm [thumb-nail] of space between the longest toe and the end of the footwear when standing).
4. Good flexibility across balls of the footwear (the footwear should bend easily at the balls of the footwear).
5. Firm heel counter (Hold the sides of the heel of your footwear between your thumb and forefinger and try to push them together. If the heel compresses, it is too soft to give your foot support).
6. Heel height of less then 2.5cm (As heel height increases, the pressure under the balls of the foot becomes greater).
7. Good and appropriate fastening mechanism (Velcro, laces, buckles or elastic).
8. Footwear must be the same shape as your feet (pointy footwear causes constriction and compaction of toes).
9. Well padded soled footwear (cushioning soles help to absorb shock and reduce pressure under the feet).

1.8 Global and foot specific outcomes measure used in this study

1.8.1 Modified Health Assessment Questionnaire

The Health assessment questionnaire (HAQ) (Appendix 3, pg. 69), is a well-validated, reliable, self-administered questionnaire that measures the functional status and health related quality of life (HR-QOL) of rheumatic disease patients (Pollard *et al.*, 2006). They explained that the HAQ scores focuses on the patients' physical disability and it assesses

the upper and lower limb functions in relation to the degree to which the patient finds difficulty to perform activities of daily living. The HAQ score does not consider individual areas of health or daily living, which needs improvement. It actually determines largely upon joint damage, especially in longstanding disease (HAQ scores increases with increasing disease duration) (Smolen and Aletaha, 2004). This questionnaire was developed about twenty five years ago at Standford University where it was used as an outcome measure in patients with a variety of rheumatic diseases (Pollard *et al.*, 2006).

For this study the mHAQ was administered. The rheumatoid patients at the Chris Hani Baragwanath Hospital (CHBH) are familiar with its usage and it is a shorter version of the full HAQ, which saves time and increases feasibility (Kvien, 2002). This was the quantitative data collection instrument used to gain the overall current health status and impairment resulting from the effects of the arthritis.

1.8.2 Foot Health Status Questionnaire

The FHSQ (Appendix 3, pg. 67) is a self administered questionnaire designed to measure foot health related quality of life. It was developed in 1996 by S.C Wearing (Bennett *et al*., 1998) as an honours dissertation, Australia. It went through a rigorous validation process in 1998 and proved to demonstrate a high degree of content, criterion, and construct validity and re-test reliability The sole intention of this tool was to be used in the assessment of patients undergoing surgical treatment for common foot conditions (classic time series design: pre and post operative status); however its use is not limited to this. It has been highlighted that this tool is potentially useful in determining any changes between different groups of people with different types of foot problems (Bennett *et al.*, 1998).

The FHSQ has been used in evaluating the effectiveness of foot orthoses (Rome, 2003), as well as assessing footwear (Williams *et al.*, 2007), plantar pressure studies, skin, nail, neurological, orthopaedic and musculoskeletal disorders. It measures the levels of foot pain in terms of; type, severity and duration, foot function (feet impact on physical function), footwear related quality of life (lifestyle issues related to footwear and feet) and general foot health perceptions (self perception of body image related to feet) (Bennett and Patterson, 1998).

This questionnaire is simple, easy to read, has a high degree of clinical utility and proven to identify changes in foot health status. It is to the point and takes about three to five minutes to complete (Bennett and Patterson, 1998). This instrument can be used either in a repeated measures study design or randomised control trial. It captures patient's subjective perceptions of their own health.

It was used in this study to see if rheumatoid foot problems and/or footwear play a role in the foot health status of the RA patients. It can also be used as a region specific measure of health to complement global measures of health.

1.8.3 Footwear Suitability Scale

This FWS Scale (Appendix 3, pg.71) was developed in the context of the diabetic foot. Assessment was based on examining the patient's footwear for specific variables to assess the characteristics of suitable footwear and then grade it according to suitability. These ten criteria come from the Health promotion folder for podiatrist (Australian Podiatry Association, Queensland, 1995).

Nancarrow (1999), used the FWS scale and piloted it for self-administration at a diabetes education workshop where these ten criteria were condensed to eight criteria (Appendix 4, pg.76). These eight criteria were used, but were administered by the principal researcher.

This FWS scale was used with the intention to find out if RA sufferers wore suitable footwear appropriate for their particular needs. Assessment of the width and depth of the footwear was also done with the intention to find out if the footwear worn by these patients accommodated their foot deformities, if present. This assessment will be used to highlight the extent to which footwear education and footwear may be improved due to rheumatoid foot deformities.

1.8.4 Foot Problems Survey

The FP Survey is a data capturing sheet which was developed to record clinical findings in the rheumatoid foot (Appendix 3, pg. 73). Prevalence studies of foot and ankle problems in RA have been done since the 1970s but mostly in European countries. This FP survey was developed from a thorough literature review, previous questionnaires and review of previous prevalence studies done on foot problems in RA patients. The principal researcher compiled and completed the questionnaire which involved evaluation of patients by observation of prevalent foot problems as well as some clinical test for other joint involvement.

1.9 Aim of current study

The aim of the study was to determine the nature, extent and functional impact of the foot problems on HR-QOL in RA patients. There is little data on prevalence of foot deformities in South Africans and little is known about the nature and extent of rheumatoid foot problems in South Africa (Woodburn and Helliwell, 1997).

1.10 Ethics and Approval

The study was approved by the committee for research on human subjects (Appendix 5, pg. 78) of the University of the Witwatersrand.

CHAPTER 2

PATIENTS AND METHODS

2.1 Patient selection and sample size

One hundred consecutive patients with RA seen in the outpatient arthritis clinic at CHBH in Soweto were invited to take part in the study. They were selected mainly on availability and were not selected on the basis of their clinical status (severity of disease or symptoms). Patients were enrolled in the study if they met the inclusion and exclusion criteria. This included a definite diagnosis of RA according to the 1987 ACR criteria (Appendix 3, pg. 66) and having RA of more than two years. Exclusion criteria included previous foot surgery, co-morbid peripheral vascular disease, diabetes mellitus, peripheral neuropathy or significant foot trauma. Patients were given a subject information sheet (Appendix 6, pg. 79) to read and were required to sign a consent form (Appendix 6, pg. 80). No patients withdrew from the study at any time during the study.

2.2 Study design

This was a cross sectional design study, where all the data was collected at the same time (Figure. 2) (Bailey, 1994). Correlation research was relevant here. With this design all the conditions were the same. Patients were recruited and all outcome measures were administered. All outcomes measures (mHAQ, FHSQ, FWS scale) used in this study have been reported extensively.

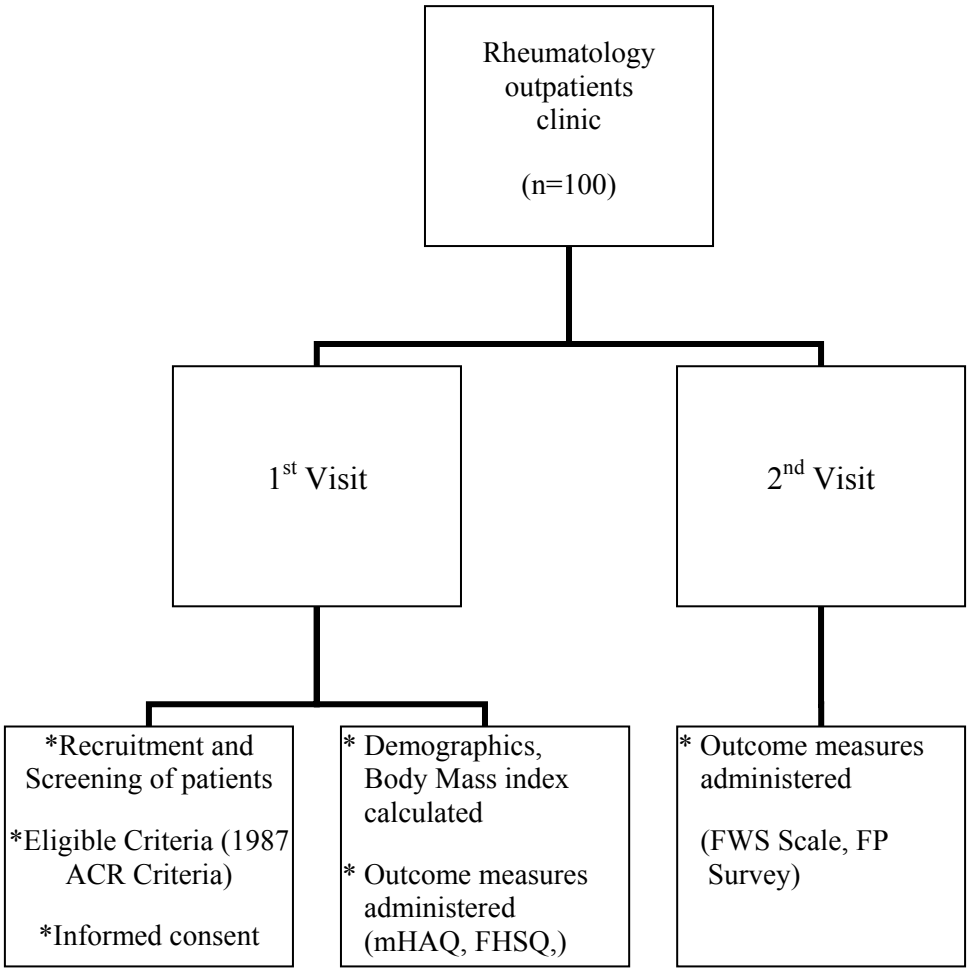

Figure. 2 Flow chart of study design

2.3 Methods

Data was collected from consenting patients over two visits (Tuesday and Thursday) for a period of at least two to three months. The first visit consisted of recruitment, capturing demographics and completion of the questionnaire with the assistance of a nursing assistant. This part of the questionnaire was completed by patients with the assistance of the nurse assistant. Other relevant information from patient files and the body mass index was also captured at the first visit. The second visit was for the clinical part which included observations and physical examination of the foot and footwear of the RA patients. This was conducted by the principal researcher. Patients were remunerated for thier traveling expenses.

The questionnaire included the predesigned protocols, in the English language, which assessed the patients overall and foot functional status. These were the mHAQ and the FHSQ. The second visit included inspection of the RA patients' feet (FP Survey) and footwear (FWS Scale) by the principal researcher.

2.4 Questionnaires

2.4.1. Modified Health Assessment Questionnaire

The mHAQ consists of twenty questions with eight domains. The eight domains focused on the areas of dressing and grooming, arising, eating, walking, hygiene, reach, grip and common daily activities. Each question has four possible descriptor scales, which has a score of 0 (without any difficulty), 1 (with some difficulty), 2 (with much difficulty) and 3 (unable to do) assigned to them. For each of the eight domains the highest score reported by the patient for any of the domain sub-scale questions represents the score for that domain. Activities requiring assistance from another person or and assistive device scores at least two (much difficulty).

The maximum score in each domain are added up and divided by eight to give a disability index of between 0 and 3. Zero (0) represents no functional disability and three (3) represents very severe functional disability (Pollard *et al.*, 2006). There seem to be no official consensus on what constitutes mild, moderate or severe disability. Krishnan *et al.*, (2004) considered a score of ≤ 1.0 to indicate mild disability, and a score of ≥ 2.0 to indicate severe disability. The disability index values in between indicates moderate disability and a score of 0 represents no disability.

2.4.2 Foot Health Status Questionnaire

There are three sections to the FHSQ of which only section one was applied in this study (Bennett and Patterson, 1998).

Section One: There are thirteen questions (with likert-type scale responses) which span over four domains of foot health. There are four questions under the foot pain and foot function domains, three under the footwear domain and two under the general foot health domain.

For the purpose of this study verbal descriptors were used and each of the four domains respondents' scores ranged from one to five. The score from each question was entered into a specific computer program (version1.03, 1998) designed to be used in conjunction with the FHSQ. The program automatically re-codes the necessary variables (to achieve better linear fit). The program then sums the responses across items in the same domain and the program then transforms the raw domain score to individual domain scores from zero to fifty [0-50], representing poorest state of foot health; to a maximum score of one hundred [51-100], signifying optimum foot health (Bennett and Patterson, 1998). The meaning of scores is tabulated in Table 2 (Bennett *et al.*, 1998).

Table 2. Description of the FHSQ domain scores

DOMAIN	*DESCRIPTION*	*LOWEST SCORE (0)*	*HIGHEST SCORE (100)*
FOOT PAIN	Evaluates type, severity, duration	Extreme/significant foot pain - acute in nature	No pain or discomfort in any part of the foot
FOOT FUNCTION	Evaluates feet in terms of impact on physical function	Severe limitation in performing a broad range of physical activities because of the feet (walking, working and moving about	Ability to perform all desired physical activities: walking, working and moving about including climbing stairs
FOOTWEAR	Evaluate lifestyle issues related to footwear and feet particularly shoe choice and comfort	Extremely limited access to suitable footwear	No problems with obtaining suitable footwear
GENERAL FOOT HEALTH	Evaluates self-perception of feet in relation to body image	The General perception of feet is in a poor state of health and condition	Perception of the feet to be in an excellent state of health and condition

2.4.3 Footwear Suitability Scale

The FWS Scale involves inspection of the footwear by the principal researcher to determine the suitability of footwear worn by the RA patients. This consisted of checking the heel height by measuring the heel with a ruler. Length was measured while patient was standing by firstly noting the longest toe of the patient and then when in footwear palpating and checking if there is a one thumb-nail space between the longest toe and the end of the front of the footwear. The heel counter was compressed side to side by holding the heel of the shoe between the thumb and forefinger and pushing them together. If it compresses, it's too soft to give support. Other features were observed and noted.

A tick is then placed in the box next to the criteria that represents the characteristic feature of the footwear worn by the RA patient. If a tick is not placed in every box, your footwear is probably not protecting and supporting your foot as much as it should be. If all the boxes had a tick, the footwear worn was Grade 0 (Optimal shoe which fulfils all the criteria). If the footwear had only one item missing it was considered Grade 1 (Good). If the footwear was lacking two or more features it was Grade 2 (Fair) and if it caused injury to the foot it was Grade 3 (Poor). For this study the grades were coupled as suitable (Grade 0 and 1) and unsuitable (Grade 2 and 3) (Nancarrow, 1999).

The second part of this footwear inspection involved assessment of the width and depth of the footwear worn by the RA patients. Width was assessed with the patient standing in his/ her footwear. The upper material of the footwear across the metatarsal heads was grasped (pinch test). If the upper feels tense and stretched and cannot be pinched, the footwear was not wide enough. If wrinkles appear or you can pinch more than two centimetres then the footwear may be too wide. Depth of footwear was performed with the patient standing in his/her footwear and asked to take a step forward and pause just before toe-off, while still weight-bearing equally on both feet. The upper of the flexed foot above the fourth and fifth toes were palpated. If toes were cramped, then the depth in toe puff is deemed inadequate (Huges, 1995).

2.4.4 Foot Problems Survey

Evaluation of patients included a weight-bearing and non-weight bearing (NWB) examination by the principal researcher. This assessment involved observational as well as some clinical tests for other joint involvement. For this study specific digital conditions

were assessed, noted if present or absent and location of it. They were not assessed to see if deformity was flexible or fixed. Location of pain in the foot was also noted.

The foot conditions were assessed in four areas:

1. Digital deformities which included hallux valgus deformity, under-riding fifth digit, under-riding second and third digit, override second and third digit, tailors bunion, hammer toes, claw toes, mallet toe and others which included retracted toes, hyper-extended hallux and floating fifth digit. These digital deformities were assessed just by inspection.
2. Structural deformities which included pes planovalgus of the rearfoot and pes planus of the midfoot.
3. Dermatological problems, which included metatarsal corns and callous, digital corns and callous, other skin problems or foot infection (hyperkeratosis medial side of the hallux, anhidrosis, tinea pedis, interdigital maceration), and nail problems.
4. Other foot problems included deviation of lesser digits, splaying of forefoot, migration of fibro fatty pad, Achilles tendonitis, swollen feet, rheumatoid nodules, ulcer and burning feet.

Initially patients were lying supine, some digital deformities, bony prominences, dermatological conditions and other obvious problems were noted. Achilles tendonitis was assessed by dorsiflexing the ankle slightly with the knee straight and palpating the area where the Achilles tendon inserts into the calcaneus and noting if any pain, swelling or nodules exists. Comparison between both sides is essential as even normal Achilles tendon is sensitive to squeezing pressure (Alexander, 1997).

Structural deformities were assessed by telling the patients to lie prone with foot hanging off the table. The leg is rotated so that the foot is perpendicular to the floor, this helps with the marking of the back of the leg and heel. The opposite limb is flexed and rotated which helps stabilize against the medial aspect of the knee (figure four position). After measuring for the midline a series of dots is placed on the lower leg and heel. The leg and heel bisection lines are drawn but are not connected as to avoid soft tissue distortion when patient stands. The foot was then placed in neutral position and any variations from normal observed as recommended by (Thomson *et al.*, 2002). Neutral position with regards to the subtalar joint in an ideal foot is when the foot is neither in a pronated or supinated position (Seibel, 1988). The researcher just visualized and noted any forefoot and rearfoot relationship and any subtalar joint positions in relation to the lower leg.

Pes planus of the midfoot was assessed by getting the patient to march on the spot so that they will be placed in a proper angle and base of gait. The researcher took note if there was a depressed medial longitudinal arch and if the "too many toes sign" was present, which would suggest rearfoot valgus and forefoot abduction. If these position were noted the patient had pes planus deformity of the midfoot present. This deformity was not assessed to see if it was flexible or fixed.

The patient was then told to march on the spot again. The rearfoot alignment was noted by standing behind the patients and nothing the position of the calcaneus (rearfoot) in relation to the ground (weight bearing surface) and noting if pes planovalgus of the rearfoot exists (Kindsfater *et al.*, 1997).

2.5 Statistical analysis

Data collected was captured using Microsoft access and excel sheets and analyzed using the statistical package Intercoded Stata 9.0 for Microsoft Windows. Descriptive statistics were used to describe the clinical variables. To test association of clinical outcomes with categorical values, the Pearson's chi-square test (χ^2) was used except in cases where the sample size was small in which the two-tailed Fisher's exact test was used (Diamond and Jefferies, 2001). In the case of continuous variables, associations with clinical outcomes were tested using the Student's -t test. For correlation between the two sets of continuous data the Pearson's correlation coefficient (r) was applied (Diamond and Jefferies, 2001). For multivariate analysis logistic regression was applied (Babbie, 2004). A p value <0.05 was considered to be statistically significance.

CHAPTER 3

RESULTS

3.1 Descriptive statistics

3.1.1 Demographics features

The demographics features are summarized in Table 3.1. The total population was one hundred RA patients of whom 89% were sero-positive for rheumatoid factor. Majority of the patients (74%) were between the ages 40-60 years and 76% had disease duration in excess of 5 years. All were Black Africans except one who was Asian.

Table 3.1 Demographics features

		Sample size (n=100)
1. Female: Male Ratio		**19:1**
2. Race:	**Black Africans**	**99**
	Asian	**1**
3. Age: Mean (SD)		**49.9 (8.4)**
4. Disease Duration: Mean (SD)		**12.2 (7.9)**
5. Rheumatoid Factor Positive		**89%**
6. Prior visit to a Podiatrist		**27%**

3.1.2 Health Assessment Questionnaire and its domains

The mean (± SD) mHAQ score was 1.3 (0.6). Of all the 100 patients, 10% had no functional disability, 43% had mild functional disability, 43% moderate functional disability and 4% had severe functional disability.

The highest to lowest mean score for the eight domains are summarized in Table 3.2 Patients scored the worse in the reach and grip domains and intermediate in the other domains, suggesting that functional disability of the upper limbs and hand is mostly affected. The activities in the reach domain could also be related to the foot in terms of a patients body weight been transferred to the feet as the patient needs stability to keep upright when standing and reaching for a heavy object above their heads.

Table 3.2 Health Assessment Questionnaire domain scores

HAQ domains	Mean (±SD)
1. Reach	**1.68 (0.95)**
2. Grip	**1.68 (0.91)**
3. Errand Activities	**1.34 (0.88)**
4. Walking	**1.27 (0.86)**
5. Hygiene	**1.26 (0.93)**
6. Eating	**1.21 (0.97)**
7. Dressing and Grooming	**1.2 (0.92)**
8. Arising	**1.2 (0.80)**

3.1.3 Foot Health Status Questionnaire and its domains

The mean (±SD) FHSQ score was 41.3 (12.4). The mean scores for the FHSQ domains are summarised in Table 3.3

Table 3.3 Foot Health Status Questionnaire domain scores

FHSQ domains	Mean (±SD)
1. Foot pain	**32.9 (23.1)**
2. Foot function	**39.5 (24.1)**
3. Footwear	**48.1 (16.8)**
4. General foot health	**44.5 (16.1)**

The foot health status across the four FHSQ domains is represented in Figure 3.1 The majority of patients (79%) considered their foot health across the four domains to be in a poor state of health and condition and scored the worst in the foot pain domain. Almost three quarters (74%) of patients considered their feet to have an impact on physical function in terms of limitation in performing physical activities like walking, working and moving about because of their feet. The same proportion had extremely limited access to suitable footwear and 69% of patients had the general perception of their feet being in a poor state of health and condition.

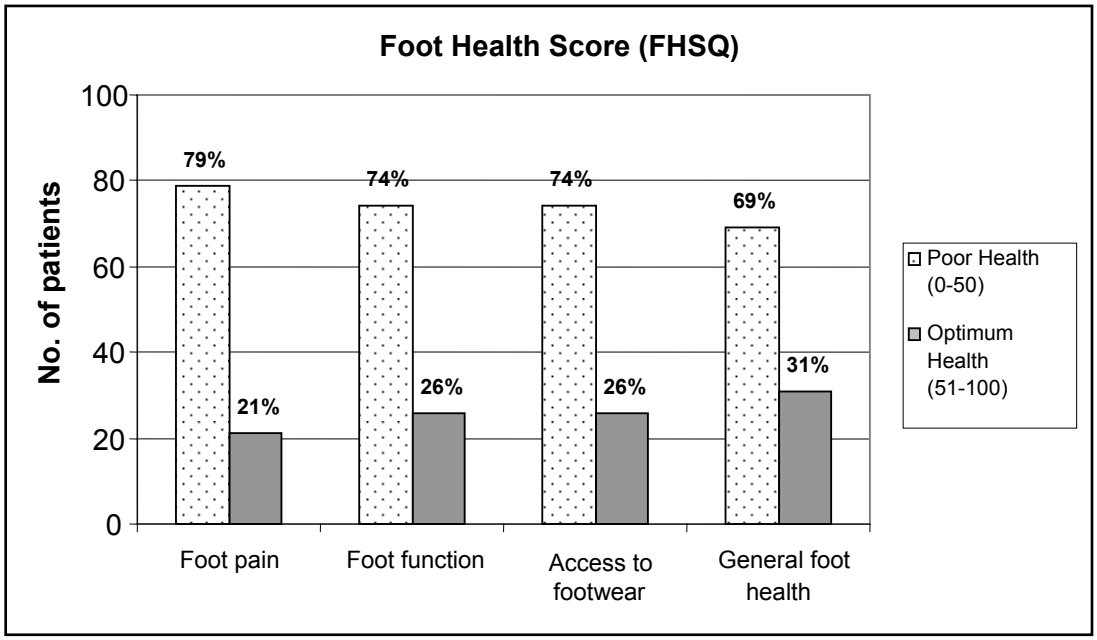

Figure 3.1 Foot Health Status Questionnaire domain scores

3.1.4 Foot Problem Survey

3.1.4.1 Digital deformities

Overall all patients had at least one foot deformity present and almost all had a forefoot deformity. 98% had digital deformities. As shown in Table 3.4, the three most common deformities present was hallux valgus deformity (74%), followed by retracted toes (54%) and tailors bunion (53%). The least common was under riding second and third digit.

Table 3.4 Digital deformities

DIGITAL DEFORMITIES	n=100
Hallux valgus deformity	74%
Retracted toes	54%
Tailors bunion	53%
Hammer toes	37%
Under-riding fifth digit	31%
Hyper-extended hallux	30%
Claw toes	22%
Overriding second and third digit	12%
Floating fifth digit	7%
Mallet toes	4%
Under-riding second and third digit	3%

3.1.4.2 Structural deformities

The most common structural deformities present was pes planovalgus of the rearfoot (68%) followed by pes planus of the midfoot (47%).

3.1.4.3 Dermatological conditions

Of the 93 patients with dermatological problems as shown by Table 3.5, the most common dermatological findings were with digital corns and callus (59%) followed by 51% with metatarsal corns and callus. Nail problems (45%) consisted of conditions such as onychauxic nails (37%), onychogryphosis (2%), onycholysis (2%) and blackish

discolouration (4%). Interdigital maceration and tinea pedis were present but made up the minority of just 6% and 2%.

Table 3.5 Types of dermatological problems

DESCRIPTION	Sample size (n=93)
Digital corns and callus	59 (63%)
Metatarsal corns and callus	51 (55%)
Nail problems	45 (48%)
Hyperkeratosis the medial side of hallux	40 (43%)
Anhidrosis	10 (11%)

3.1.4.4 Other foot problems

Other foot problems present included splaying of forefoot (99%), migration of fibro fatty pad (97%), bony prominences (34%), deviation of lesser digits (29%), Achilles tendonitis (28%), burning feet (25%) and rheumatoid nodules (1%).

3.1.5 Footwear Suitability Scale

3.1.5.1 Footwear check list

As shown in Figure 3.2, the most frequent finding which was deemed problematic were that 83% of footwear worn were not the same shape as the patient's feet, and the same amount did not have a firm heel counter for support. Further noted 80% of patients did not wear the correct length footwear (shoe space). A small number of patients wore footwear with good breathable material (26%) and well padded sole (30%). In just over half the patients (56%) the footwear was deemed not protect their feet from injury.

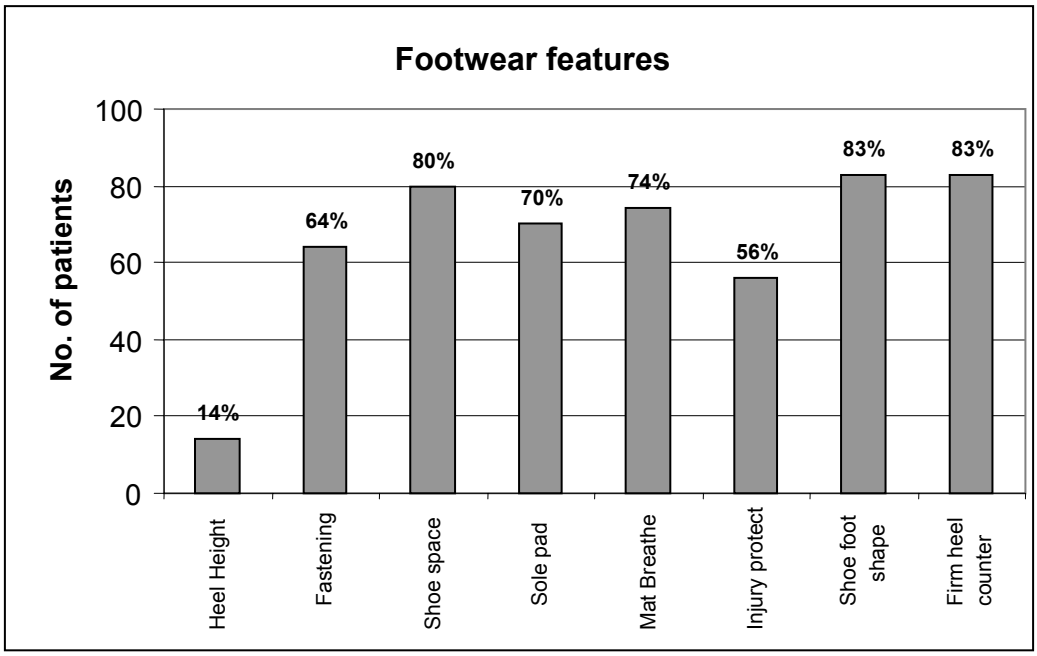

Figure 3.2 Footwear inadequacies present in footwear worn by rheumatoid patients

3.1.5.2 Depth and width of footwear

Assessment of toe box showed that only 5% of footwear was deemed adequate with respect to both depth and width. 57% of footwear was able to be assessed for correct depth and 58% of footwear was able to be assessed for correct width. The balance could not be assessed due to inappropriate footwear like sandals, thongs and slippers. Of those in whom footwear could be assessed, 45 (79%) patients had worn footwear of inadequate toe depth, either because the footwear was narrow and deep, narrow and shallow or wide and shallow. Inadequate width was observed in 49 (84%) of cases.

3.1.5.3 Category of footwear

Most of the patients (93%) wore grade 2 (Fair) and grade 3 (poor) footwear and were categorised as unsuitable footwear and only 7% wore grade 0 (excellent) and grade 1 (good) shoes which deemed to be suitable.

3.1.6 Pain and discomfort experienced in the feet

The most common location of pain and discomfort (Figure 3.3) was the ankles (55%), followed by the forefoot (24%), while heel and sole pain were very rare.

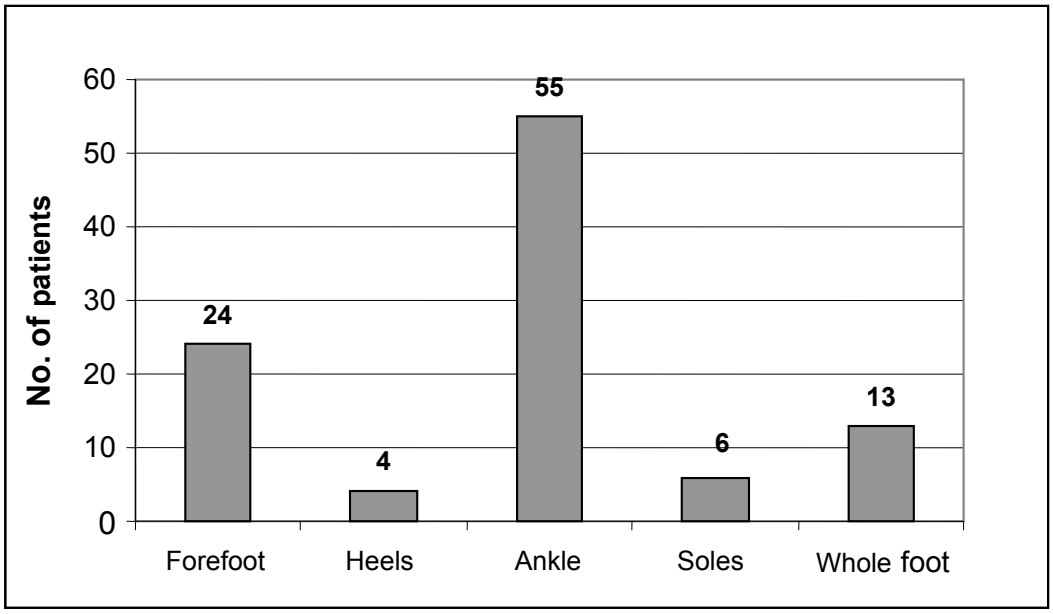

Figure 3.3 Region of pain and discomfort in the feet

3.2 Inferential statistics

3.2.1 Health Assessment Questionnaire and it correlates

3.2.1.1 Impact of foot problems on Health Assessment Questionnaire

In analysing the relationship between foot problems and the global mHAQ no significant associations were found, except for metatarsal corns and callus (p= 0.005) ie. Metatarsal corn and callus had a negative impact on the RA patients overall functional disability. However a strong associations between Achilles tendonitis and domains of rising (odds ratio= 3.03, 95% CI= 1.1 – 8.2, p=0.01) and reach (odds ratio=3.28, 95% CI= 1.1 – 10.9, p=0.01) of the mHAQ was observed. Pes planovalgus of the rearfoot also showed an association with the walking (odds ratio= 3.85, 95% CI= 1.3 – 12. 7, p=0.007) of the mHAQ.

3.2.2 Foot Health Status Questionnaire and it correlates

3.2.2.1. Impact of foot problems on Foot Health Status Questionnaire

Overall no significant correlations were found between global FHSQ and foot problems except metatarsal corns and callus, which negatively impacted on the global FHSQ score (p= 0.02) (Figure 3.4). On analysing the relationship between specific FHSQ domains and foot problems, tailors bunion showed a strong association with the foot function domain (odds ratio= 2.92, 95% CI= 1.1 – 7.6, p=0.014), the retracted toe abnormality with the footwear domain (odds ratio= 2.72, 95% CI= 1.1 – 6.6, p=0.015) and pes planovalgus of the rearfoot showed a significant correlation with the general foot health domain (p=0.013).

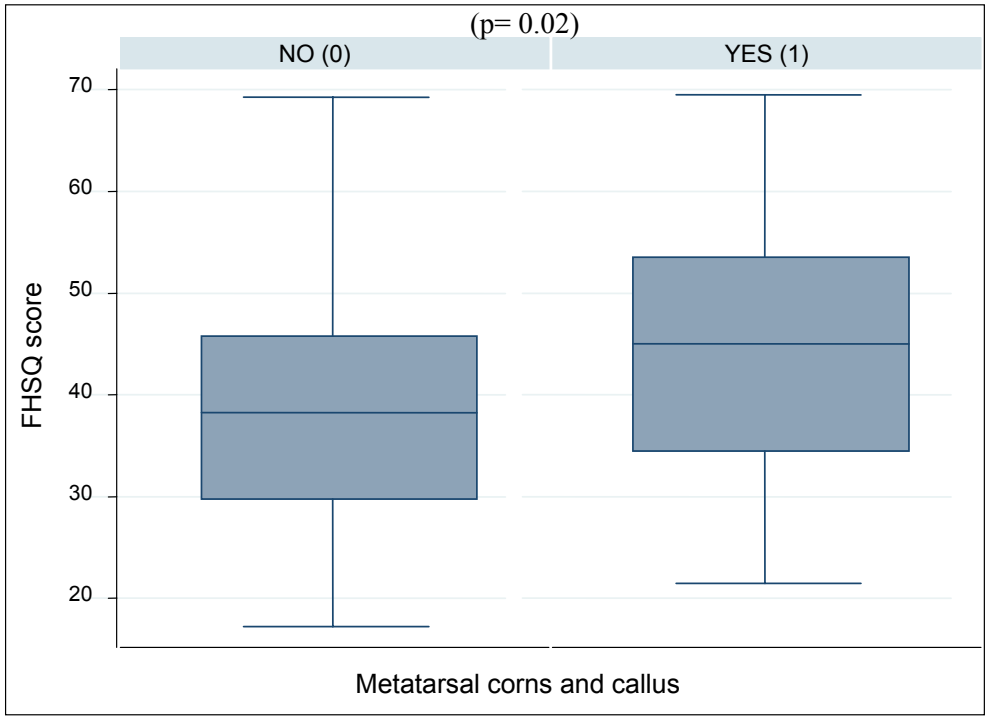

Figure 3.4 Global FHSQ verses foot problems

3.2.3 Health Assessment Questionnaire verses Foot Health Status Questionnaire

3.2.3.1 Global Health Assessment Questionnaire verses global Foot Health Status Questionnaire scores

As shown in Figure 3.5, a strong correlation was observed between the global mHAQ and global FHSQ ($r=-0.5489$, $p<0.0001$), indicating that foot dysfunction is a major driver of overall functional disability in this cohort of patients. The mHAQ accounts for 30.1% of the variability in the global FHSQ. The regression equation shows that for every unit increase in the global FHSQ score there is decrease of 0.0298 in the global mHAQ.

More specifically the foot pain and foot function domains of the FHSQ (Table 3.6), showed a significant correlation with the global mHAQ. Multinomial logistic regression analysis (Table 3.7) showed foot function to be the only independent predictor of mHAQ. The mHAQ accounts for 35.8% of the variability in the foot function domain of the FHSQ (Figure 3.6). The regression equation shows that for every unit increase in the foot function domain of the FHSQ there is decrease of 0.0168 in the global mHAQ.

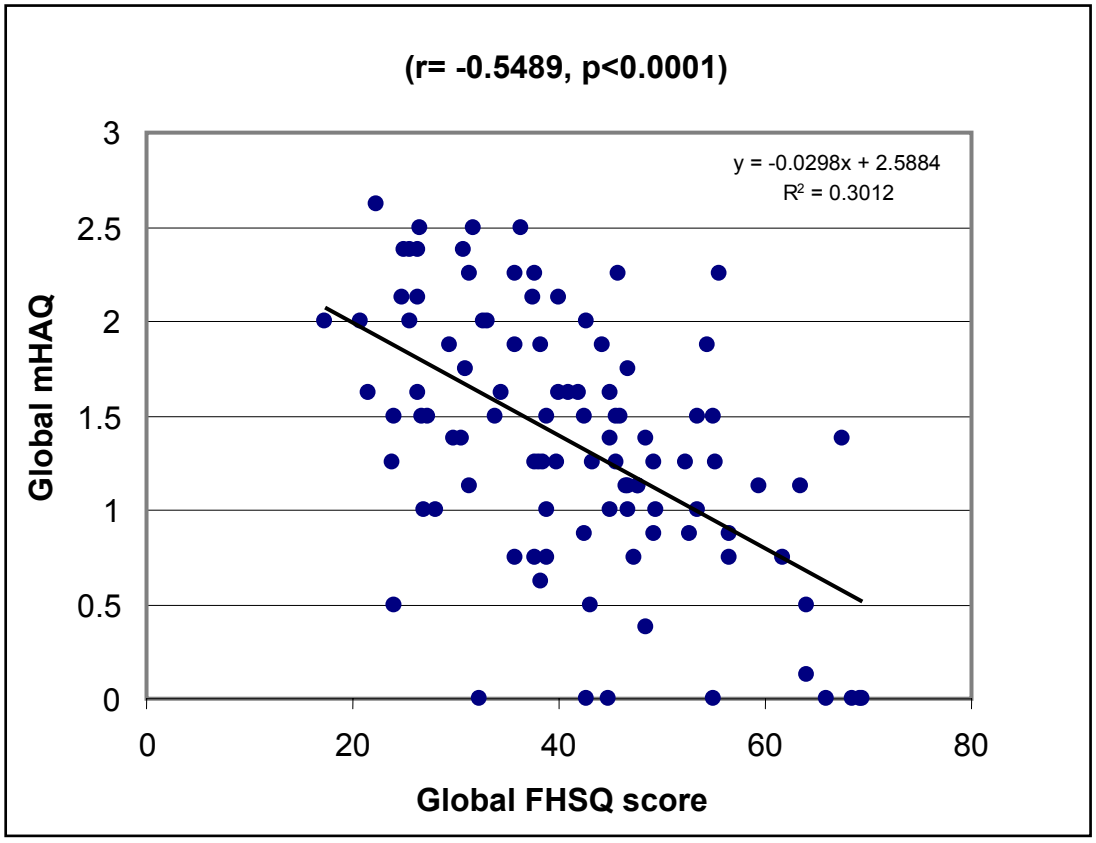

Figure 3.5 Global mHAQ verses global FHSQ score

Table 3.6 Correlation between global mHAQ and specific FHSQ domains

DESCRIPTION	r – value	P_Value
Foot pain	-0.472	**0.0000**
Foot function	-0.599	**0.0000**
Footwear	0.027	0.789
General foot health	-0.145	0.148

Table 3.7 Multinomial logistic regression for mHAQ categories and FHSQ domains

				Number of obs	=	100
				LR chi2 (8)	=	42.09
				Prob > chi2	=	0.0000
Log likelihood = -80.656711				Pseudo R2	=	0.2069

HAQ categories	RRR	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Mild Difficulty						
Foot pain	1.007122	.0188659	0.38	0.705	.9708162	1.044786
Foot function	.9499351	.0174102	-2.80	**0.005**	.9164173	.9846789
Foot wear	.9989948	.0213172	-0.05	0.962	.9580755	1.041662
General foot health	1.015039	.0244938	0.62	0.536	.9681493	1.064199
Moderate Difficulty						
Foot pain	.9794791	.0253	-0.80	0.422	.9311263	1.030343
Foot function	.9088686	.0253389	-3.43	**0.001**	.8605377	.9599139
Foot wear	1.018671	.0309673	0.61	0.543	.9597491	1.081211
General foot health	1.021234	.0325628	0.66	0.510	.9593653	1.087092

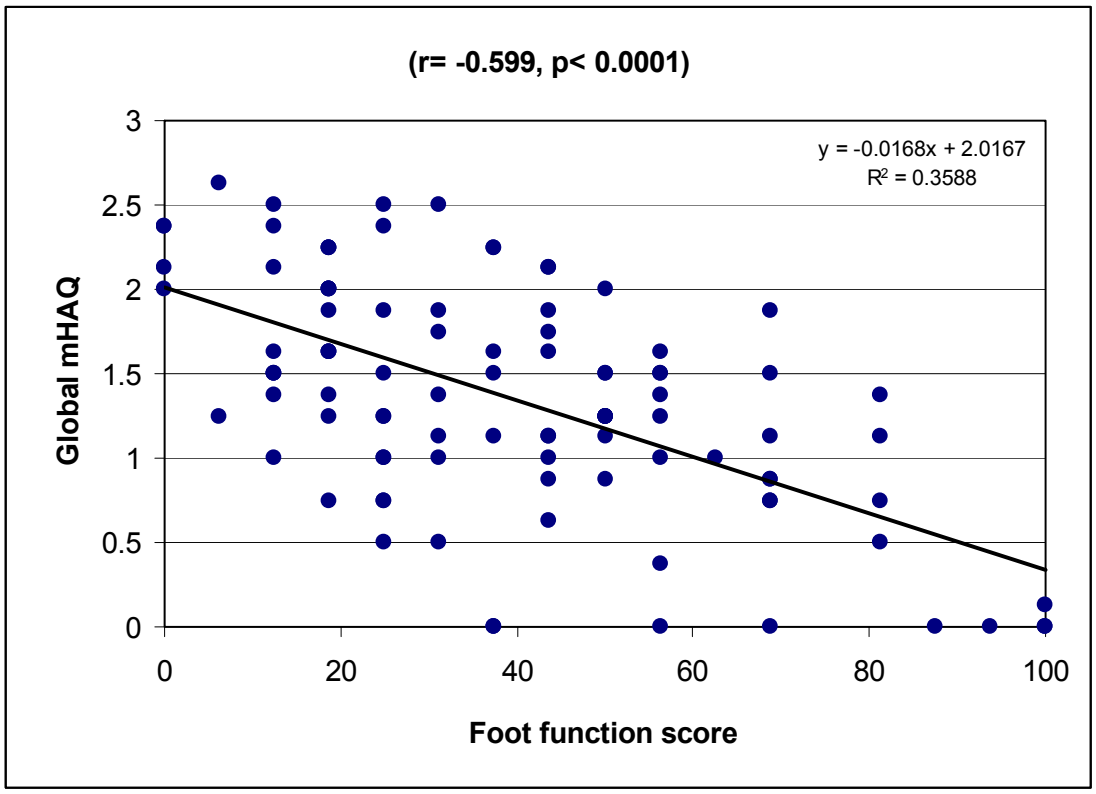

Figure 3.6 Global mHAQ verses foot function domain score

3.2.3.2 Relationship of specific Health Assessment Questionnaire domains to foot pain and foot function domains

Table 3.8, shows the relationship between the mHAQ domain and the foot pain and foot function domains. In particular, the rising and hygiene domains of the mHAQ showed a strong association with the foot pain domain of the FHSQ (p=0.002) and (p=0.002) respectively. There was also a strong association between errand activities (p=0.006) of the mHAQ and foot pain domain. The rising (p=0.001), walking (p=0.008), hygiene (p=0.02) and errands activities (p=0.002) domains showed strong associations with the foot function domain of the FHSQ.

Table 3.8 Correlation of mHAQ domains with foot pain and foot function domains

DESCRIPTION	P_Value
Foot pain vs. Rising	**0.002**
Foot pain vs. Hygiene	**0.002**
Foot pain vs. Errand activities	**0.006**
Foot function vs. Rising	**0.001**
Foot function vs. Walking	**0.008**
Foot function vs. Hygiene	**0.023**
Foot function vs. Errand activities	**0.002**

A weak, but an association was observed between rising domain of the mHAQ and the general foot health domain of the FHSQ (p=0.024). No relationships were noted between mHAQ domains and footwear domain of the FHSQ.

3.2.4 Footwear Suitability Scale

3.2.4.1 Impact of Footwear Suitability Scale on Health Assessment Questionnaire

No significant relationships were observed between FWS scale and the global mHAQ. The walking domain of the mHAQ showed an association with depth of footwear (p=0.019).

3.2.4.2 Impact of Footwear Suitability Scale on Foot Health Status Questionnaire

No significant relationship existed between FWS scale, global FHSQ and its domains except for the foot pain domain and width category (p=0.052) and footwear domain and grades of footwear (p=0.027).

In general all patients whether they considered their foot health to be in a poor state of health or optimum state, wore unsuitable footwear. A large number of patients in the foot pain domain (77%), foot function domain (64%), footwear domain (48%) and general foot health domain (48%), who wore unsuitable footwear, considered their foot health status to be in a poor state of health and condition.

3.2.4.3 Impact of foot problems on Footwear Suitability Scale

No significant association existed between foot problems and FWS scale. The only foot problem involved was pes planus of the midfoot (flatfoot), which showed an association with the width category of footwear (p=0.027).

A trend can be observed between foot problems and suitability of footwear worn by RA patients. Table 3.9, represents the grades of footwear worn by the rheumatoid patients who have specific foot deformities. It is arranged according to the most common deformity to the least present. From the 74 patients who had hallux valgus deformity present only 5 (7%) wore suitable footwear and 69 (93%) wore unsuitable footwear. The least foot problem present was hammer toes and majority of these patients also wore unsuitable footwear.

Table 3.9 Trend between foot problems and suitability of footwear

DESCRIPTION	**GRADES OF FOOTWEAR**	
	Suitable	**Unsuitable**
Hallux valgus deformity (n=74)	5 (7%)	69 (93%)
Pes planovalgus rearfoot (n=68)	4 (6%)	64 (94%)
Digital corns and callus (n=59)	6 (10%)	53 (90%)
Retracted toes (n=54)	2 (4%)	52 (96%)
Tailors bunion (n=53)	4 (7%)	49 (92%)
Metatarsal corn and callus (n=51)	5 (10%)	46 (90%)
Pes planus of the midfoot (n=47)	1 (2%)	46 (98%)
Hammer toes (n=37)	4 (11%)	33 (89%)

CHAPTER 4

DISCUSSION

The present study is one of the first attempts to investigate the extent of rheumatoid foot problems and its impact on functional disability in South Africans. It involved mainly Black indigent females with RA. The demographics of this cohort are representative of patients generally seen at the arthritis clinic of the hospital, as this hospital serves mainly the two to three million population of Soweto. As in previous studies from this centre the female to male ratio was much higher than the 3:1 ratio reported in RA patients in general. This probably represents the pattern of use of health services in Soweto, where unemployed women and housewives mainly receive health care at primary health clinics and hospitals while employed males working in the city usually seek medical attention from private practitioners (Tikly *et al.*, 2003).

That the majority of patients were rheumatoid factor positive is again consistent with previous studies (Benitha and Tikly, 2007). The long standing disease duration in this study relates in part to the inclusion criteria where only patients with established disease of greater than two years were included. The rationale for this was because significant rheumatoid foot and ankle deformities are a common feature of established RA (Michelson *et al.*, 1994).

All of the patients in this study were found to have foot deformity. This observation is similar to Michelson *et al.* (1994) who found 94% of patients in their study had foot deformity. Digital deformities were present in almost all patients in the present study and the most common specific deformity was hallux valgus deformity (74%). In a previous

study similar but lower involvement of hallux valgus deformity (71%) was found (Vidigal *et al.*, 1975). The end result of forefoot deformities, including hallux valgus deformity, tailors bunion, retracted toes, hammer toes and splaying of forefoot, is increased forefoot width and increased height of the toes (Smyth and Janson, 1997).

Tailors bunion and retracted toes were strongly associated with poor foot function and unsuitable footwear, as assessed using the FHSQ. More specifically, results of the FHSQ show that tailors bunion was associated with limitation in performing a broad range of physical activities such as walking, working and mobility in general, while patients with the retracted toe abnormality had limited access to suitable footwear. A recent study in Australia showed that hallux valgus and hallux rigidus had a negative impact on footwear fit and overall foot health in the general population (Gilheany *et al.*, 2008).

Structural deformities contribute to collapse and elongation of the arch which in turn may cause foot lengthening (Haslock and Burrow, 2002). More than two thirds of patients (68%) in the present study had pes planovalgus deformity of the rearfoot and almost half of the patients (47%) had pes planus of the midfoot comparable to the 64% of Caucasian patients with RA found to have pes planus of the midfoot (Michelson *et al.*, 1994). In that study the peroneal tendons were assessed and showed weakness which in turn resulted in posterior tibial tendon dysfunction. The present study found pes planus of the midfoot had a significant negative impact on patients' perception of general foot health, while pes planovalgus of the rearfoot showed a very significant negative impact on walking, as assessed by the mHAQ.

It has been suggested that degeneration and inflammation of the Achilles tendon contribute to limiting activities that require weight-bearing in the lower limbs (Ross, 2002). Consistent with this notion, Achilles tendonitis affected a broad range of activities, including standing up from an armless chair, getting in and out of bed, reaching and getting down a two kilogram object from above their head and bending down to pick up clothing from the floor, as assessed by the mHAQ.

Forefoot problems are common in RA patients (Vidigal *et al.*, 1975; Bálint *et al*., 2003 and Farrow *et al.*, 2005). In this study all patients had one or more forefoot abnormalities. Of particular note in the present study is that even though all patients had forefoot deformity only 24% of them reported the forefoot to be the most painful joint. Two thirds (68%) of patients had rearfoot involvement, while 55% reported the ankle as the most painful joint. A study by Mody and Meyers (1989) in Black South Africans also revealed a higher frequency of ankle pain (96%) compared to forefoot pain (71%). One possible explanation for the higher rate of rearfoot involvement is the different pattern of joint involvement as observed previously in Black patients in whom wrist, knee and ankle joint was common (Maritz *et al.*, 2005). Alternatively others have suggested that excessive physical labour and walking contributes to the risk of ankle disease in indigent Black South Africans (Benard and Stephens, 1979).

In excess of 90% of patients had one or more dermatological problems, including digital corns and callus, metatarsal corns and callus, nail problems, hyperkeratosis at the medial side of the hallux and anhidrosis. These secondary dermatological problems are likely to aggravate pain and discomfort and reduce mobility (Woodburn *et al.*, 2000). Only metatarsal corns and callus were found to significantly impact on overall physical function

as measured by the mHAQ, and more specifically overall foot health status as measured by the FHSQ. In an interventional study, Woodburn *et al.* (2000) showed that debridement of forefoot callosities in rheumatoid arthritis patients significantly reduces forefoot pain, thus regular podiatric clinical care to metatarsal corns and callous can reduce pain. This emphasizes the importance of podiatric services in the overall management of patients with RA.

Analysis of the questionnaire relating to function (mHAQ) showed that a large proportion of patients had overall moderate to severe functional disability. Earlier studies in Africa have suggested that RA is mild and is seldom a cause of significant disability. More recent studies from Johannesburg have shown that RA in Black Africans is often associated with profound functional disability (Tikly *et al.*, 2003; Benitha and Tikly, 2007). A closer look at the mHAQ scores shows that patients did especially worse in the domains of reach and grip, suggesting that the upper limb function, in particular hand function was more severely compromised. This is consistent with other studies showing wrist and hand involvement in Black South African patients with RA was common (Mody and Meyers, 1989; Maritz *et al.*, 2005).

The FHSQ was originally developed to assess response to surgical intervention in patients with foot problems. It has since been used across a wide spectrum of pathologies. These include evaluating the effectiveness of foot orthoses in management of plantar heel pain (Rome, 2003); investigating the outcome of prescribing non-casted innersole (Nancarrow, 2001), foot deformity such as hallux valgus and hallux rigidis (Gilheany, 2008) and neurological (Charcot Marie-Tooth disease), orthopaedic and soft tissue (Claisse *et al.*, 2005). Except for two studies, one involving evaluating new design footwear compared to

traditional footwear design (Williams *et al.*, 2007) and another a cross-cultural adaptation (translation) of the FHSQ into Brazilian-Portuguese language (Ferreira *et al.*, 2008), there have been no studies of the use of the FHSQ in RA.

Although this instrument has not been so extensively used in RA, the face validity and content validity of the FHSQ has made it a potentially useful instrument in RA. The result of the present study shows that the instrument has good construct validity in RA particularly in the foot pain and foot function domains. Moreover, the results between the global HAQ and global FHSQ suggest that foot dysfunction is a major driver of overall functional disability in RA., where 30% of the variability of the mHAQ can be explained by global FHSQ. Moreover, a closer analysis showed that a strong correlation between the foot pain and foot function domains and mHAQ exists, with foot function being the only independent correlate with global HAQ. Here 36% of the variation of the mHAQ can be explained on the basis of foot dysfunction.

Analysis of the foot pain and foot function domains to specific mHAQ domains, showed strong associations with rising, hygiene and errand activities. The foot function domain also showed a significant association with walking. These findings are not surprising as there is evidence to suggest that patients in the general population are more susceptible to impaired balance (falls) and functional limitation in doing daily activities due to their foot problems (Smyth and Janson, 1997; Menz and Lord, 2001). Foot pain and foot function are contributors to these difficulties as all these activities require the full integrity of the foot for weight-bearing and ambulation (Jones *et al.*, 1996).

As in the case of the FHSQ, the FWS scale has not been widely used in RA but has been previously applied to the diabetic population (Nancarrow, 1999). The FWS scale revealed that the overwhelming majority of patients wore unsuitable footwear for their foot type. This is not surprising as the forefoot in RA widens as opposed to the trendy shoes which are narrow and pointy, worn today. A previous study (Nixon *et al*., 2006), which assessed appropriately sized footwear of US Veterans reported that only 25.5 % of the overall population (n=440) wore appropriate footwear. They further discussed that poor fitting footwear may play a role in creating or exacerbating other complications in normal individuals.

In general few associations were found between FWS scale and other outcome measures used in this study such as mHAQ and FHSQ. What was observed was that inadequate depth footwear negatively impacted on the walking domain of the mHAQ and there was a trend towards inadequate width footwear impacting on the foot pain domain of the FHSQ. Digital and forefoot problems in RA patients need to be protected and accommodated by footwear that has a wide and deep toe-box. The present study showed these RA patients wearing inadequate depth and width footwear. An earlier study revealed that extra depth shoes allow improvement in physical function, walk pain and start pain compared to those who wore regular footwear (Bowen *et al.*, 2005).

There was a poor correlation between FWS Scale and foot deformities. In the present study footwear worn was not the same shape as the patient's feet. Wrong shaped shoes (narrow or pointy) and friction on the top of the toes from the footwear contribute to secondary callosities (Nancarrow, 1999), as seen in over fifty percent of patients in the present study.

The footwear in the present study did not have a firm heel counter to support the heel adequately and might contribute to the symptoms of Achilles tendonitis. Footwear should also be large enough to accommodate orthotics and have a stable heel counter to provide stability to the rearfoot (Cracchiolo, 1997). Many patients did not have the correct length of footwear which could result in impaction forces causing injury to toes and putting pressure on the toe-nails. More than half of the patients footwear did not have the correct restraining mechanism to secure the shoe to the foot which might result in secondary corns and callus on dorsum of toes due to rubbing of the footwear.

Considering the high frequency of foot involvement observed in the present study, it is disturbing to note that only a quarter of patients had previously received podiatric care from the resident podiatrist at the hospital. Studies done in other centres in Western countries have shown some evidence that there is a need for specialist foot care services (Woodburn and Helliwell, 1997; Williams and Bowden, 2004). The poor utilization of podiatry services at CHBH might be related to a number of factors. One is the lack of understanding and education on both the part of the patients and doctors in the arthritis clinic and the other is that many of the doctors are junior doctors who have little or no knowledge of the role the rehabilitation services, in particular podiatry, has in the overall management of RA.

4.1 Limitation of study

This was a cross-sectional study and by doing a longitudinal study it would give us more depth on the nature, extent and functional impact of the foot problems on HR-QOL in RA patients. I did not look at how socio-economic status of the RA patients impacted on overall quality of life. The relationship between disease activity and radiological changes in relation to all these outcome measures was were determined. Footwear purchasing styles, cost-implications and place of purchase of footwear were also not determined. This would highlight the need for appropriate footwear for a specific ethnic and foot type.

CHAPTER 5

CONCLUSION

This study provides further evidence that foot problems are extremely common in RA. All patients in this study had foot deformity and one or more forefoot abnormalities. It was further evident that the ankle is a common site of pain and discomfort in South African Blacks.

In this group of patients with functional disability, as measured by the mHAQ, there was significant foot functional disability. Importantly a strong correlation of the FHSQ and in particular its two domains with the mHAQ are evident that the FHSQ in addition to having face and content validity, has construct validity. It thus has the potential to be a valuable tool in assessing the RA foot in longitudinal studies. Secondly, and more importantly these results show that foot function is a major driver of global functional disability.

Patients in the present study had overall poor foot health status. They considered their feet, to cause significant foot pain, to have an impact on physical function, have limited access to suitable footwear and general perception to be in a poor state of foot health and condition. The FWS scale showed a large percentage (93%) of patients with unsuitable footwear but not related to foot function.

This study demonstrates the large unmet podiatric needs of patients with RA. On the basis of the high percentage of foot deformity present, there needs to be better integrated podiatry services at the CHBH, which will better address the needs of the rheumatoid patients at the rheumatology clinic.

The close relationship of rheumatoid foot deformities to functional class seen in an outpatients setting, has been highlighted in this study. Aspects regarding Black patients rheumatoid foot deformities can assist in streamlining a more specific treatment regime.

RECOMMENDATION

With limited resources and cost constraints, a reasonable amount of care through podiatric services in rheumatoid patients, would reduce morbidity and in the long term, improve functionality. Some of these patients may become economically productive, also reduce the need or medication and present earlier for surgery before irreversible damage has taken place. Therefore further extensive investigation on early podiatric intervention and RA foot problems in South African Blacks needs to be undertaken. This also serves to be a strong argument to determine the general need for podiatry services to be part of the multidisciplinary rheumatology clinic at CHBH and other public health care facilities in Gauteng. Lastly, the utilization of the FHSQ as an outcome measure in RA would prove to be valuable.

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APPENDIX 1: DEFINITIONS

1. **Quality of life-** Niezegoda and Pater cited by Bennett and Patterson (1998) states that concept of quality of life is often poorly defined in literature and appears as a multi-dimensional construct which includes physical functioning, physical symptoms related to disease and treatment, social interaction and psychological functioning.

2. **Hallux valgus deformity-** lateral drift of the great toe in association with joint subluxation. It is usually bilateral and more common in females. There is a presence of a medial eminence of the first metatarsal head (bunion). Synovitis weakens the capsular resistance to the laterally directed force of the shoe on the hallux with resultant hallux valgus (Alexander, 1997).

3. **Tailor's bunion:** subluxation in the transverse plane of the fifth MTP joint with the toe in a varus position (Apley and Solomon, 1994).

4. **Hammer toes -** the proximal toe joint is fixed in flexion, whilst the distal joint ant the MTP joints are extended. The second toe of one or both feet is commonly affected, and hyperextension of the MTP joint may go on to dorsal dislocation. Shoe pressure may produce painful corns and callosities on the dorsum of the toe and under the prominent metatarsal heads (Apley and Solomon, 1994).

5. **Claw toes –** dorsiflexion of the MTP joint, plantarflexion of the both IP joints without fixation and with apical loading in stance This deformity is seen in neurological disorders (eg. Poliomyelitis and peroneal muscle atrophy) and in rheumatoid arthritis (Apley and Solomon, 1994).

6. **Pes planus** (synonyms: flat foot/valgus foot) implies that the medial border of the foot almost touches the ground. Acquired pes planus may be due to tendon rupture or joint erosion in rheumatoid arthritis. It is an abnormality that usually tends to make the foot supple (or to collapse) because it lacks supination sufficient to form a rigid lever during push-off in gait.

7. **Pes planovalgus of the rearfoot –** Synoviits and bony erosion at the hindfoot and ankle joint causes pain and deformity. This deformity is resultant form either collapses at the joint articulation from the bony erosion or attrition and rupture from tenosynovitis (tibialis posterior tendon most involved). The navicular subluxes laterally on the talar head, this head drops and the forefoot deviates laterally with progressive valgus malalignment of the calcaneus. There is often pain present at the medial arch and ankle region. (Alexander, 1997).

8. **Valgus**- everted position or a fixed deformity in the frontal plane

9. **Varus-** Inverted position or a fixed deformity in the frontal plane

APPENDIX 2:

Table A. The 1987 Revised criteria for classification of rheumatoid arthritis

CRITERION	DEFINITION
1. Morning stiffness	Morning stiffness in and around the joint before maximal improvement.
2. Arthritis of three or more joint areas	At least three joint areas have simultaneously had soft tissue swelling or fluid (not bony overgrowth alone) observed by a physician. The 14 possible joint areas are right or left PIP, MCP, wrist, elbow, knee, ankle and MTP joints.
3. Arthritis of hand joints	At least one joint area swollen as above in a wrist, MCP or PIP.
4. Symmetric arthritis	Simultaneous involvement of the same joint areas (as in 2) on both sides of the body. Bilateral involvement of PIPs, MCPs, or MTPs is acceptable without absolute symmetry.
5. Rheumatoid nodules	Subcutaneous nodules, over bony prominences or extensor surfaces or in juxtaarticular regions, observed by a physician.
6. Serum rheumatoid factor	Demonstration of abnormal amounts of "serum rheumatoid factor" by any method that has been positive in less than 5% of normal control subjects.
7. Radiologic changes	Radiologic changes typical of RA on PA hand and wrist roentgenograms, which must include erosions or unequivocal bony decalcification localized to or most marked adjacent to the involved joints. (osteoarthrosis changes alone do not qualify.)
For classification purposes, a patient shall be said to have RA if he/she has satisfied at least four of the above seven criteria. Criteria 1-4 must be present for at least six weeks. Patients with two clinical diagnoses are not excluded. Designation as "classic", "definite" or "probable" RA is not to be made.	

PIPs, proximal interphalangeal joints; MCPs, metacarpophalangeal joints; MTPs, mettarsophalangeal joints; PA, posteroanterior. From Arnett, FC, Edworthy, SM, Black, DA, et al.: The American Rheumatism Association 1987 revised criteria for the classification of rheumatoid arthritis. Arthritis Rheum. 31:315, 1988

APPENDIX 3:

QUESTIONNAIRE

Subject No. _____

Subject name _____

Hospital Number _____

Age _____ (years)

Gender Male ☐ Female ☐

Race African Blacks ☐ Indians ☐ Whites ☐ Coloured ☐

Other _____

Disease duration _____ (years)

Date of onset _____

Rheumatoid Factor _____

Co-morbid factors _____

Body Mass Index _____ (kg/m^2)

Have you ever visited a Podiatrist? Yes ☐ No ☐

Subject No. _____

1987 ACR (American College of Rheumatology)
Criteria for the classification of acute arthritis of rheumatoid arthritis

1. **Morning stiffness lasting at least 1 hour** ☐

2. **Arthritis of 3 or more joint area**
   (At least 3 joint areas simultaneously have had soft tissue swelling or fluid [not bony overgrowth alone] – joints areas Right/Left PIP, MCP, wrist, elbow, knee, ankle & MPJs.) ☐

3. **Arthritis of hand joints**
   (At least one area swollen in the wrist, MCP, or PIP joint) ☐

4. **Symmetric arthritis**
   (Simultaneous involvement of same joint area on both sides of the body) ☐

5. **Rheumatoid nodules**
   (Subcutaneous nodules, over bony prominence/ extensor surfaces/juxtaarticular regions) ☐

6. **Serum rheumatoid factor**
   (Abnormal amount of SRF by any methods for which results has been positive in <5% of normal control subjects) ☐

7. **Radiographic changes**
   (Typical of RA on posteroanterior hand & wrist radiographs, must include erosions or unequal bony decalcification localized in or most marked adjacent to the involved joints) ☐

For classification purposes a patient shall be said to have RA if he/she has satisfied at least ***4*** or these ***7*** criteria. Criteria ***1*** to ***4*** must have been present for at least 6 weeks. Patients with 2 clinical diagnoses are not excluded.

Subject No. _____

A. FOOT HEALTH STATUS QUESTIONNAIRE

* **Please cross the block, which best describes your situation. Answer all questions.**

The following questions are about the **foot pain** you had **during the past week.**

1. **What level of pain have you had during the past week?**

☐	☐	☐	☐	☐
None	Very mild	Mild	Moderate	Severe

2. **How often have you had foot pain?**

☐	☐	☐	☐	☐
Never	Occasionally	Fairly often	Very often	Always

3. **How often did your feet ache?**

☐	☐	☐	☐	☐
Never	Occasionally	Fairly often	Very often	Always

4. **How often did you get sharp pain in your feet?**

☐	☐	☐	☐	☐
Never	Occasionally	Fairly often	Very often	Always

These questions are about how much your foot interferes with activities you might do during a typical day.

During the last week:

5. **Have your feet caused you to have difficulties in your work or activities?**

☐	☐	☐	☐	☐
Not at All	Slightly	Moderately	Quite a bit	Extremely

6. Were you limited in the kind of work you could do because of your feet?

☐	☐	☐	☐	☐
Not at All	Slightly	Moderately	Quite a bit	Extremely

7. How much does your foot health limit you in walking?

☐	☐	☐	☐	☐
Not at All	Slightly	Moderately	Quite a bit	Extremely

8. How much does your foot health limit you from climbing stairs?

☐	☐	☐	☐	☐
Not at All	Slightly	Moderately	Quite a bit	Extremely

The following questions are about the **shoes** that you wear.

9. It is hard to find shoes that do not hurt my feet

☐	☐	☐	☐	☐
Strongly Agree	Agree	Neither agree or disagree	Disagree	Strongly disagree

10. I have difficulty finding shoes that fit my feet

☐	☐	☐	☐	☐
Strongly Agree	Agree	Neither agree or disagree	Disagree	Strongly disagree

11. I am limited in the number of shoes I can wear

☐	☐	☐	☐	☐
Strongly Agree	Agree	Neither agree or disagree	Disagree	Strongly disagree

12. In general, what condition would you say your feet are in?

☐	☐	☐	☐	☐
Excellent	Very good	Good	Fair	Poor

13. How would you rate your overall foot health?

☐	☐	☐	☐	☐
Excellent	Very good	Good	Fair	Poor

HEALTH ASSESSMENT QUESTIONNAIRE

NAME_____ **UF**_____ **DATE**_____

We are interested in learning how your illness affects your ability to function in daily life. Please feel free to add any comments at the end of this form.

Please tick the one response which best describes your usual abilities over the past week.

	Without ANY difficulty	With SOME difficulty	With MUCH difficulty	Unable to do
1. DRESSING AND GROOMING Are you able to:				
- Dress yourself, including tying shoelaces and doing buttons?	.....	.....	.....	.....
- Shampoo your hair?	.....	.....	.....	.....
2. RISING Are you able to:				
- Stand up from an armless straight chair?	.....	.....	.....	.....
- Get in and out of bed?	.....	.....	.....	.....
3 EATING Are you able to:				
- Cut your meat?	.....	.....	.....	.....
- Lift a full cup or glass to your mouth?	.....	.....	.....	.....
- Open a new carton of milk or soap powder?	.....	.....	.....	.....
4. WALKING Are you able to:				
- Walk outdoors on flat ground?	.....	.....	.....	.....
- Climb up five steps?	.....	.....	.....	.....

Please tick any aids or devices that you usually use for any of these activities:

..... Cane
..... Walking frame
..... Crutches
..... Wheelchair

..... Devices used for dressing (button hook,zipper pull, long handled shoe horn, etc.)
..... Built-up or special utensils
..... Special or built-up chair

Other (Specify) .....

Please tick any categories for which you usually need help from another person:

..... Dressing and Grooming ..... Eating ..... Rising ..... Walking

Please tick the one response which best describes your usual abilities over the past week.

	Without ANY difficulty	With SOME difficulty	With MUCH difficulty	Unable to do
5. HYGIENE				
Are you able to:				
- Wash and dry your entire body?	.....	.....	.....	.....
- Take a bath?	.....	.....	.....	.....
- Get on and off the toilet?	.....	.....	.....	.....
6. REACH				
Are you able to:				
- Reach and get down a 2kg object (e.g.a bag of potatoes)from just above your head?	.....	.....	.....	.....
- Bend down to pick up clothing from the floor?	.....	.....	.....	.....
7. GRIP				
Are you able to:	.....	.....	.....	.....
- Open car doors?	.....	.....	.....	.....
- Open jars which have been previously opened?	.....	.....	.....	.....
- Turn taps on and off	.....	.....	.....	.....
8. ACTIVITIES				
Are you able to:				
- Run errands and shop?	.....	.....	.....	.....
- Get in and out of a car?				
- Do chores such as vacuuming, housework or light, gardening?	.....	.....	.....	.....

Please tick any aids or devices that you usually use for any of these activities:

..... Raised toilet seat
..... Bath seat
..... Jar opener (for jars previously opened)
..... Bath rail
..... Long handled appliances for reach

Other (specify) .....

Please tick any categories for which you usually need help from another person:

..... Hygiene ..... Gripping and opening things ..... Reach ..... Errands and housework

*** OFFICIAL USE ONLY ***

Subject name _____ **Subject No.** _____

C. FOOTWEAR EXAMINATION CHECKLISTS

a) General shoe style

Mule	☐	Walking shoes	☐
High heels	☐	Oxford shoe	☐
Court shoe	☐	Athletic shoe	☐
Slippers	☐	Boot	☐
Sandal	☐	Backless slipper	☐
Moccasin	☐	Thong/Slip slops	☐

Others _____

b) Footwear suitability checklist and assessment for proper fit.

1. Is the heel of your shoe less than 2.5cm? ☐
2. Does your shoe have laces, buckles or elastic to hold it onto your feet? ☐
3. Do you have 1cm (approximately thumb-nail length) of space between your longest toe and the end of your shoe when standing? ☐
4. Do your shoes have a well-padded sole? ☐
5. Are your shoes made from material, which breathes? ☐
6. Do your shoes protect your feet from injury? ☐
7. Are your shoes the same shape as your feet? ☐

8. Is the heel counter of your shoe firm? ☐

If you have not put a ✓ in every box, your footwear is probably not protecting and supporting your foot as much as it should be.

9. Depth (toe box)
   - Narrow and shallow ☐
   - Narrow and deep ☐
   - Wide and deep ☐
   - Wide and shallow ☐

10. Width (pinch test)
    - Positive ☐
    - Negative ☐

Category of footwear (Footwear Suitability Scale):

Grade 0	☐	Optimal shoe, which fulfils all the criteria
Grade 1	☐	Shoe conforms to standards with only one item missing
Grade 2	☐	Shoe was lacking two or more features
Grade 3	☐	Shoe which caused injury to the foot

Subject name _____ **Subject No.** _____

D. FOOT PROBLEMS SURVEY

a) Do you have foot problems? Yes ☐ No ☐

The feet present with:

1. Digital Deformities: Yes ☐ No ☐

Forefoot

a) Hallux Valgus deformity Present ☐ Absent ☐
Underride 2nd & 3rd digit Yes ☐ No ☐
Override 2nd & 3rd digit Yes ☐ No ☐

b) Tailors Bunion Present ☐ Absent ☐

c) Hammer toe/s Present ☐ Absent ☐
1st ☐ 2nd ☐ 3rd ☐ 4th ☐ 5th ☐

d) Claw toe/s Present ☐ Absent ☐
1st ☐ 2nd ☐ 3rd ☐ 4th ☐ 5th ☐

e) Mallet toe/s Present ☐ Absent ☐
1st ☐ 2nd ☐ 3rd ☐ 4th ☐ 5th ☐

f) Others Yes ☐ No ☐

_____

g) Deviation of lesser digits (Fibula) Yes ☐ No ☐
(MPJ subluxation)

h) Splaying of Forefoot Present ☐ Absent ☐

i) Bony prominences Yes ☐ No ☐
(e.g. depressed metatarsal heads)

Location _____

Weightbearing

Resting Calcaneal Stance Position (General appearance of foot on the ground eg. MLA, calcaneal position)

Angle and Base of gait Yes ☐ No ☐

MidFoot

j) Pes Planus (flatfeet) Present ☐ Absent ☐

Rearfoot

k) Position of calcaneus in relation to the ground

Inverted ☐ Everted ☐

Pes Planovalgus rearfoot Present ☐ ☐

Absent

2. Dermatological problems Present ☐ Absent ☐

a) Metatarsal Corns/Callous

1st ☐ 2nd ☐ 3rd ☐ 4th ☐ 5th ☐

Others _____

b) Digital Corns/Callous (dorsal proximal aspect of Inter phalangeal joint)

1st ☐ 2nd ☐ 3rd ☐ 4th ☐ 5th ☐

Others _____

c) Skin problems/Foot infection Present ☐ Absent ☐

Appearance _____

d) Nail problems Present ☐ Absent ☐

Appearance _____

3. <u>Others</u>

a) Migration/displacement of Fibro fatty pad — Yes ☐ No ☐

b) Achilles tendonitis — Yes ☐ No ☐

c) Swollen feet — Yes ☐ No ☐

d) Rheumatoid nodules — Yes ☐ No ☐

Location _____

e) Ulcer — Yes ☐ No ☐

Location _____

f) Burning/tingling feet — Yes ☐ No ☐

Location _____

Where do you experience pain and discomfort on your feet?

Toes ☐

Heels ☐

Ankle ☐

Soles ☐

Arches ☐

Whole foot ☐

No response ☐

APPENDIX 4:

Explanation of criteria used to determine the suitability of footwear fit

1. IS THE HEEL OF YOUR SHOE LESS THAN 2.5CM?

As the height of your heel increases, the pressure under the balls of your foot becomes greater. Increased pressure can lead to callus and ulceration.

2. DOES YOUR SHOE HAVE LACES, BUCKLES OR ELASTIC TO HOLD IT ONTO YOUR FEET?

If you wear slip-on shoes with no restraining mechanism, your toes must curl up to hold the shoe on. This can cause the tops of your toes to rub on your shoes leading to corns and calluses. Secondly, the muscles in your feet do not function as they should to help you walk; instead they are being used less efficiently to hold your shoes on.

3. DO YOU HAVE 1CM (APPROXIMATELY THUMB-NAIL LENGTH) OF SPACE BETWEEN YOUR LONGEST TOE AND THE END OF YOUR SHOE WHEN STANDING?

This is the best guide for the length of the shoe, as different manufactures create shoes which are different sizes. Your toes should not touch the end of the shoe as this is likely to cause injury to the toes and place pressure upon the toe-nails.

4. DO YOUR SHOES HAVE A WELL-PADDED SOLE?

Shoes should have a supportive, but cushioned sole to absorb shock and reduce pressure under the feet. Padded footwear, socks and some innersoles can significantly reduce the pressure under your feet.

5. ARE YOUR SHOES MADE FROM MATERIAL, WHICH BREATHES?

A warm, moist environment can harbour organisms such as those which cause tinea. Moist skin is softer and more prone to injury. Try to wear hosiery which will remove moisture from your skin and allow your skin to breathe.

6. DO YOUR SHOES PROTECT YOUR FEET FROM INJURY?

The main function of footwear is protection from the environment. Ensure your shoes are able to prevent entry of foreign objects which can injure the foot. Make sure tour shoes do not cause injury to your feet.

7. ARE YOUR SHOES THE SAME SHAPE AS YOUR FEET?

Many shoes have pointed toes and cause friction over the tops of the toes which lead to corns callus and ulceration. If you can see the outline or your toes imprinted in your shoes, then the shoe is probably the wrong shape for your foot.

8. IS THE HEEL COUNTER OF YOUR SHOE FIRM?

Hold the sides of the heel of your shoe between your thumb and forefinger and try to push them together. If the heel compresses, it is too soft to give your foot support. The heel counter provides much of the support of the shoe and must be firm to press.

APPENDIX 5:

Ethics clearance form

APPENDIX 5:

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Division of the Deputy Registrar (Research)

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
R14/49 Gosai

CLEARANCE CERTIFICATE	**PROTOCOL NUMBER M040517**
PROJECT	The nature, extent and functinal impact of foot problems in established Rheumatoid Arthritis".
INVESTIGATORS	Ms H Gosai
DEPARTMENT	Private Bag X92, Bryanston 2021
DATE CONSIDERED	04.05.28
DECISION OF THE COMMITTEE*	Approved unconditionally

Unless otherwise specified this ethical clearance is valid for 5 years and may be renewed upon application.

DATE 04.06.29 **CHAIRPERSON** .....
(Professor PE Cleaton-Jones)

*Guidelines for written 'informed consent' attached where applicable

cc: Supervisor : Prof M Tikly

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10005, 10th Floor, Senate House, University.
I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. **I agree to a completion of a yearly progress report.**

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

13/3/04

APPENDIX 6:

Subject information sheet and consent form

Dear patient,

I am Hema Gosai, a professional Podiatrist who is currently doing a study as part of a Masters degree, in Rheumatoid Arthritis patients with foot problems.

Foot and ankle problems are common in rheumatoid arthritis, but limited research has been done on the rheumatoid foot in South Africa.

I would therefore like to invite you to participate in the study, which will involve

1) Answering some questions about yourself and effects the disease has on the feet.
2) Having your feet and footwear examined for foot problems and footwear suitability, as well as measuring your plantar loading pattern.

The whole process of questions and evaluation of the footwear and plantar foot pressure measurement will take about 30 minutes on two occasions.

The information collected will be used as part of a report for this study and some information may be published at a later date. Everything said and recorded in this study will be treated as confidential and nothing will be revealed to anyone in a way that could identify you or your name.

You have been chosen at random so there is no significance in the fact that you have been asked to read this letter. Remember that involvement in this study is voluntary and you are free to withdraw at any stage, without such a decision influencing your future treatment at the hospital.

If you have any questions, please ask.

Should you agree to participate in this study, please sign the consent form attached.

Thank you for your time and attention.

Hema Gosai, Podiatrist, 2004

CONSENT FORM

Subject No. _____

THE NATURE, EXTENT AND FUNCTIONAL IMPACT OF FOOT PROBLEMS IN THE RHEUMATOID ARTHRITIS PATIENTS

I, Hema Gosai have fully explained the purpose of the study, the duration of the examination and the type of examination that will be used. I have assured the subject of safety and confidentiality and that their involvement is voluntary and they are free to withdraw at any time from the study with no penalty.

Researcher's Signature _____

Date _____

I, _____ (participant) agree that the proceeding of the study were explained to me. I also understand that my involvement is voluntary and that I am free to withdraw my consent and discontinue at any time from the study with no penalty. In signing this consent form I agree to participate voluntarily in this study.

Signature of Participant _____

Date _____

Witness Signature _____

Witness Signature _____

APPENDIX 7:

1. RESULTS

1.1. Co-morbid Factors of rheumatoid patients

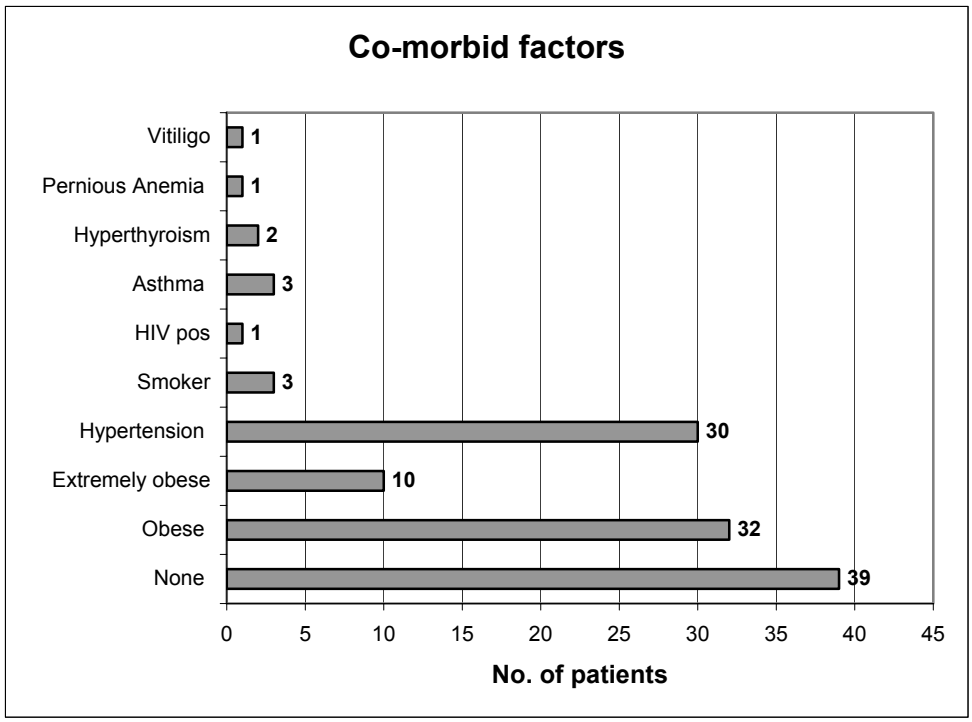

Fig. 4 Co-morbid factors present in rheumatoid arthritis patients

Hypertension and obesity (Figure 4) represents the most common and major co-morbid factors effecting about 30 and 32 patients respectively. 10 patients (10%) are extremely obese. Co-morbid factors such as smoking and asthma effects about 3 patients each, 2 patients (2%) suffers with hyperthyrodism and 1 patient (1%) each is effected by having the co-morbid factor of having being HIV positive, pernious anemia and vitiligo. Body Mass Index (BMI) is a simple, universal measure of "fatness" and health. This sample groups BMI was calculated to see if it was an effecting co-morbid factor. There is also a table with BMI descriptors, which gives better description of the patient's weight height ratio

1.2 Body Mass index

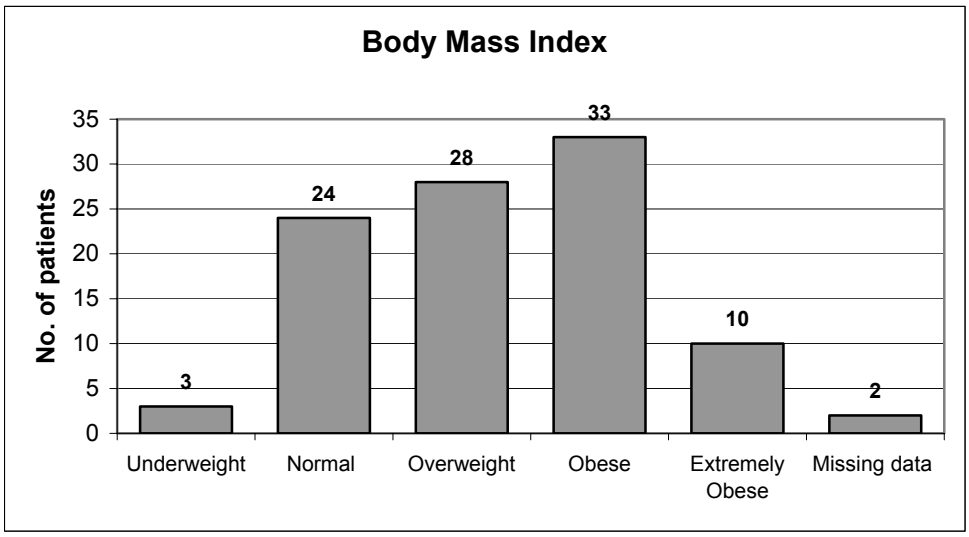

Fig. 5 Body mass index of rheumatoid arthritis patients

From the hundred patients (n=100) 33 patients (33%) shows signs of being obese (Figure 5) with 10 patients (10%) being extremely obese. Overweight patients represented about 28%. The remaining patients were in the range of normal (24%) body weight and underweight (3%). 2 patients (2%) data was not captured.

1.3 Footwear styles

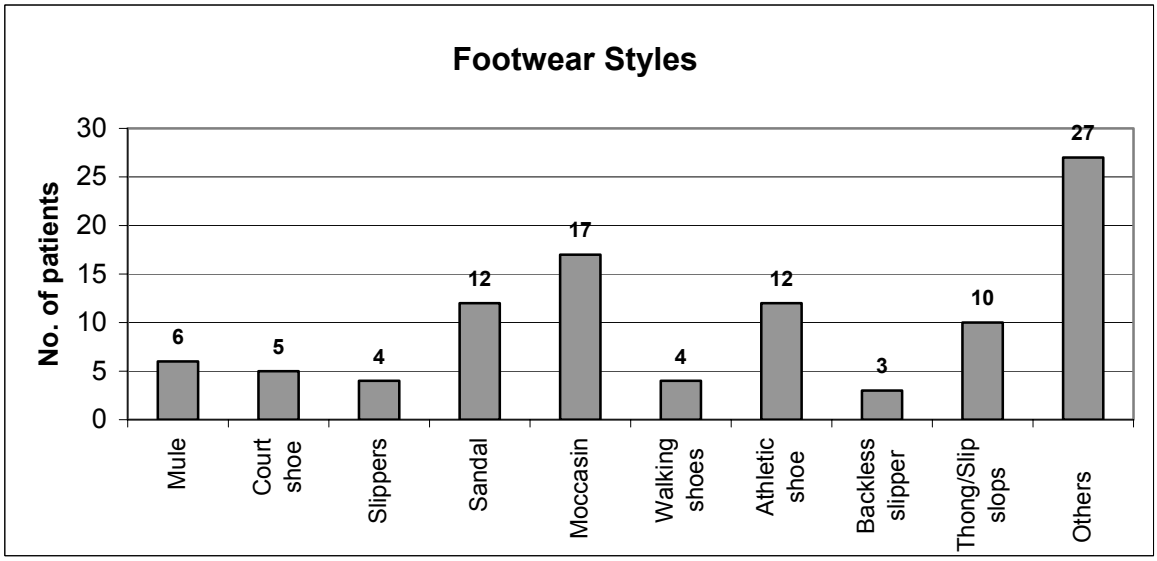

Fig. 6 Footwear styles

This study population (Figure 6) had a variety of different types of shoe styles. 6 patients (6%) were wearing mules, 5 patients (5%) had on court shoes, 4 patients (4%) had on slippers, 12 patients (12%) had on slippers, 17 patients (17%) had on moccasins, 4 patients (4%) had on walking shoes, 12 patients (12%) had on athletic shoes, 3 patients (3%) had on backless slippers, 10 patients (10%) had on thongs and 27 patients (27%) were wearing other styles. These other styles included backless and slip-on athletic shoes, knee high boots, a boot shoe, backless and slip-on moccasins and backless sandals.

APPENDIX 8:

Sample photographs of rheumatoid arthritis patients



Figure 7. Foot deformity and footwear worn by rheumatoid arthritis patients in this study