DECLARATION:

I Sally-Ann Barker Clur hereby declare that this dissertation is my own work and has not been presented for any other degree of another university.

signed 

SALLY-ANN CLUR

on 7th May 1997.
at Johannesburg.

A Geographic Profile of Rheumatic Fever and Heart Disease Cases seen at three teaching hospitals of the University of the Witwatersrand from January 1993 to December 1995.

By

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Edginton and Gear[20] looked at the problem over the 1977-1981 period. There were 205 children admitted to Baragwanath Hospital with rheumatic fever or heart disease equivalent to an admission rate of 10/1000 in children under 10 years of age. In the 5-9 year old group it was equivalent to 70/1000 admissions. Cardiac surgery was required in 44 children (21%), at a mean age of 7 years. Of these, 73% were from outside Soweto, reflecting the high rate of referrals from other centres. The mortality rate for the rheumatic admissions was 12%, 23 died from chronic disease and 2 from acute severe carditis. Regular attendance for prophylaxis was 17% in the Soweto children when a figure of 70%[9] has been quoted for optimal prophylaxis. Twenty seven children were readmitted to hospital during the period studied. The total costs to Baragwanath Hospital were estimated at 1,5 million rand. In contrast there were 34 rheumatic fever admissions to the Johannesburg Hospital in the same period, equivalent to a paediatric admission rate of 1/1000. A community based programme to encourage secondary prophylaxis was started and after 7 months a 38% regular attendance rate for prophylaxis was achieved.

Du Plessis[10] (1973) reported on 48 children (6-16 years old) who underwent mitral valve replacement with a Starr-Edwards prosthesis for a mitral valve that was not repairable. Of these, 47 suffered from rheumatic heart disease. Twenty four (50%) were Black, 6 Coloured and 4 White. There were 12 (25%) hospital deaths and 5 late deaths. Two patients were lost to follow-up. Complications included endocarditis (4), thrombo-embolism (5), valve dysfunction (3) and haemolysis (1). Only 67% survived surgery with an improved condition indicating the high morbidity and mortality in this group of young, sick children.

Van der Horst[48] in the same year reported on 51 young rheumatic heart disease patients who had valve replacements, he had fewer complications as he avoided long term anticoagulation, but his mortality rate was 14%.

Ransome and Roode[22] in 1981-1984 studied 46 acute rheumatic fever patients admitted to Coronation Hospital, then a predominately Coloured and Indian hospital. Thirty five developed rheumatic heart disease of whom 26 had carditis in the acute episode. Three patients with recurrent disease died and 3 had emergency surgery, one of whom subsequently died. There were 12 recurrent cases, 6 of these were regularly getting 4 weekly bicillin. Compliance with prophylaxis was only acceptable in 22 cases and of these 11 were irregular attenders. This study demonstrates the difficultly with compliance with bicillin prophylaxis and its fallibility when given four weekly. The severity of the disease in South Africa was also demonstrated.

1.4 REVIEW OF PREVIOUS SOUTH AFRICAN RESEARCH

The last study to look at the prevalence of rheumatic heart disease in South Africa was performed in 1972 by McLaren et al.[24] They found an overall prevalence of 6,9 per 1000 among Black school children, with a maximum of 20/1000 in 7th and 8th grade children. A rise in prevalence occurred with increasing family size (four or more siblings). They found no significant correlation in the prevalence with language, the home or school areas of the children, or the carriage rate of B-haemolytic streptococcus. B-haemolytic streptococcus was isolated from the throats of 52/1000 Soweto children. Of the rheumatic fever patients 92% were asymptomatic, while 5% had severe valve lesions. Ninety three percent had mitral incompetence, which was isolated in 47,5%. They concluded that a comprehensive preventative campaign directed at primary and secondary prophylaxis and an improvement in the socio-economic status of the communities at risk was urgently needed in South Africa. Not only did their study demonstrate a high prevalence of rheumatic heart disease in Soweto children but the rate was one of the highest rates seen in comparable studies anywhere in the preceding 30 years. (See Table 1.1. page 6) The asymptomatic rate was higher than the 30-40% reported in Baltimore[27] and by the WHO in 1973.[30]

Chesior et al[61] described 127 children admitted with acute rheumatic fever to the paediatric wards at Baragwanath Hospital from 1962 to 1964. This represented a very high hospital admission rate of 10,6/1000 medical admissions. Thirteen comma four percent were under 5 years of age and 86,6% were between 5 and 10 years old. Eighty seven percent (101) had carditis, cardiac failure was present in 23% and the mortality rate was 3,9% indicating the frequency and severity of cardiac involvement at a young age in this group.

Two hundred and eight consecutive patients were admitted to Baragwanath Hospital in the same period for mitral valve surgery, 181 with mitral stenosis and 27 with mitral incompetence.[62] Of the 27 patients with mitral incompetence, 13 (48%) were under 19 years of age and 11 (40,7%) were less than 14 years old. Of the 181 patients with mitral stenosis, 39 (21,6%) were under 20 years of age and 13 (7,2%) were under 15 years of age, which contrasted markedly with the age incidence reported in other studies of the time.

If one studies the reported cases of acute rheumatic fever in South Africa recently the problem appears less severe.[44-47] (See Table 1.2)

Table 1.2 Reported cases of, and mortality from, acute rheumatic fever in South Africa 1992-1996.

Year	Deaths	Cases
Jan-Dec 1992	0	32
Jan-Dec 1993	3	34
Jan-Dec 1994	1	30
Jan-Dec 1995	0	20
Jan-Dec 1996	0	24

[44-47]

The reporting of medical conditions in South Africa is fraught with limitations so these figures do not give an accurate reflection of the disease. To appreciate the true picture incidence and prevalence figures are required. Exact population data are not available for South Africa. The last screening survey (of few) was done in 1972.[24] Thus it is difficult to express the South African problem in terms of true incidence or prevalence.[42] (See also Section 1.1.6. page 5) Some attempt at defining the problem is required and this study tries to achieve a first step towards this aim.

1.3.RESEARCH PROBLEM:

South Africa has the unique situation of tertiary care facilities juxtaposed against conditions that foster rampant rheumatic fever and heart disease.[10,41] The disease remains prevalent in all race-groups but is more common and severe in the Black race-groups[4,14,21] that were historically deprived in the apartheid era.[18] In 1972 the prevalence rate of rheumatic fever in Soweto was 6,9/1000 in the 2-18 year old age group.[24] In 1973 it was listed among the first 10 causes of death in the 15-24 year age-group.[20] It is responsible for about 15% of the paediatric cardiac population. These patients are frequent visitors to the outpatient clinics and take up a disproportionate amount of time.[43] The disease prevalence appears anecdotally to have increased recently, possibly mirroring the United States experience. Patients presenting at the paediatric teaching hospitals of the University of the Witwatersrand appear to have more severe disease, often presenting in cardiac failure and requiring surgical intervention.[11,21,24] As conservative surgery or homograft replacement is not advisable in the acute phase, mechanical valve replacement results which requires lifelong anticoagulant therapy.[11] It would seem that in South Africa rheumatic fever is more a rural than an urban disease,[11,34] is encountered at a younger age[34,41] and frequent relapses occur.[34,41] Rarely do we see the first acute episode at our hospitals, suggesting that many first episodes are missed and thus prophylaxis is not started timeously, with severe consequences.[10]

In 1972 the urgent need for a comprehensive preventative campaign directed at rheumatic fever prophylaxis and socio-economic upliftment, was recognised.[24] In 1983 it was suggested that a national register of rheumatic fever patients be instituted along with patient identity/record cards,[14,24] to help alleviate the unnecessary burden which the disease places upon South Africa. This remains long overdue.

Besides the long-recognised social factors of the disease, the social disruptions secondary to political and non-political unrest may also be related to this apparent increase in prevalence and severity of the disease. Streptococcal sore throats may not have been treated and penicillin prophylaxis declined as clinics were closed and patients were afraid to venture out.

These limitations can be overcome by adopting an organised, systematic approach,[13] ideally with a national plan for action with specific objectives, activities and ongoing self-evaluation.[9,13] A community based service can be implemented through existing primary health care facilities without major additional cost.[9,13] Communication between the different level medical care givers, schools and laboratories is vital.[9,11,14] Patients and their families need to be adequately informed and educated.[6,9,10,24] This should be an ongoing process.[9] A central patient register[9,12,13,14,26,30] should be kept so that non-compliant patients can be identified, followed up and efforts made to motivate them to get regular prophylaxis. The additional use of identification cards recording injection dates and therapy have been shown to be beneficial.[6,14,26] For an example of a simple, inexpensive form of health education designed to promote secondary prophylaxis by three weekly benzathine penicillin injections see Appendix B.

Methods to limit the pain of the injections should be looked at. The mixing of the benzathine penicillin with lignocaine or the application of a topical anaesthetic cream prior to the administration of the injection are possibilities.

A fear of penicillin reactions may limit its usage.[3] These are rare,[7,10] especially in children,[4] and when they occur, following the use of benzathine penicillin, they are usually transient.[4] The rarity of occurrences is due to the formation of blocking antibodies that prevent the penicillin-derived antigen from combining with a sensitising antibody.[3] Thus the concern is exaggerated.

Routine examinations of higher primary school children by trained auscultators, to detect the reservoir of children with undiagnosed rheumatic heart disease[6,12,24], may be worthwhile in areas of high prevalence of rheumatic fever.[3] This is important as mild mitral incompetence, the commonest valve lesion found, can regress if recurrences of rheumatic fever are prevented and infective endocarditis does not supervene.[24] Active case finding of this type is time consuming and expensive and auscultators need to be trained. It remains, however, an important component of secondary prevention.[9] In many countries nurses have proved to be both reliable and efficient in the identification of children who require medical examination. In areas where there is a high risk of rheumatic fever case finding surveys are likely to be cost effective. This can be maximised by integrating them into general purpose health surveys of school children. The information gathered in these surveys provides a useful basis for estimating the size of the problem in a community and for planning future extensions of the prevention programme. This by-product further justifies regular school screening surveys.[9] Functional school health services are required[12] and these should be established where they do not exist.[9]

In theory the prevention of recurrent attacks should be a simple matter, in practice however, especially in countries with limited resources,[3] several factors stand in the way. If advanced disease is already present at first medical contact then secondary prophylaxis can do little to alter the poor prognosis of these patients.[4] Delays in getting medical attention may be caused by a lack of accessible medical care, ignorance, varying world views and ideas on disease causation, poverty or failure to recognise a first acute episode[4,13] if it presents with carditis alone or is atypical.

Poor compliance plagues most secondary prophylaxis programmes.[3,14,30] Factors contributing to this are the distances the patients have to travel to get their injections,[6,7] travel expenses,[6,9] a fear of the injections,[6] painful injections, poor communication, cultural contradictions,[6] lack of motivation[6] and a poor understanding of the illness.[31] Inadequate managerial and infrastructural support,[3] scarcity of trained personnel,[9] the cost[4,13] and availability of medication,[3,13] equipment and supplies[3] are also limiting.

sore throats need attention,[9,14,18,24] treatment of all sore throats with penicillin in high prevalence areas,[14] provision of accessible health centres and walk-in clinics,[3,24] throat culture services,[3,9] subsidies on prophylactic medication,[3] diagnostic screening[3,4] and school health programmes[3,9,13,14] possibly with prophylactic penicillin given to whole schools at a time,[11,12] especially during periods of peak streptococcal infection, or even the giving of penicillin to traditional healers for distribution.

For the children who suffer severe, irreversible heart damage as a result of their first attack, secondary prophylaxis is no consolation.[3,15] Despite the above mentioned limitations, community health efforts at primary prevention have been shown to be cost effective and should be encouraged.[18,37] In Costa Rica[37] the treatment of all suspected streptococcal sore throats with benzathine penicillin, with the elimination of throat cultures, was shown to reduce the incidence of rheumatic fever from 120/100 000 in 1950 to 90/100 000 in the 1970's. The use of benzathine penicillin injections was considerably cheaper than a 10 day course of oral penicillin and with its use compliance was no longer a problem. Another example is a study done in Baltimore[31] where with comprehensive care, including anti-streptococcal therapy of sore throats, a 60% reduction in the incidence of rheumatic fever was obtained.

As many developing countries are unlikely to achieve a state of high economic development in the foreseeable future,[12] it is unrealistic to expect them to start population-wide campaigns. They should rather start limited programmes aimed at defined risk groups, e.g. school children, in high-risk areas, use established health facilities and expand from there.[13]

1.2.2. SECONDARY PREVENTION:

A co-operative study co-ordinated by the WHO has shown that systematic prevention of rheumatic fever recurrences benefits the patient and also has economic advantages.[9,27] It is an attainable goal, as the target group is limited[9] to those who have a history of acute rheumatic fever or established rheumatic heart disease, and effective drugs are available.[4] It should be the first priority of prevention.[9,12,14] The success of secondary prophylaxis is maximised by the fact that recurrences cause disproportionately high mortality and morbidity.[3,19] It takes the form ideally of three weekly injections of long acting benzathine penicillin,[3,9] to maintain adequate penicillin blood levels,[4,12,39,40] until early adulthood.

A secondary prophylaxis study done in Barbados in 1974[6] was achieved at a cost of US $325 per month when the estimated cost of maintaining paediatric beds for rheumatic fever was estimated at US $1 260 per month. This calculation did not consider the clinical deterioration that accompanies each recurrence of rheumatic fever. In 1989 [9] the WHO calculated that, assuming the cost of one bicillin injection was $1,25 per day and the average cost of hospitalisation in a developing country was $25 per day, then $4 spent on prophylaxis would have averted the expenditure of $25 in hospital. This does not take into account the costs related to surgical treatment, nor does it express the benefits such as reduced disability and increased years of healthy productive life.[9] The costs of rheumatic fever prevention are thus minimal compared to the costs of managing established rheumatic heart disease.[26]

1.2.1.PRIMARY PREVENTION:

The idea of primary prophylaxis was proposed in 1937[2] and would be the ideal method for coping with rheumatic fever in a community[6,12] as it has been established that the treatment of streptococcal pharyngitis with penicillin[1,3] for ten days prevents 90% of attacks of rheumatic fever.[31] The streptococcal pharyngitis does, however, have to be identified.[3,13] Primary prevention is limited by the huge size of the population at risk,[3,19] problems of medical care access[3] and the difficulty in the diagnosis of streptococcal sore throats.[3,11,19] A throat swab culture has been the gold standard for this for many years[1,2,17,19,24] but the delay in obtaining results has been problematic.[17] Also facilities are required for the incubation of the throat swabs in outpatient departments. Rapid tests for the detection of group A streptococci from the throat swab using latex agglutination and enzyme immunoassay are available.[9,14,17] They are expensive and have a specificity of 95%[17] or more, but their sensitivities vary from 60-96%,[14,17] so cases can be missed. Another problem is that a third of rheumatic fever cases occur in the absence of a preceding sore throat and a third following mild infections.[27]

The possibility of the development of a multivalent vaccine against the most virulent and rheumatogenic subtypes of strep. pyogenes has been investigated for a long time.[9,11,17,19] It is a valid public health alternative[17,24] but is fraught with technical difficulties.[4,19] There have been concerns that the vaccine may in fact sensitise the patient to,[13,18] rather than prevent, rheumatic fever. However with the improved understanding of the structure, function and immunology of the M-proteins there is reason for optimism.[17] Other considerations include; socio-economic upliftment,[24] education of the general public and medical personnel that

1.2. PRIMARY HEALTH CARE SIGNIFICANCE:

In developing countries rheumatic fever and heart disease, often with devastating long term sequelae, continue to be a major public health problem.[1,3,13,18,33] The disease is the commonest form of acquired heart disease in children and young adults[26] and is the most common cause of cardiovascular deaths in the first 5 decades of life.[26] It affects preferentially population groups who cannot easily afford their own medical care,[3] has long-lasting limiting affects on life style and employability of patients[3,5,14] resulting in reduced productivity and economic output.[9,14] Importantly, many first attacks and most recurrences can be prevented.[3,26]

Costs of treatment and morbidity and mortality are considerable. Patients become financial and social burdens to their families, their communities, the State and its taxpayers.[14] Treatment does not generally cure damaged valves, it is only symptomatic and supportive.[9] Repeated hospitalisation causes a considerable drain on human and material resources.[9] Secondary prophylaxis is required in the long term. Balloon valvotomy, valve repair and replacement requires expert teams in tertiary care centres.[3,4,33] Few developing countries can provide these facilities or guarantee the long term anticoagulant therapy, surveillance[9] and ongoing prophylaxis[18] required after surgery. The costs of anticoagulation and thrombo-embolic complications are thus substantial in rural and unsophisticated patients.[9,10-12,33,34]

The total cost of 8227 valve replacements at major centres in South Africa from 1982-1987 was R 205 675 000.[34,26] A mitral valve replacement was estimated to cost R25 000 in 1987.[26] An operative mitral valvotomy was estimated to cost R5 500[35] and a mitral balloon valvotomy was estimated to cost R10 500,[35] (assuming 4 days hospitalisation), in a teaching hospital in 1993. The average cost for mitral valve surgery, with a 7-10 day hospital stay, in a private hospital is R40 000-45 000. A St Jude valve costs between R11 500 and R12 000. The fees for the individual members of the specialist team have to be added to this as well as blood transfusion expenses, approximately a further R25 000. This gives a total cost in the region of R80 000. (private communication with Morningside Clinic) The cost in terms of human suffering and misery is incalculable.[14] In contrast, 10 years of three weekly bicillin injections, (assuming the patient fell ill at 10 years of age), would cost R13,36[36] x 52/3 x 10 = R2 316 (This excludes syringe, needle, swab and travel expenses and inflation.)

1.1.7 SEVERITY:

"Not only has rheumatic fever become less common in Western countries but the disease has become milder".[3] The mortality rate in developing countries is much higher and death occurs at a younger age.[1,3,12,19] In the West rheumatic fever mortality rates are between 0,6 and 1,6%.[3] In recurrent attacks this increases to 2,3 - 3%.[3] Mortality rates of 14% in Pakistan,[3] 23% in Mississippi (1971),[31] 18% in Iran (1969)[32] and 3,9% in South Africa (1964)[21] have been reported during acute attacks. Factors that contribute to this include; the early age of onset with more time for mitral stenosis to develop,[3] poor general health and nutrition,[3] delay in getting medical care[3] and recurrent acute episodes.[3,19]

1.1.8.PROGNOSIS:

The course of rheumatic fever cannot be predicted at the onset but the disease usually abates within 6 weeks in 75%, by 12 weeks in 90% and in more than 6 months in less than 5% of cases.[2] The long term prognosis of rheumatic fever is correlated most closely with the severity of carditis during the acute attack.[2,5,19] Ninety five percent of rheumatic fever patients with no carditis, who take prophylaxis and have no relapses, will not have rheumatic heart disease 10 years later.[2,5] Of those with mild acute carditis (mild mitral incompetence) with no congestive cardiac failure or pericarditis, 30% have murmurs 10 years later. Forty percent of those with diastolic murmurs in the acute episode and 70% of patients who have cardiac failure or pericarditis in acute attack will have residual heart disease. This is worse in those who have repeated attacks. Those who present with pure chorea have a high incidence of late cardiac disease, usually mitral stenosis.[2]

Table 1.1. The prevalence of rheumatic heart disease in different countries.

Place of Survey	Year	Age Range (years)	Prevalence /1000
Rocky Mountain	1956-61	Predominantly 18	5,3
San Luis Valley	1960	6-18	3,7
Denver	1963	5-18	1,7
Japan	1966	Schoolchildren	3,8
	1971	5-15	0,1
Tokyo	1966	Schoolchildren	0,3
India	1966-70	0-20	1,4
	1978	Schoolchildren	6-11
Oregon	1966	College students	2,1
Egypt	1967	6-12	1,3
	1972	6-12	10
Teheran	1969-70	4-15	22,0*
Barbados	1970	5-11	1,0
Morocco	1970	6-14	9,5
Soweto	1972	2-18 and 6-18	6,9 & 7,1
Bolivia	1973	Schoolchildren	17
Jamaica	1975-85	Schoolchildren	1,1

*Based on 500 children examined at one school

(9,24,29)

Over the past 20 years there have been unexpected and dramatic changes in the epidemiology of rheumatic fever in developed countries. Mini-epidemics were reported in the United States from 1984 to 1988.[9,17,29] The disease was noted in children of White middle class families, many living in suburban[9] or rural neighbourhoods with ready access to medical care.[17] Thirty to 75% had carditis.[17] The causative strains have been highly mucoid and rich in M-protein (more virulent), and more of the M3 and M18 subtypes have been isolated.[5,17]

It is generally believed that rheumatic heart disease is widely prevalent in developing countries[2] but reliable statistics are difficult to obtain.[12,13] As population size is often unknown in developing countries, one has to rely on a combination of clinical experience, epidemiological surveys,[13,17,24] statistics of hospital admissions[5,13,17,24] and the registration of deaths[12,13,17,24] to estimate prevalence in these areas. Considering these limitations a reasonable estimate is 10/1000 in the 5-15 year age group.[9,14] Heart screening surveys in countries like India, Algeria, South Africa and Pakistan have put the prevalence at 2-20/1000 school children,[3,4] (see Table 1.1. page 6) and as high as 33/1000 in urban slums in developing countries.[13] In contrast the prevalence of rheumatic fever in affluent countries is between 0,1 and 0,5/1000.[4,5,9,30]

With 15-20 million new cases in the world annually,[28] the incidence rate for rheumatic fever can be estimated at about 100/100 000 in developing countries.[9] In Sri Lanka in 1978 the incidence was 47/100 000 and 140/100 000 in 15-19 year olds.[3,29]

2.5 DATA ANALYSIS:

The prevalence of congenital heart disease is relatively constant[1]. The measured ratio of rheumatic fever/ heart disease to congenital heart disease patients, seen from a given area was compared to the expected ratio of rheumatic fever/ heart disease to congenital heart disease patients. In this way areas from which relatively more, or relatively less rheumatic fever/ heart disease sufferers were seen than expected were identified. Thus a proportional analysis, using the number of congenital heart disease patients seen from an area as a control, was used to overcome the need for accurate population data. The areas from which relatively more rheumatic fever/ heart disease patients were seen, thus possibly have a higher relative prevalence of the disease and were highlighted as priority areas.

The expected ratio used was derived from the ratio of rheumatic fever/ heart disease to congenital heart disease patients in the whole sample. ie 312:1747 = 0,179. (See Results section 3.1. pages 35 to 39). The result was tested for a significant difference from the expected ratio using the **Chi-Square Test for Goodness of Fit** on Epi Info 6, a computer programme that performs statistical analysis. A P value <0.05 was taken as significant, i.e. that there is only a 5% chance that the observed ratio is more than, or less than the expected ratio by chance alone.[50]

The Chi-Square Test for Goodness of Fit is appropriate here as it is designed to compare the sample obtained with what one would expect from the hypothesized distribution to see if this fits the data in the sample.[51] That is, when we "expect" different proportions in different categories.[50]

We have:-
F(x) = true but unknown distribution of x
F*(x)= completely specified distribution function - the hypothesized distribution function

Suppose we have c categories, j=1,2....c, with a probability pj of the n cases falling into each category, then:-

for Ho: F(x) = F*(x) for all x (As there is no difference between the categories, the proportion in each of the categories should be equal.)
for HA: F(x) not = F*(x) for at least one x

Test Statistic:

$$\chi^2 = \sum_{j=1}^{c} \frac{(Oj-Ej)^2}{Ej}$$

Oj = observed proportions
Ej = expected proportions

[50,51]

Table 2.1. The area codes used in the study continued.

CODE	ADDRESS
NW1400	North-West Province, exaluding the areas listed below
NW1401	Zeerust
NW1402	Rustenburg
NW1403	Potchefstroom, Ikageng
NW1404	Klerksdorp, Jouberton, Hartebeesfontein, Tsepong Hospital
NW1405	Lichtenburg
NW1406	Brits
NW1407	Ga-Rankuwa, Mabopane
NW1408	Mafikeng, Vryburg
NW1409	Ventersdorp
NP1400	Northern Province, excluding the areas listed below
NP1401	Pietersburg
NP1402	Gazankulu, Giyani
NP1404	Tzaneen
NP1405	Louis Trichardt
NP1406	Venda, Thohoyandou
NP1407	Potgietersrus
NP1408	Phalaborwa
NP1409	Hoedspruit, Tintswalo Hospital, Acornhof
NP1410	Thabazimbi
NP1411	Lebowa
NP1412	Lebtaba

Table 2.1. The area codes used in the study continued.

CODE	ADDRESS
G1001	Edenvale
G1002	Bedfordview
G1003	Germiston
G1004	Alberton and Suburbs
G1005	Thokoza, Eden Park, Palm Springs, Pholo Park
G1006	Katlehong, Natalspruit Hospital
G1007	Vosloorus
G1008	Boksburg
G1009	Benoni, Actonville, Wattville
G1010	Brakpan
G1011	Springs, Far East Rand Hospital (Pholosong)
G1012	Kwa-Thema
G1013	Daveyton
G0904	Tsakane
G0905	Duduza
G1100	Western Gauteng excluding areas listed below
G1101	Randfontein, Mohlakeng
G1102	Krugersdorp, Paadekraal Hospital
G1103	Roodepoort, Witpoortjie, Weltevreden Park
G1104	Kagiso, Leratong Hospital
G1105	Bekkersdal
G1106	Westonaria
G1107	Carltonville, Khutsong

Table 2.1. The area codes used in the study continued.

CODE	ADDRESS
G1203	Sandton
G1204	Midrand
G1205	Tembisa
G1206	Kempton Park
G1208	Ivory Park
G1209	Magaliesburg
G1600	Pretoria Central
G1601	Hammanskraal
G1602	Centurion
G1603	Mamelodi
G1604	Attridgeville
G1605	Laudium
G0901	Gauteng south of Kliprivierberg
G0902	Orange Farm
G0903	Evaton
G0906	Nigel
G0907	Heidelburg
G0908	Vereeniging
G0909	Vanderbijl Park
G0910	Sebokeng
G0911	Ennerdale
G0912	Walkerville - Grasmere - Lawley
G0915	Kliprivor, Randvaal, Meyerton

Table 2.1. The area codes used in the study.

CODE	ADDRESS
G0100	Johannesburg West, Coronation - Florida - Northcliff - Newclare
G0200	Riverlea
G0300	Noordgesig
G0500	Eldorado Park, Nancefield, Naturina
G0600	Lenasia
G0700	Johannesburg Centre and North, M2 - Greenside - Highlands North
G0800	Alexandra Township
G0900	Johannesburg South, M2 - Turfontein -Kliprivlersberg
G1300	Soweto and suburbs not listed below
G1301	Dobsonville
G1302	Zola
G1303	Meadowlands
G1304	Mofolo
G1305	Chiawelo
G1306	Dhlamini
G1307	Diepkloof
G1308	Orlando and Orlando West
G1309	Naledi
G1310	Jabulani
G0400	Kliptown and Klipspruit
G1201	Honeydew, North Riding, Muldersdrift
G1202	Randburg, Jukskei Park

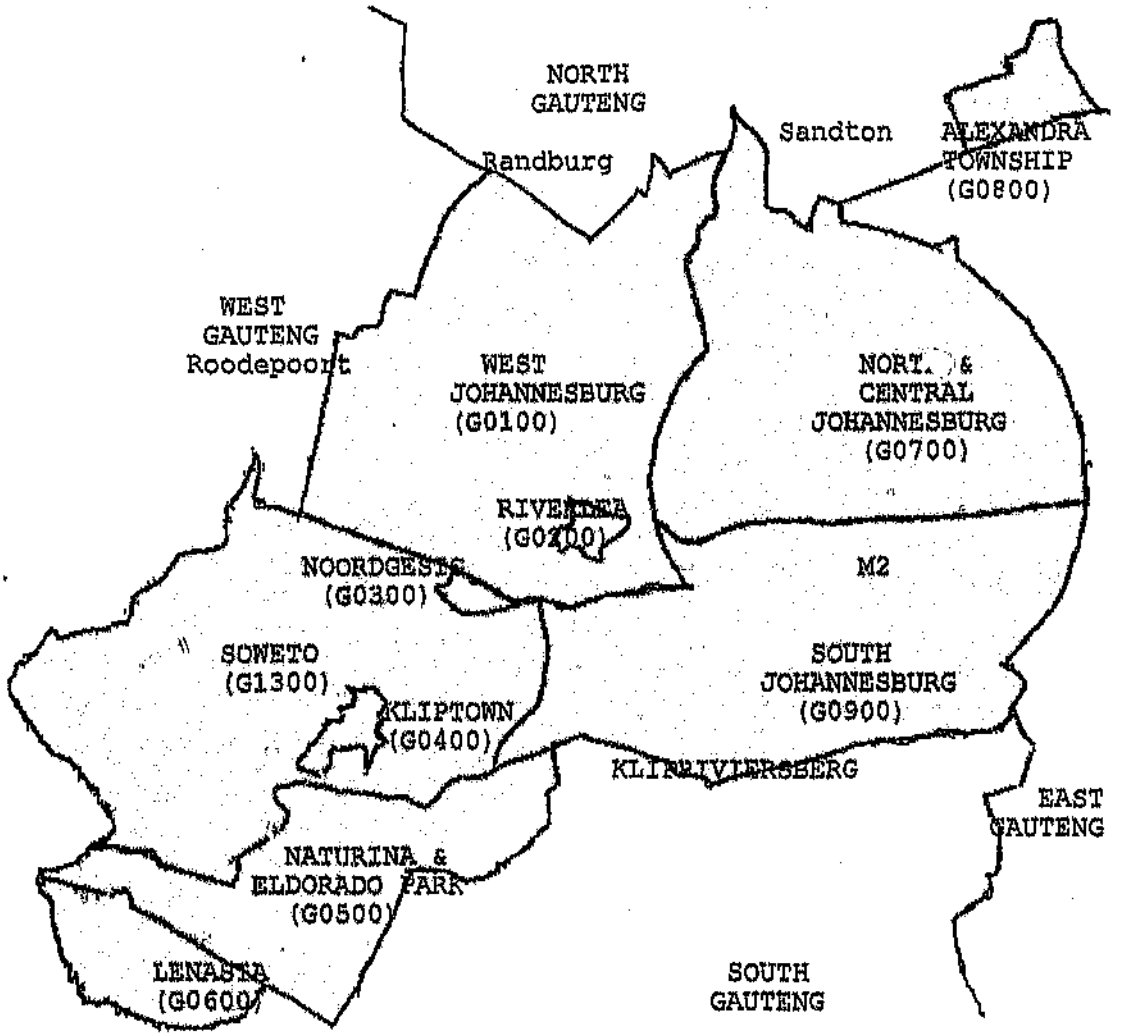


Figure 2.2 Map showing the divisions of Gauteng centre used in the study.

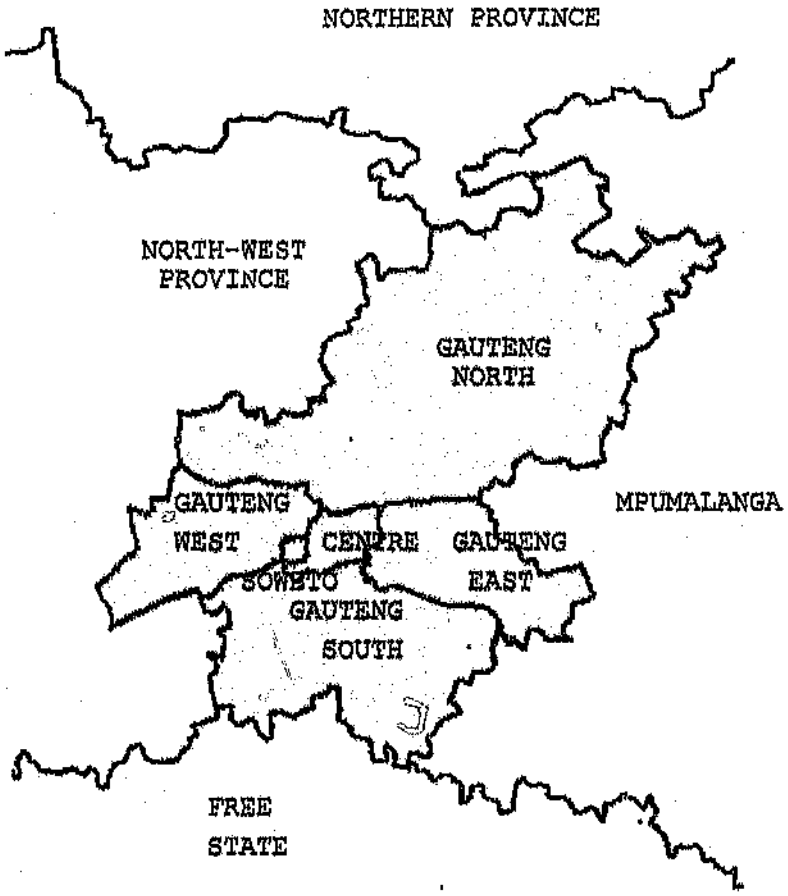


Figure 2.1. Map showing the divisions of Gauteng used in the study.

2.3 AREA DIVISIONS:

South Africa was initially divided into sections according to the nine provinces. As most of the patients seen at the University of the Witwatersrand teaching hospitals were expected to originate from Gauteng, Gauteng was further divided into Soweto, central, western, southern, eastern and northern sections as shown in Figure 2.1. (Page 22) Gauteng centre was subdivided as shown in Figure 2.2. (Page 23) Further subdivisions were according to the area codes in the following Table 2.1. (Pages 24-27)

2.4 ETHICAL CLEARANCE:

This was obtained from the University of the Witwatersrand Ethics Committee. The certificate is attached as Appendix C.

2. MATERIALS AND METHODS:

A retrospective analysis of patients seen or admitted with rheumatic fever or heart disease in 1993, 1994 and 1995 was undertaken using the paediatric computer databases in the J.G. Strijdom/ Coronation, Baragwanath and Johannesburg Hospitals. The Coronation Hospital database was under the control of the author, the Johannesburg Hospital database was kept by Mrs. V. Hunter and Dr. J. Du Plessis updated the Baragwanath Hospital database. A concerted effort was made to keep these databases accurate and as complete as possible. Some of the figures published in reference 42 of this thesis were derived from these databases and they are regarded as reliable.

2.1 INCLUSION CRITERIA:

All patients with rheumatic fever or heart disease (study cases) and all patients with congenital heart disease (control cases) seen at the paediatric cardiac clinics or admitted to the paediatric wards of the above mentioned hospitals from the beginning of January 1993 until the end of December 1995, who had a documented address or area of origin, were included. The need to perform surgery or balloon valvotomy in the rheumatic fever/ heart disease patients was used as a marker of disease severity. As it is difficult to get accurate addresses, an effort was made to enquire from the patients themselves where they became ill.

2.2 SELECTION OF CONTROLS:

As already mentioned, the determination of incidence and prevalence rates is very difficult due to the unreliability of our population census figures. However "the prevalence of congenital heart disease has been remarkably constant throughout the world and over the years."[1] Assuming the prevalence of congenital heart disease is constant, then the comparison of the ratio of the number of patients seen with rheumatic fever/ heart to those with congenital heart disease, from various areas, would show the variability in the number of rheumatic fever/ heart disease patients seen from the different areas. Thus a proportional analysis using the patients with congenital heart disease as a control was used to overcome the need for accurate population data. An idea of the relative prevalence of rheumatic fever/ heart disease in the various areas in was thus obtained. (See section 2.5 Data Analysis page 28)

1.5 AIMS OF THE INVESTIGATION

Rheumatic fever remains a formidable problem in South Africa.[24] There are however, no true incidence and prevalence figures as accurate population data are not available.[42] This study was undertaken to get a better idea of the problem in South Africa, hoping to identify areas of high prevalence and/ or severity of rheumatic fever and heart disease in the districts that refer to the three paediatric teaching hospitals of the University of the Witwatersrand. Although it is recognised that a hospital based consecutive sample cannot provide exact prevalence data, it can still show the magnitude of the problem in the referral communities.[18]

A proportional analysis using the number of patients seen with congenital heart disease as a control, was devised to overcome the need for accurate population data.(See Materials and Methods section 2.5. page 28) In this way information was gathered regarding the relative ratio of rheumatic fever/ heart disease to congenital heart disease cases seen from various areas, and regarding the relative severity of the rheumatic heart disease in those areas. Priority areas were then identified. These areas can be further investigated for possible causative factors, e.g break down of existing primary health care, inadequate primary health care, socio-economic factors such as unemployment and crowding, or some combination of these. Once problems have been identified action can be initiated to control them. Preventative programmes limited to these defined areas can later be expanded in realistic stages to contiguous areas and gradually reach nation-wide proportions. [13,14] Considering the financial constraints in South Africa presently this is a feasible approach to adopt.

1.6 HYPOTHESES:

Ho(1): There is no difference in the ratio of rheumatic fever/ heart disease to congenital heart disease cases seen from different geographic areas.

HA(1): There is a difference in the ratio of rheumatic fever/ heart disease to congenital heart disease cases seen from different geographic areas.

Ho(2): There is no difference in the ratio of severe to non-severe rheumatic fever/ heart disease patients seen from different geographic areas.

HA(2): There is a difference in the ratio of severe to non-severe rheumatic fever/ heart disease patients seen from different geographic areas.

rheumatic heart disease at Ga-Rankuwa Hospital. Forty percent of these were lost to follow up. Of the 33 patients from the then northern and north-eastern Transvaal, 20 could not be accounted for. Reasons for this included the following; poor patient and parental comprehension of the prolonged and regular follow up required after surgery, peripheral hospitals failed to identify patients as cardiac patients receiving anticoagulation therapy, anticoagulant therapy was not controlled, means of tracing defaulting patients were not investigated, facilities for laboratory investigations were available but not used and the financial and social burden to patients was too high. This study gives some insight into the question of what happens, in developing countries, to patients with rheumatic heart disease after they have had mitral valve surgery. It appears that we may well be "attempting to mop up the water while leaving the faucet open."[18]

Daniels et al in 1994,[39] looked at whether bicillin, 1,2 million units every 4 weeks was appropriate for rheumatic fever prophylaxis in South Africa as a recurrence rate of 3-8% had been reported in other studies, in patients on this regime. Of 51 patients studied, 45 had low serum penicillin levels (<0,02ugms/ml) at the end of 4 weeks. Of these, 15 had no penicillin detected in their urine suggesting that they were at high risk for recurrences of rheumatic fever. Of 29 patients given 1,8 million units of penicillin, 14 had sub-therapeutic levels at the end of 4 weeks. They all had penicillin detected in their urine suggesting the presence of tissue-bound penicillin that might be important in preventing rheumatic fever. As the administration of the higher dosage would necessitate a double injection and thus affect compliance adversely, they recommended that rheumatic fever patients receive benzathine penicillin 1,2 million units 3 weekly, as recommended by the WHO, until strategies for secondary prophylaxis have been evaluated further.

A study done at Ga-Rankuwa Hospital[48] (1995), looked at rheumatic mitral incompetence and its complications in 101 patients. They found that rheumatic mitral incompetence as a pure functional disorder was rare (7%) and occurred predominantly in young women. Mitral incompetence was frequently complicated by left atrial dilatation and left ventricular dilation. Atrial fibrillation occurred in 16%. The pathogenesis of atrial fibrillation was obscure except for an association with increasing age. Pulmonary hypertension occurred in 81% regardless of atrial size and left ventricular end-diastolic diameter and function. Pulmonary hypertension and atrial fibrillation were found to be strong predictors of functional disability. Systemic embolisation was not observed and infective endocarditis and acute exacerbation of rheumatic fever occurred in 5% and 4% of patients respectively.

Skoularigis et al[7] studied 254/308 patients (mean age 18+/-9 years) who underwent primary mitral valve repair for rheumatic mitral incompetence from 1981 to 1989. Mitral valve repair is said to be associated with better long-term survival, better left ventricular performance and lower thrombo-embolic and anticoagulant related haemorrhagic complications than valve replacement. However, they showed that repair in this young population is associated with a high long-term morbidity and that the presence of active carditis has a significant adverse effect on the success of mitral valve repair. The authors suggested that improved preoperative selection of patients excluding those with rheumatic activity, atrial fibrillation or associated mitral stenosis may improve the long-term results of mitral valve repair.

Marcus et al[41] reported on 712/737 consecutive Black rheumatic fever/heart disease patients 4-73 years old (median 25 years), seen at Baragwanath Hospital from 1983 to 1986 who underwent cardiac surgery. Pure mitral regurgitation was found in 219, 275 had pure mitral stenosis and 220 had mixed lesions. Of those with pure incompetence, 105 were still active as opposed to only 5 with pure stenosis. Pure mitral regurgitation was most common in the first and second decades (mean age 19+/-11 years), with the relative prevalence of mitral stenosis increasing with age. Of the patients with mitral incompetence, 46 were less than 10 years old and 20% of those with mitral stenosis were under 20 years of age. This demonstrated that, in contrast to the United States, pure mitral incompetence is as frequent as pure mitral stenosis but has a different time course, surgical anatomy and relation to ongoing disease activity. The large number of patients that required surgery attests to the virulent nature of rheumatic fever in many Black South African children and adolescents.[18]

Prinsloo[33] in 1993 reported that of 222 cardiac patients seen at Kalafong Hospital in the two year period (May 1990 to April 1992), 46 (20,7%) had rheumatic heart disease. Acute first episode rheumatic fever occure in 11 while 35 had chronic valvular lesions. Two patients underwent emergency valve replacement. The spectrum of cardiac disease in this hospital is assumed to be broadly representative of the Northern Province. Congenital heart disease was present in 150 (67,6%). Residential information was available in 208 patients. About 2/3 of all patients and 2/3 of rheumatic heart disease patients came from outside the Pretoria area, mostly from the rural areas.

Factors influencing patient compliance with postoperative anticoagulant therapy in paediatric patients was studied by Van Dyk and Tranfic[11] from March 1988 to December 1992. In that time 50 patients received valve replacements for

Looking at **Gauteng north**, most (4 or 30.8%) of the 13 rheumatic fever/ heart disease patients seen from this subdivision, originated from Honeydew, North Riding and Muldersdrift. Three (23%) came from Randburg and Jukskei Park. Tembisa and Hammanskraal each contributed 2 (15.4%) rheumatic fever/ heart disease sufferers. Kempton Park and Randburg and Jukskei Park were each the source of 20 of the 117, (17.1%), congenital heart disease patients seen from Gauteng north. Honeydew, North Riding and Muldersdrift contributed 19 (16.2%) and Sandton 18 (15.4%) of the congenital heart disease patients seen from this subdivision. Of the 25 patients that presented from the Pretoria area, 23 (92%) were patients with congenital heart disease. (See Table 6.1.3. page 71)

The whole of Gauteng north presented with an as expected ratio of rheumatic fever/ heart disease to congenital heart disease patients seen. Within north Gauteng, the area from Sandton up to the northern Gauteng border, showed a significantly lower than expected ratio. The other areas had as expected ratios. (See Table 3.1.1. page 35 and 36)

Of the 37 rheumatic fever/ heart disease patients seen from **Gauteng south**, 10 originated from Evaton (27%). Nine (24.3%) were from Sebokeng, 5 (13,5%) from Vanderbijl Park and 4 each (10,8%) from Orange Farm and Vereeniging. Most of the 153 congenital heart disease patients seen from Gauteng south were from Sebokeng (42 or 27.5%). Vereeniging was the area of origin of 30 (19.6%) of the congenital heart disease patients, while 19 (12.4%) came from Evaton. (See Table 6.1.4. page 71)

Gauteng south gave an as expected ratio of rheumatic fever/ heart disease to congenital heart disease patients seen. A significantly higher than expected ratio was obtained in Evaton, and in the combined analysis of Evaton and Heidelburg, Evaton and Walkerville and Orange Farm and Evaton. The rest of the subdivisions showed an as expected ratio. This suggests that rheumatic fever is a problem in Evaton and possibly also Heidelburg, Walkerville and Orange Farm. (See Table 3.1.3. page 35 and 37)

Roodepoort contributed 6 (31.6%), Randfontein 5 (26.3%) and Krugersdorp 4 (21.1%) of the 19 rheumatic fever/ heart disease patients seen from **Gauteng west**. The 120 congenital heart disease patients seen from this area were mostly from Krugersdorp (26), Kagiso (25) and Randfontein (21). (See Table 6.1.6. page 72) Although the numbers in the subdivisions of Gautong west were small their individual analyses and their combined analyses showed an as expected ratio of rheumatic fever/ heart disease to congenital heart disease cases seen in all calculations. (See Table 3.1.3. pages 35 and 37)

Table 3.1.3. Rheumatic fever/heart disease patients and Controls seen from January 1993 to December 1995 with areas of origin, ratios, Chi-Square analysis and p values continued. (RHD/CHD TOTAL = 312/1747 = 0.179)

ORIGIN	RHD	CHD	RHD/CHD	Chi^2	P value	COMMENT
AREAS IN NORTH-WEST:						
NORTH-WEST UNSPECIFIED	4	34	0.118	0.63	0.426373	
RUSTENBURG	5	6	0.833	7,86	0.00566	#, > RHD
KLERKSDORP	7	34	0.206	0.12	0.731670	
POTCHEFSTROOM	3	18	0.167	0.01	0.911743	#
GA-RANKUWA	2	5	0.4	0.98	0.322120	#
MAFIKENG	1	9	0.111	0.21	0.649501	#
ZEERUST	0	12	---	2.14	0.143212	#
RUSTENBURG & GA-RANKUWA	7	11	0.636	7.89	0.004977	#, > RHD
AREAS IN NORTHERN PROVINCE:						
PIETERSBURG	11	5	2.2	35.75	0.000000	#, > RHD
GAZANKULU	3	2	1.5	7.82	0.005162	#, > RHD
TZANEEN	4	2	2.0	12.38	0.000433	#, > RHD
LOUIS TRICHARDT	2	0	inf	11.2	0.000818	#, > RHD
NOORDSRUIT	2	1	2.0	6.19	0.012833	#, > RHD
VENDA	2	9	0.222	0.08	0.779356	#
POTGIETERSRUS	2	5	0.4	0.98	0.322120	#

CHD=Congenital He t Disease, RHD=Rhoumatic Heart Disease/ Fever
#=Numbers too small for analysis alone, inf=infinity

The majority of the patients from Soweto did not specify a suburb in their addresses. Of those that did, the majority of the rheumatic fever/ heart disease patients seen, were from Diepkloof, (6 or 10.7%), Orlando and Orlando West and Meadowlands (5 or 8.9% each). Most of the 320 congenital heart disease patients who specified a suburb in their addresses, were from Diepkloof (36 or 11.3%) and Orlando and Orlando West (37 or 11.6%). Of note, no rheumatic fever patients originated from Naledi. (See Table 6.1.2. page 70)

Soweto and the independent analysis of its subdivisions showed an as expected ratio of rheumatic fever/ heart disease to congenital heart disease patients seen. (See Table 3.1.1. page 35 and 36)

Table 3.1.3. Rheumatic fever/heart disease patients and Controls seen from January 1993 to December 1995 with areas of origin, ratios, Chi-Square analysis and p values continued. (RHD/CHD TOTAL = 312/1747 = 0.179)

ORIGIN	RHD	CHD	RHD/CHD	Chi^2	P value	COMMENT
AREAS IN GAUTENG EAST:						
BENONI AREA	3	17	0.176	0.00	0.984776	#
EDENVALE, BEDFORDVIEW & GERMISTON	0	39	---	6.97	0.008312	< RHD
BOKSBURG	0	28	---	5.00	0.025339	#, < RHD
BOKSBURG, BRAKPAN & SPRINGS	0	56	---	10.0	0.001564	< RHD
ALBERTON & DAVEYTON	3	38	0.079	1.96	0.161720	
EASTERN SUBURBS (north of M2) & ALBERTON	4	126	0.032	14.75	0.000123	< RHD
EASTERN SUBURBS, ALBERTON & DAVEYTON	6	150	0.04	15.51	0.000082	< RHD
BENONI & VOSLOORUS	5	29	0.172	0.01	0.942039	
THOKOZA (G1005)	6	28	0.214	0.16	0.685048	
KATLEHONG (G1006)	14	73	0.192	0.06	0.807034	
TSAKANE	5	14	0.357	1.84	0.174779	#
KWA-THEMA	3	4	0.75	4.18	0.040932	#, > RHD
DUDUZA	2	4	0.5	1.84	0.214248	#
VOSLOORUS	2	12	0.167	0.01	0.927889	#
TSAKANE & DUDUZA	7	18	0.389	3.21	0.073221	#
KWA-THEMA & DUDUZA	5	8	0.625	5.49	0.019089	#, > RHD
KWA-THEMA, DUDUZA & TSAKANE	10	22	0.455	6.48	0.011100	#, > RHD
KWA-THEMA, DUDUZA, TSAKANE & THOKOSA	16	50	0.32	4.24	0.039455	> RHD
KWA-THEMA, DUDUZA, TSAKANE & KATLEHONG	24	95	0.253	2.33	0.127072	
TSAKANE, DUDUZA & VOSLOORUS	9	30	0.3	1.9	0.167552	
KWA-THEMA, DUDUZA, TSAKANE & VOSLOORUS	12	34	0.353	4.28	0.038620	> RHD
SOUTHERN TOWNSHIPS (G1009,6,7,12(G0904,5)	30	159	0.04	0.38	0.537199	
SOUTHERN TOWNSHIPS & DAVEYTON	32	136	0.237	1.18	0.277898	

CHD=Congenital Heart Disease, RHD=Rheumatic Heart Disease/ Fever
#=Numbers too small for analysis alone

Table 3.1.3. Rheumatic fever/ heart disease patients and Controls seen from January 1993 to December 1995 with areas of origin, ratios, Chi-Square analysis and p values continued. (RHD/CHD TOTAL = 312/1747 = 0.179)

ORIGIN	RHD	CHD	RHD/CHD	Chi^2	P value	COMMENT
AREAS IN GAUTENG SOUTH:						
EVATON	10	19	0.526	8.43	0.003695	#, > RHD
WALKERVILLE	2	4	0.5	1.54	0.214248	#
HEIDELBURG	3	5	0.6	3.11	0.077938	#
ORANGE FARM	4	10	0.4	1.96	0.161445	#
EVATON & HEIDELBURG	13	24	0.542	11.49	0.000699	> RHD
EVATON & WALKERVILLE	12	23	0.522	9.97	0.001595	> RHD
EVATON & ORANGE FARM	14	29	0.483	10.13	0.001456	> RHD
EVATON, WAKERVILLE & HEIDELBURG	15	28	0.536	13.02	0.000308	> RHD
EVATON, WAKERVILLE, HEIDELBURG & ORANGE FARM	19	36	0.5	14.65	0.000129	> RHD
VEREENIGING	1	30	0.133	0.3	0.581634	
VANDERBIJL PARK	5	14	0.357	1.84	0.174778	#
VANDERBIJL & VEREENIGING	9	44	0.205	0.14	0.710465	
VANDERBIJL & ORANGE FARM	9	24	0.375	3.77	0.052173	
SEBOKENG	9	42	0.214	0.25	0.619376	
SEBOKENG & VEREENIGING	13	72	0.181	0.00	0.971053	
SOUTH-EASTERN AREA (G0901,6,7,11,12,15)	5	38	0.132	0.42	0.519160	
AREAS IN GAUTENG WEST:						
KRUGERSDORP (G102)	5	25	0.192	0.02	0.879534	#
RANDFONTEIN (G1101)	4	21	0.191	0.01	0.905979	#
ROODEPOORT (G1103)	6	19	0.316	1.52	0.217326	#
BEKKERSDAL (G1105)	2	9	0.222	0.08	0.779356	#
KAGISO (G1104)	1	25	0.04	2.59	0.107856	#
KRUGERSDORP & RANDFONTEIN	9	47	0.191	0.04	0.847992	
RANDFONTEIN & BEKKERSDAL	6	30	0.2	0.06	0.800044	
KRUGERSDORP & ROODEPOORT	11	45	0.244	0.88	0.348723	
ROODEPOORT & BEKKERSDAL	8	28	0.283	1.4	0.236840	
G1100/1/4/5/6/7	8	75	0.107	1.96	0.161189	

CHD=Congenital Heart Disease, RHD=Rhoumatic Heart Disease/ Fever
# = Numbers too small for analysis alone

Table 3.1.3. Rheumatic fever/ heart disease patients and Controls seen from January 1993 to December 1995 with areas of origin, ratios, Chi-Square analysis and p values continued. (RHD/CHD TOTAL = 312/1747 = 0.179)

ORIGIN	RHD	CHD	RHD/CHD	Chi^2	P value	COMMENT
AREAS IN SOWETO:						
SOWETO UNSPECIFIED	26	106	0.245	2.12	0.145395	
MEADOWLANDS	5	31	0.161	0.04	0.832498	
DIEPKLOOF	6	36	0.167	0.02	0.875440	
ORLANDO & ORLANDO WEST	5	37	0.135	0.34	0.557155	
ORLANDO & CHIAWELO	7	55	0.127	0.7	0.396308	
DHLAMINI & DIEPKLOOF	7	42	0.167	0.03	0.865552	
ZOLA & MEADOWLANDS	7	43	0.163	0.05	0.820132	
ZOLA & DOBSONVILLE	6	30	0.206	0.06	0.800044	
ZOLA, DOBSONVILLE, NALEDI & JABULANI	8	50	0.16	0.08	0.772713	
MOFOLO, CHIAWELO, & KLIPTOWN	5	55	0.091	2.17	0.140689	
MOFOLO, CHIAWELO, DHLAMINI & KLIPTOWN	6	60	0.1	1.89	0.169604	
AREAS IN GAUTENG NORTH:						
HONEYDEW AREA (G1201)	4	19	0.211	0.09	0.764653	#
RANDBURG AREA (G1202)	3	20	0.15	0.08	0.777830	#
RANDBURG & HONEYDEW AREA	7	39	0.179	0.0	0.990261	
MAGALIESBURG & G1201,G1202	7	41	0.171	0.01	0.912361	
TEMBISA	2	11	0.180	0.00	0.981418	#
KEMPTON PARK	0	20	---	3.57	0.058767	#
TEMBISA & G1201	6	30	0.2	0.06	0.800044	
TEMBISA & G1202	5	31	0.161	0.04	0.832477	
NORTH-EASTERN GAUTENG NORTH(G1203,4,5,6 & G1600,1,2,3,4,5)	6	76	0.079	3.92	0.047825	< RHD
N-E GAUTENG N & IVORY PARK	6	78	0.086	4.19	0.040615	< RHD
ALEXANDRA, TEMBISA, IVORY PARK & MIDRAND	15	75	0.2	0.16	0.688782	

CHD = Congenital Heart Disease, RHD = Rheumatic Heart Disease/ Fever
N-E. = North Eastern, N. = North
= Numbers too small for analysis alone

Table 3.1.3 Rheumatic fever/heart disease patients and Controls seen from January 1993 to December 1995 with areas of origin, ratios, Chi-Square analysis and p values. (RHD/CHD TOTAL = 312/1747 = 0.179)

ORIGIN	RHD	CHD	RHD/CHD	CHI^2	P VALUE	COMMENT
OUT OF SOUTH AFRICA	5	34	0.147	0.16	0.687542	
KWA-ZULU NATAL	16	34	0.471	11.04	0.000893	> RHD
NORTHERN PROVINCE	30	32	0.938	53.26	0.000000	> RHD
MPUMALANGA	17	41	0.415	9.04	0.002639	> RHD
NORTH-WEST PROVINCE	20	122	0.164	0.13	0.722519	
FREE STATE	4	22	0.182	0.00	0.973723	#
EASTERN CAPE	10	15	0.667	12.00	0.000531	#, >RHD
GAUTENG	210	1447	0.145	7.92	0.004880	< RHD
E CAPE + KZN	26	49	0.531	22.21	0.000002	> RHD
E CAPE + NP	40	47	0.851	64.29	0.000000	> RHD
GAUTENG + FREE STATE	214	1469	0.146	7.78	0.005288	< RHD
AREAS IN GAUTENG:						
GAUTENG CENTRAL	47	452	0.104	12.76	0.000354	< RHD
GAUTENG NORTH	13	117	0.111	2.69	0.101255	
GAUTENG EAST	38	285	0.133	2.88	0.089545	
GAUTENG WEST	19	120	0.158	0.24	0.62561	
GAUTENG SOUTH	37	154	0.241	2.76	0.096716	
SOWETO	56	320	0.175	0.02	0.888453	
AREAS IN GAUTENG CENTRAL:						
JOHANNESBURG CENTRE & N.	8	166	0.048	15.12	0.000101	< RHD
SOUTH JOHANNESBURG	1	34	0.029	4.12	0.042485	< RHD
WEST JOHANNESBURG	7	94	0.074	5.31	0.021246	< RHD
SOUTH-WEST JOHANNESBURG (G0200,G0300,G0600,G0900)	8	86	0.093	3.23	0.072486	
LENASIA	4	34	0.118	0.63	0.426373	
NOORDGESIG & LENASIA	5	44	0.114	0.93	0.333974	
ELDORADO PARK & NATURE	12	46	0.260	1.37	0.221809	
ALEXANDRA	12	60	0.2	0.13	0.717591	
RIVERLEA & ELDORADO PARK	14	54	0.25	1.56	0.211303	

CHD = Congenital Heart Disease, RHD = Rheumatic Heart Disease/ Fever
E. = Eastern, KZN = Kwa-Zulu Natal, NP = Northern Province, N. = North
# = Numbers too small for analysis alone

Table 3.1.2 Rheumatic fever/ heart disease patients and Controls seen from January 1993 to December 1995 that originated from Gauteng.

Origin	RHD Coro	RHD JHB	RHD Bara	RHD Total	CHD Coro	CHD JHB	CHD Bara	CHD Total
Central	28	15	4	47	188	218	46	452
North	5	5	1	11	25	57	12	94
East	1	10	27	38	14	126	145	285
West	8	5	6	19	41	40	39	120
South	1	2	34	37	17	26	110	153
Pretoria	0	2	0	2	0	18	5	23
Soweto	2	1	53	56	18	18	284	320
Total	45	40	125	210	303	503	641	1447

RHD=Rheumatic fever/ heart disease, CHD=Congenital Heart disease, Coro=Coronation Hospital, JHB=Johannesburg Hospital and Bara=Baragwanath Hospital.

The majority of the 47 rheumatic fever/ heart disease patients seen from Gauteng central originated from the Eldorado Park, Nancefield and Naturina area and Alexandra Township, (12 or 25.5% each). The least rheumatic fever/ heart disease patients seen from this subdivision, came from Noordgesig and Johannesburg South, (1 or 2.1% each). Most of the 452 congenital heart disease patients seen from Gauteng central were from Johannesburg centre and north, (166 or 36.7%). (See Table 6.1.1. page 70)

Gauteng central had a significantly lower ratio of rheumatic fever/ heart disease patients to congenital heart disease patients seen. (See Table 3.1.3. page 35) Within Gauteng central, Johannesburg centre and north, (area code G0700), south, (area code G0900), and west, (area code G0100), all demonstrated significantly lower than expected ratios. The remaining subdivisions had as expected ratios. (See Table 3.1.1. page 35)

Of the 10 rheumatic heart disease sufferers from the Eastern Cape, 9 were from the Transkei. Together they made up 3.2% of the rheumatic fever/ heart disease patients seen. The 15 congenital heart disease cases that originated from this Province, represented 0.9% of the congenital heart disease patients seen. Nine of these (60%) were from Transkei. The Eastern Cape patients were seen predominently at Baragwanath Hospital. (See Table 3.1.1. page 31)

The ratio of rheumatic fever/ heart disease patients to congenital heart disease cases seen is higher than expected among the patients from the Eastern Cape. The numbers were small however. The combined analysis of the Eastern Cape and Kwa-Zulu Natal and of the Eastern Cape and the Northern Province, (they have similar ratios), gave a significantly higher than expected ratio ir both calculations. (See Table 3.1.3. page 35)

Only 4 of the rheumatic fever/ heart disease patients and 22 of the congenital heart disease cases seen originated from the Free State. This is equivalent to 1.3% of the rheumatic fever/ heart disease patients and also of the congenital heart disease sufferers seen. Fourteen (63.6%) of these congenital heart disease cases presented at the Johannesburg Hospital. (See Table 3.1.1. page 31) The ratio of the rheumatic fever/ heart disease patients seen from this Province was as expected but the numbers are too small to draw certain conclusions from. (See Table 3.1.3. page 35)

3.1.2 Gauteng and Subdivisions

Of the congenital heart disease cases seen, 82.8% were from Gauteng while only 67.3% of the rheumatic fever/ heart disease patients were from Gauteng. (See Table 3.1.1. page 31) A significantly lower than expected ratio of rheumatic fever/ heart disease to congenital heart disease patients seen was found in the Gauteng region. This suggests that rheumatic fever/ heart disease is relatively less of a problem here. (See Table 3.1.3. page 35)

From Table 3.1.2. on page 34 it can be seen that most of the 499 patients seen from Gauteng central were examined at the Coronation and Johannesburg Hospitals, (46.7% and 43% respectively).The eastern Gauteng region fed the Baragwanath and Johannesburg Hospitals. Each of these hospitals saw 172, (53.3%), and 136 (42.1%), of these 323 patients respectively. Patients from western Gauteng presented fairly evenly between the three hospitals. Baragwanath Hospital saw the majority of the 190 patients from south Gauteng (75.8%) and 89.6% of the 376 patients from Soweto. Of the rheumatic fever/ heart disease sufferers that presented to the Baragwanath Hospital however, 70.2% were from outside Soweto. (See Table 3.1.1. page 31 and Table 3.1.2. page 34)

Twenty rheumatic fever/ heart disease patients presented from the North-West Province making up 6.4% of the rheumatic fever/ heart disease patients with known addresses. They reported mainly to the Baragwanath Hospital. (14 or 70%) (See Table 3.1.1. page 31) Seven (35%) originated from Klerksdorp and 5 (25%) from Rustenburg. Although 12 (9.8%) of the congenital heart disease patients from this area were seen from Zeerust, no rheumatic fever patients came from there. (See Table 6.1.7. page 73)

Of the congenital heart disease patients seen, 122 (6.9%) came from the North-West Province. This represented the largest number of congenital heart disease patients seen from Provinces other than Gauteng.(See Table 6.1.7. page 73) Thirty four (27.9%) presented from Klerksdoorp and 18 (14.8%) from Potchefstroom. They presented mainly to Baragwanath Hospital (79 or 64.8%)(See Table 3.1.1. page 31)

Although an as expected ratio of rheumatic fever/ heart disease to congenital heart disease patients seen, was found in the North-West Province, it was higher than expected in Rustenburg. The numbers were too small, however, for certain significance. (See Table 3.1.1. page 35 and 39)

The 17 rheumatic fever/ heart disease patients seen from Mpumalanga represented 5.5% of all the rheumatic fever/ heart disease patients seen. Eleven (64.7%) presented at the Baragwanath Hospital and 6 (35.3%) at the Johannesburg Hospital. (See Table 3.1.1 page 31)

The 41 congenital heart disease patients from Mpumalanga contributed 2.3% of the congenital heart disease patients seen with known addresses. Twenty two (53.7%) were seen at Baragwanath Hospital while 18 (43.9%) presented at the Johannesburg Hospital. (See Table 3.1.1. page 31)

The ratio of rheumatic fever to congenital heart disease patients seen from Mpumalanga was significantly higher than expected. (See Table 3.1.3. page 35)

Kwa-Zulu Natal contributed 16 (5.1%) of the rheumatic fever/ heart disease patients seen. They (56.3%) were seen mainly at the Johannesburg Hospital. Thirty four congenital heart disease sufferers originated from Kwa-Zulu Natal making up 2% of the congenital heart disease patients seen. Twenty five (73.5%) presented to the Johannesburg Hospital. (See Table 3.1.1. page 31) The ratio of rheumatic fever/ heart disease sufferers to congenital heart disease patients seen was significantly higher than expected in this Province. (See Table 3.1.3 page 35)

A significantly higher than expected ratio of rheumatic fever/ heart disease to congenital heart disease cases seen was obtained from the Northern Province. (See Table 3.1.3. page 35) Within this Province the ratio was significantly higher than expected in Pietersburg, Tzaneen, Gazankulu, Louis Trichardt, Hoedspruit and Lebowa but the numbers in each of these areas were too small to draw firm conclusions from. (See Table 3.1.3. page 39)

Table 3.1.1 Rheumatic fever/ heart disease patients and Controls seen at three teaching hospitals of the University of the Witwatersrand from January 1993 to December 1995 and their areas of origin.

Origin	RHD Coro	RHD JHB	RHD Bara	RHD Total	CHD Coro	CHD JHB	CHD Bara	CHD Total
N Province	3	13	14	30	0	12	20	32
K-Z Natal	2	9	5	16	3	25	6	34
Mpumalanga	0	6	11	17	1	18	22	41
East Cape	0	4	6	10	3	3	9	15
Free State	0	2	2	4	2	14	6	22
North-West	3	3	14	20	6	37	79	122
Gauteng	45	40	125	210	303	503	641	1447
Out of SA	1	3	1	5	7	14	13	34
Total	54	80	178	312	325	626	796	1747
Unknown	1	20	160	181	46	258	825	1129
Grand Total	55	100	338	493	371	884	1621	2876
% Known	98,2	80,0	52,7	63,3	87,6	70,8	49,1	60,7
% Gauteng	83,3	50,0	70,2	67,3	93,2	80,4	80,9	82,8
Transkei	0	4	5	9	0	0	9	9
Severe RHD	8	45	109	162				
% Severe RHD	14,5	45,0	32,2	32,9				
Deaths	1	2	?					

RHD=Rheumatic fever/ heart disease, CHD=Congenital Heart disease, SA=South Africa, K-Z Natal=Kwa-Zulu Natal, N. Province=Northern Province, Coro=Coronation Hospital, JHB=Johannesburg Hospital & Bara=Baragwanath Hospital.

3. RESULTS:

3.1 FIRST HYPOTHESIS:

Ho(1): There is no difference in the ratio of rheumatic fever/ heart disease to congenital heart disease patients seen from different geographic areas.

HA(1): There is a difference in the ratio of rheumatic fever/ heart disease to congenital heart disease patients seen from different geographic areas.

A total of 493 patients with rheumatic fever or heart disease were seen at the three mentioned teaching hospitals from January 1993 to December 1995.(See Table 3.1.1. page 31) Of these 312, (63.3%), had documented addresses and were analysed. There were 2876 cases of congenital heart disease seen in the same period. Of these 1747 (60.7%) had known addresses and were included in the analysis. (See Table 3.1.1. page 31)

The ratio of rheumatic fever/ heart disease to congenital heart disease patients seen in each area is shown in Table 3.1.3 on pages 35 to 39. Using the ratio of the whole sample, viz. 312/1747 = 0.179, as the expected ratio, the ratios of the different areas were compared to this and tested for a significant difference using the Chi-Square Test for Goodness of Fit. (See Section 2.4 Data Analysis page 28) The results of the Chi-Square analysis are also found in Table 3.1.3.

3.1.1 Provincial level

The 30 rheumatic heart disease patients that came from the **Northern Province** represented 9.6% of the rheumatic fever/ heart disease patients seen with known addresses. They presented mainly at Baragwanath and Johannesburg Hospitals, 14 (35%) and 13 (32.5%) respectively. (See Table 3.1.1. page 31) The majority (11 or 36.7%), originated from Pietersburg, while 4 (13.3%) presented from Tzaneen and 3 (10%) were from Gazankulu. (See Table 6.1.8 page 73)

Thirty two (1.8%) congenital heart disease patients presented from the Northern Province. They were largely seen at Baragwanath Hospital (20 or 62.5%) (See Table 3.1.1. page 31) Nine (28.1%) presented from Venda, while 5 (15.6%) each came from Pietersburg and Potgietersrus, and 4 (12.5%) from Letaba.(See Table 6.1.8 page 73)

If some of the Ej are small, the Chi-Square Test may not be appropriate. Cells with small Ej should be combined with other cells in a meaningful way, so that not more than 20% of the Ej are <5.0 and none <1.0.[51] Hence, where the numbers were too small for analysis then that area was combined with a similar area, (either in terms of a similar socio-economic situation, political history, proximity or similar rheumatic fever/ heart disease to congenital heart disease ratios), and the areas analysed together.

The data regarding the severity of rheumatic fever/ heart disease was analysed in a similar manner, using the Chi-Square Test for Goodness of Fit. The expected severity was taken as the ratio of severe to non-severe rheumatic fever/ heart disease in the whole sample (162:331 = 0,489) and was compared to the observed ratio in each area considered. Areas from which patients were seen with a significantly higher or lower than expected severity of rheumatic fever/ heart disease, were thus identified. (See Results section 3.2. page 48 to 50)

Soweto contributed 19.2% of the severe rheumatic fever/ heart disease patients seen from Gauteng. Fourteen (25.9%) of the 54 patients from Soweto presented with severe disease. The suburb of origin of most (7) of the severe patients from Soweto is not known. Two each are known to have come from Diepkloof and Meadowlands. Of the areas from where rheumatic fever patients originated, no severe patients are known to have presented from Dobsonville, Mofolo, Dhlamini, Orlando and Orlando West or the Kliptown area. (See Table 3.2.1 page 46 and Table 6.2. page 75)

Soweto showed an as expected ratio of severe to non-severe rheumatic fever patients seen. Only the combined analysis of the 5 areas mentioned above, where no severe rheumatic fever/ heart disease presented from, showed a lower than expected ratio, but the numbers were too small for certain significance. (See Table 3.2.2. page 48 and page 49)

Ten (52.6%) of the 19 rheumatic fever/ heart disease patients that presented from **Gauteng west** were severe. This area thus contributed 13.7% of the severe patients that originated from Gauteng. Four of these 10 severe patients were from Krugersdorp, while 2 each presented from the Roodepoort and Bekkersdal areas. No severe patients were seen from Kagiso and no rheumatic fever patients presented from Westonaria. (See Table 3.2.1. page 46, Table 6.1.6 page 72 and Table 6.2. page 75) Although an as expected ratio of severe to non-severe rheumatic fever/ heart disease sufferers was found in Gauteng West, the p value was only slightly more than 0.05. When analysed without Kagiso a higher than expected ratio was obtained suggesting that there may well a problem of severe rheumatic fever within this area. (See Table 3.2.2. page 48 and 50)

Only 8 (16.3%) of the 49 patients that presented from **Gauteng central** had severe disease making up 11% of the severe patients from Gauteng. Six of these severe patients were from Alexandra. The other two originated from Lenasia. No severe rheumatic fever patients were seen from Johannesburg west, central or south, Eldorado Park, Riverlea or Noodgesig. (See Table 3.2.1. page 46 and Table 6.2. page 74)

A significantly lower than expected ratio of severe to non-severe patients was found in Gauteng central. Johannesburg centre and Eldorado Park each showed a lower than expected ratio of severe to non-severe rheumatic fever/ heart disease patients seen. The numbers in these areas were, however, too small for certain significance. The combined assessment of Johannesburg centre with Johannesburg north and south and of Eldorado Park with Riverlea and Noodgesig, showed a significantly lower than expected ratio in both cases. (See Table 3.2.2. page 48 and page 49)

Gauteng south had a significantly higher than expected ratio of severe to non-severe rheumatic fever/ heart disease patients seen. Within this area Vanderbijl Park had a higher than expected ratio and Evaton and Sebokeng each revealed an as expected ratio. The numbers in these areas were small however. When Vanderbijl Park was analysed in combination with Vereeniging and Sebokeng a significantly higher than expected ratio was found. The combined assessment of Evaton and Sebokeng, and Evaton, Vanderbijl Park and Vereeniging, gave a significantly higher than expected ratio in both cases. This suggests that more severe disease is a problem mainly in Vanderbijl Park, Vereeniging, Sebokeng and Evaton. (See Table 3.2.2. page 48 and 49)

Seventeen severe rheumatic fever/ heart disease patients presented from Gauteng east contributing 23.3% of the severe patients from Gauteng. In total 38 rheumatic fever/ heart disease patients were from Gauteng east. Seven of the severe patients were from Katlehong, while 3 each originated from Tsakane and Kwa-Thema. Two were from Thokosa. No severe patients were seen from Alberton, Vosloorus or Duduza while no rheumatic fever patients presented from Edenvale, Bedfordview, Germiston, Boksburg, Brakpan and Springs. (See Table 3.2.1. page 46, Table 6.1.5 page 72 and Table 6.2. page 74)

Gauteng east demonstrated an as expected ratio of severe to non-severe rheumatic fever/ heart disease patients. Tsakane, Thokosa and Katlehong assessed individually showed an as expected ratio while the ratio was higher than expected in Kwa-Thema. The combined analysis of Kwa-Thema and Tsakane also gave a higher than expected ratio. The numbers were, however, small in these subsections. When Tsakane and Katlehong were analysed together an as expected ratio was obtained but the p value was only slightly more than 0.05. With the addition of Kwa-Thema to Tsakane and Katlehong a significantly higher than expected ratio was obtained. With the further addition of Thokosa the ratio remained significantly higher than expected but when Katlehong and Thokosa were assessed together an as expected ratio was obtained. This suggests that the areas that have a problem with severe rheumatic fever within Gauteng east are Kwa-Thema, Tsakane and possibly also Katlehong. (See Table 3.2.2. page 48 and 50)

Table 3.2.2. Severe and non-severe rheumatic fever/ heart disease patients seen from January 1993 to December 1995 with areas of origin, ratios, Chi-Square analysis, and p values continued.

ORIGIN	SRHD	NON-SRHD	RATIO	Chi^2	P VALUE	COMMENT
GAUTENG EAST:						
Tsakane	3	2	1.5	1.67	0.196350	#
Thokosa	2	4	0.5	0.00	0.980309	#
Katlehong	7	7	1.0	1.86	0.172138	#
Kwa-Thema	3	0	inf	6.13	0.013293	#, > SRHD
Kwa-Thema & Tsakane	6	2	3.0	6.44	0.11163	#, > SRHD
Tsakane & Katlehong	10	9	1.111	3.37	0.066533	
Kwa-Thema, Tsakane & Thokosa	8	6	1.3	3.74	0.053068	#
Kwa-Thema, Tsakane & Katlehong	13	9	1.444	6.86	0.008809	> SRHD
Kwa-Thema, Tsakane, Thokosa & Katlehong	15	13	1.154	5.44	0.019634	> SRHD
Katlehong, Benoni & Daveyton	9	9	1.0	2.4	0.121579	
Kwa-Thema, Tsakane, Katlehong & Benoni/Daveyton	14	10	1.4	7.06	0.007888	> SRHD
Katlehong & Thokosa	9	11	0.818	1.34	0.247736	
Alberton, Vosloorus & Duduza	0	5	---	2.45	0.117740	#
GAUTENG WEST:						
Roodepoort	2	4	0.5	0.0	0.980309	#
Krugersdorp	4	1	4.0	5.04	0.024823	#, > SRHD
Bekkersdal	2	0	Inf	4.09	0.043229	#, > SRHD
Whole area - Kagiso	10	8	1.25	4.20	0.040365	> SRHD
NORTHERN PROVINCE:						
Pietersburg	6	5	1.2	2.34	0.125713	#
Potgietersrus	2	0	inf	4.09	0.043229	#, > SRHD
Tzaneen	2	4	0.5	0.00	0.980309	#
Gazankulu	2	3	0.667	0.12	0.737929	#
NT1401/4/5 & 6	10	9	1.111	3.37	0.066533	> SRHD
NORTH-WEST PROVINCE:						
Klerksdoorp	4	3	1.33	1.87	0.171374	
NW1402/3/4/7 & 8	7	10	0.7	0.53	0.465376	#

RHD - Rheumatic fever/ heart disease, SRHD - Severe RHD,
- numbers too small for accurate analysis alone, inf - infinity

Table 3.2.2. Severe and non-severe rheumatic fever/ heart disease patients seen from January 1993 to December 1995 with areas of origin, ratios, Chi-Square analysis, and p values continued. (TOTAL severe RHD:non-severe RHD = 162:331 = 0.489)

ORIGIN	SRHD	NON-SRHD	RATIO	Chi^2	P VALUE	COMMENT
GAUTENG CENTRAL:						
Alexandra	6	6	1.0	1.60	0.20600	#
Lenasia & Alexandra	8	8	1.0	2.13	0.144390	
West Johannesburg	0	7	---	3.43	0.064178	#
Johannesburg Centre	0	8	---	3.92	0.047845	#,< SRHD
Edorado Park	0	12	---	5.87	0.015374	#,< SRHD
Johannesburg West, South & Centre	0	16	---	7.83	0.005136	< SRHD
Eldorado Park, Riverlea & Noodgesig	0	15	---	7.34	0.006736	< SRHD
SOWETO:						
Unspecified	7	19	0.368	0.42	0.519248	
Diepkloof & Meadowlands (G1303+7)	4	7	0.571	0.06	0.804605	#
Zola, Chiawelo & Jabulani (G1302/5+10)	3	3	1.0	0.80	0.371106	#
G1302/3/5/7+10	7	10	0.7	0.53	0.465376	
Orlando & Orlando West	0	5	---	2.45	0.117740	#
G1301/4/6/8+G0400	0	13	---	6.36	0.011655	#, < SRHD
GAUTENG SOUTH:						
Vanderbijl Park (VDBP)	4	1	4.0	5.04	0.024823	#, > SRHD
Vanderbijl & Vereeniging	7	2	3.5	8.23	0.004119	#, > SRHD
VDBP, Vereeniging & Sebokeng	12	6	2.0	9.32	0.002261	> SRHD
Sebokeng	5	4	1.25	2.10	0.147181	#
Evaton	6	4	1.5	3.34	0.067671	#
Evaton & Sebokeng	11	8	1.375	5.40	0.020166	> SRHD
Evaton & Vanderbijl	10	5	2.0	7.77	0.005311	#, > SRHD
Evaton, VDBP & Vereeniging	13	6	2.167	10.8	0.000966	> SRHD
Orange Farm, Heidelburg & Lebokeng	7	9	0.778	0.86	0.353725	

RHD = Rheumatic fever/ heart disease, SRHD = Severe RHD,
# = numbers too small for accurate analysis alone

Table 3.2.2. Severe and non-severe rheumatic fever/ heart disease patients seen from January 1993 to December 1995 with areas of origin, Chi-Square analysis, ratios and p values. (TOTAL severe RHD:non-severe RHD = 162:331 = 0.489)

ORIGIN	SEVERE RHD	NON-SEVERE RHD	RATIO	Chi^2	P VALUE	COMMENT
KWA-ZULU NATAL	7	9	0.778	0.86	0.353725	
NORTHERN PROVINCE	15	15	1.0	3.99	0.045642	> SRHD
MPUMALANGA	10	7	1.429	5.19	0.022661	> SRHD
NORTH-WEST	8	12	0.667	0.46	0.496626	
FREE STATE	2	2	1.0	0.53	0.465501	#
EASTERN CAPE	6	4	1.5	3.34	0.067671	#
FREE STATE & NORTHERN PROVINCE	17	17	1.0	4.53	0.033356	> SRHD
EASTERN CAPE & MPUMALANGA	16	11	1.455	8.53	0.003495	> SRHD
OUT OF SA	4	1	4.0	5.04	0.024823	#, > SRHD
GAUTENG	73	137	0.533	0.34	0.557361	
AREAS IN GAUTENG:						
CENTRE	8	41	0.195	6.07	0.013740	< SRHD
NORTH	4	9	0.444	0.03	0.872491	#
NORTH & SOWETO	18	49	0.367	1.09	0.296201	
NORTH & CENTRE	12	50	0.24	5.13	0.023575	< SRHD
EAST	17	21	0.810	2.43	0.119064	
WEST	10	9	1.111	3.37	0.066833	
SOUTH	20	17	1.176	7.53	0.006057	> SRHD
SOWETO	14	40	0.35	1 18	0.277995	
GAUTENG NORTH:						
Honeydew, Tembisa & Hammanskraal	4	4	0.6	1.0	0.302016	#
Randburg, Sandton & Midrand	0	5	---	2.45	0.117740	#

RHD = Rheumatic fever/ heart disease, SRHD = Severe RHD,
# = numbers too small for accurate analysis alone

Of the 16 rheumatic fever/ heart disease patients seen that originated from Kwa-Zulu Natal, 7 (43.8%) were severe. This represented an as expected ratio of severe to non-severe patients. (See Table 3.2.1. page 46 and Table 3.2.2. page 48)

Sixty percent of the patients that came from the Eastern Cape were classified as severe and all six severe patients originated from Transkei. This gave an as expected ratio of severe to non-severe patients for this Province but the numbers were small. (See Table 3.2.1. page 46 and Table 3.2.2. page 48)

Only four patients presented from the Free State and 2 were classified as severe giving an as expected ratio of severe to non-severe rheumatic fever/ heart disease patients for this Province. The numbers are too small, however, to draw definite conclusions from. (Table 3.2.1. page 46 and Table 3.2.2. page 48)

The combined analysis of the Free State and the Northern Province and of the Eastern Cape and Mpumalanga, (they have similar ratios), showed a significantly higher than expected ratio of severe to non-severe rheumatic fever/ heart disease patients seen from these areas in both calculations. (See Table 3.2.2. page 48)

3.2.2. Gauteng and Subdivisions

Of the rheumatic fever/ heart disease patients seen from Gauteng, 73 were classified as severe giving an as expected ratio for the whole Province. (See Table 3.2.2. page 48)

Gauteng south contributed 27.4% of the severe rheumatic fever/ heart disease cases that originated from Gauteng. Twenty (54.1%) of the 37 patients that presented from Gauteng south were severe. Six severe patients were from Evaton, 5 from Sebokeng, 4 from Vanderbijl Park and 3 from Vereeniging. No severe cases came from Walkerville and no rheumatic fever patients presented from south of Klipriviersberg, Nigel, Ennerdale and the Klipriver area. (See Table 3.2.1. page 46, Table 6.1.4 page 71 and Table 6.2 page 74)

Of the patients that presented from Mpumalanga, 58.8% were classified as suffering from severe rheumatic heart disease. A significantly higher than expected ratio of severe to non-severe rheumatic fever/ heart disease patients seen was observed in this area. (See Table 3.2.1. page 46 and Table 3.2.2. page 48)

Eight of the 20 (40%) patients that presented from the North-West Province were severe. Of these four were from the Klerksdorp area. The ratio of severe to non-severe rheumatic fever/ heart disease patients seen from this Province was as expected. (See Table 3.2.1. page 46, Table 3.2.2. pages 48 and 50 and Table 6.2. page 75)

Table 3.2.1 Severe and non-severe rheumatic fever/ heart disease patients seen from January 1993 to December 1995 with areas of origin and % severe patients.

ORIGIN	SEVERE RHD	NON-SEVERE RHD	TOTAL	% SEVERE
GAUTENG CENTRAL	8	41	49	16.3
GAUTENG NORTH	4	9	13	30.8
GAUTENG SOUTH	20	17	37	54.1
GAUTENG EAST	17	21	38	44.7
GAUTENG WEST	10	9	19	52.6
SOWETO	14	40	54	25.9
TOTAL GAUTENG	73	137	210	34.8
GAUTENG	73	137	210	34.8
MPUMALANGA	10	7	17	58.8
NORTH-WEST PROVINCE	8	12	20	40
NORTHERN PROVINCE	15	15	30	50
FREE STATE	2	2	4	50
KWA-ZULU NATAL	7	9	16	43.8
EASTERN CAPE	6	4	10	60
OUT OF SOUTH AFRICA	4	1	5	80
UNKNOWN	37	144	181	20.4
GRAND TOTAL	162	331	493	32.9

RHD=Rheumatic Heart Disease/ Fever

3.2 SECOND HYPOTHESIS:

Ho(2): There is no difference in the ratio of severe to non-severe rheumatic fever/ heart disease patients seen from different geographic areas.

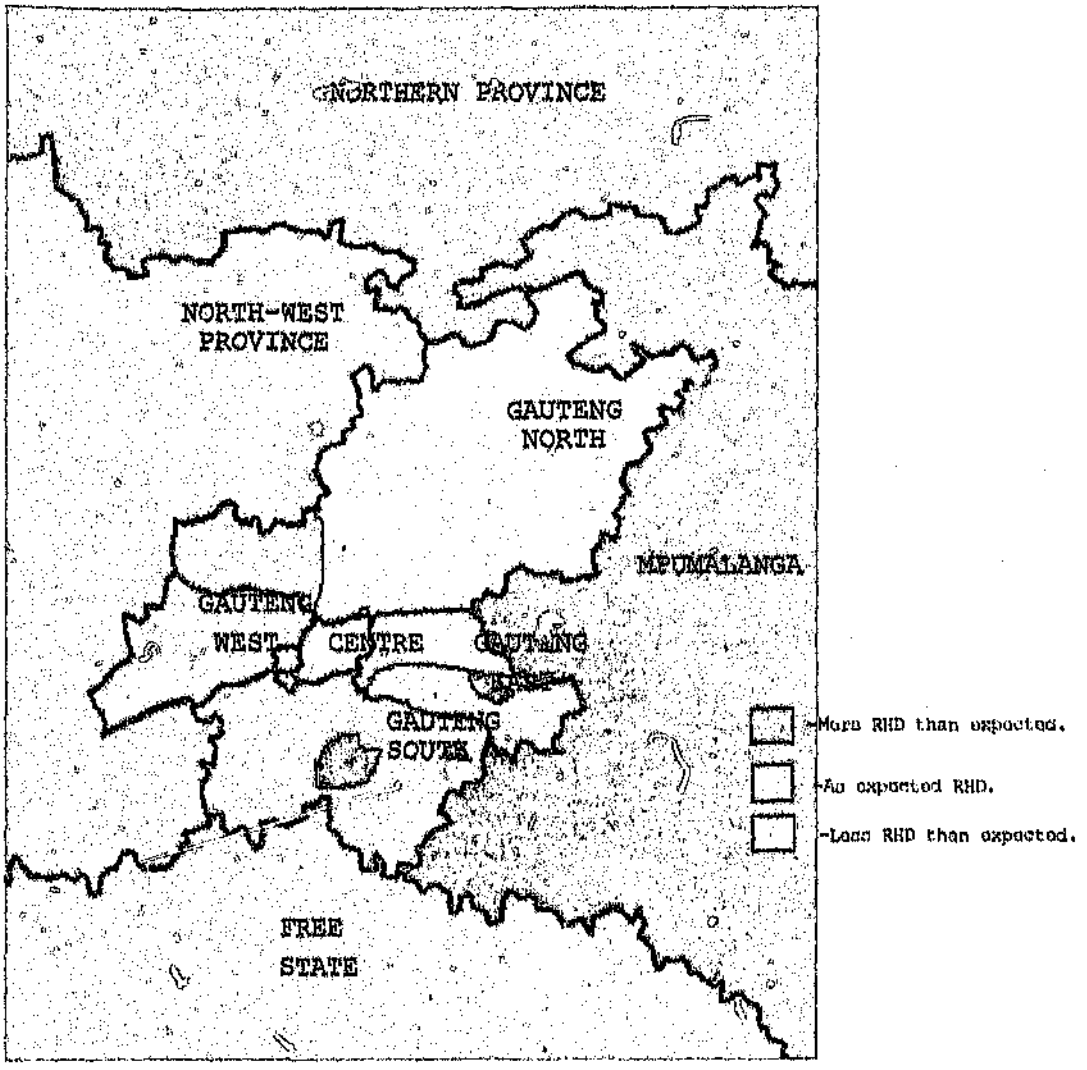
HA(2): There is a difference in the ratio of severe to non-severe rheumatic fever/ heart disease patients seen from different geographic areas.

3.2.1. Provincial Level

Severe disease was found in 162, (32.9%), of the 493 rheumatic fever/ heart disease patients seen. Thirty seven, (22.8%) of the 162 patients with severe disease were from unknown geographic origins. Of the 137 patients originating from Gauteng, 73 (34.8%), were classified as severe, while 52, (51%), of the 102 patients seen from outside of Gauteng were severe. Most of the severe patients seen (73 or 45.1%), were from Gauteng. Fifteen (9.3%) originated from the Northern Province, 10 (6.2%) from Mpumalanga, 8 (4.9%) from the North-West Province, 7 (4.3%) from Kwa-Zulu Natal, 6 (3.7%) from the Eastern Cape, and 2 (1.2%) from the Free State. (See Table 3.2.1. page 46)

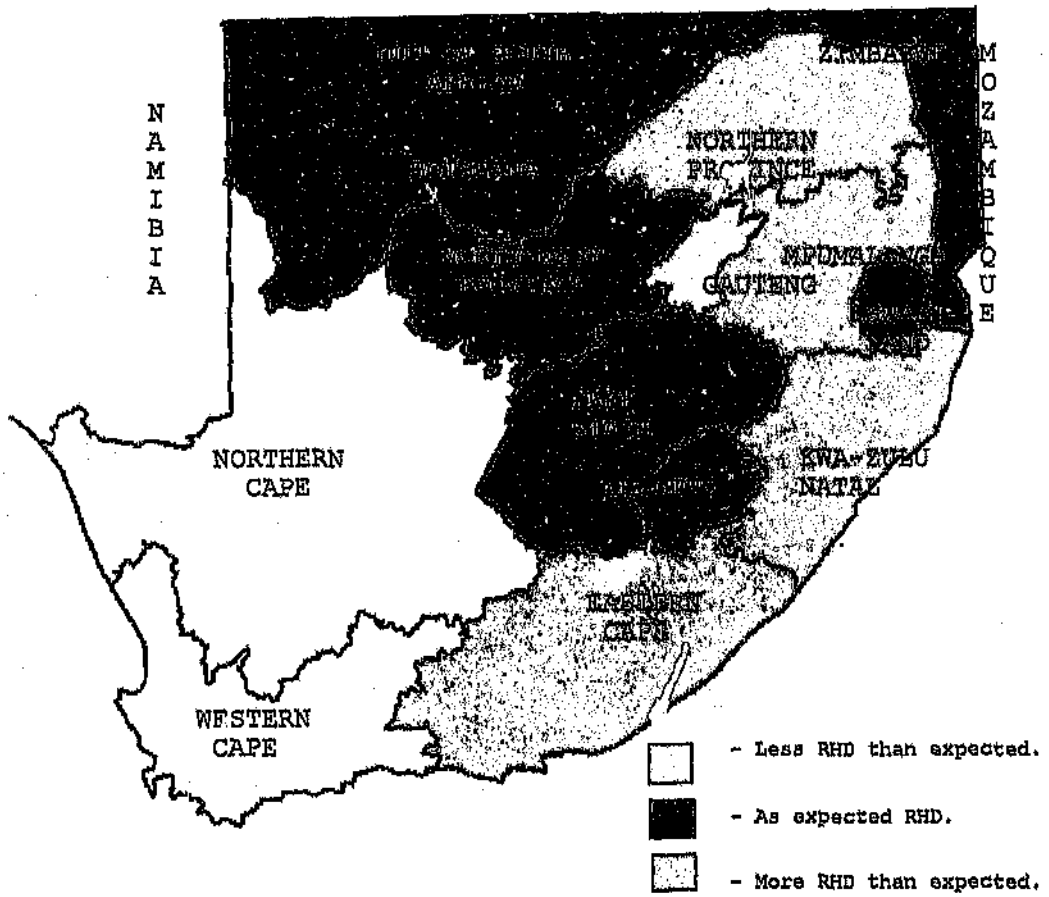
Half of the 30 rheumatic fever/ heart disease patients from the **Northern Province** were severe. Six, (40%), of these came from Pietersburg while 2 (13.3%) each presented from Potgietersrus, Tzaneen and Gazankulu. This suggests that these are possible rheumatic fever problem areas.(See Table 3.2.1. page 46 and Table 6.2. page 75)

The observed ratio of severe to non-severe rheumatic fever/ heart disease patients seen in the Northern Province was compared with the expected ratio, (162:331 = 0.489), and tested for a significant difference using the Chi-Square Test for Goodness of Fit. A significantly higher than expected ratio was obtained on analysis of this Province. Pietersburg, Tzaneen and Gazankulu showed an as expected ratio while Potgietersrus demonstrated a higher than expected ratio. The numbers of patients seen from these subdivisions were, however, too small to draw certain significance from. (See Table 3.2.2. pages 48 and 50) A similar analysis was applied to all the following areas.



RHD = Rheumatic fever/ heart disease.

Figure 3.1.2. Map of Gauteng showing the relative ratio of rheumatic fever/ heart disease to congenital heart disease patients seen in various areas



RHD = Rheumatic fever/ heart disease.

Figure 3.1.1. Map with provincial divisions of South Africa, showing the relative ratios of rheumatic fever/ heart disease to congenital heart disease patients seen from various areas.

3.1.4 Summary

Northern Province, Kwa-Zulu Natal, Mpumalanga and the Eastern Cape appear to have a problem with rheumatic fever/ heart disease as the ratio of rheumatic fever/ heart disease to congenital heart disease patients seen from these areas was significantly higher than expected. They were thus identified as priority areas.(See Figure 3.1.1. page 43)

Gauteng has a significantly lower than expected ratio of rheumatic fever/ heart disease to congenital heart disease patients seen, suggesting a relatively low risk of rheumatic fever/ heart disease in this Province as a whole. Although rheumatic fever does not appear to be a significant problem in Gauteng, there are areas within this Province that were identified as priority areas on the basis of higher than expected ratios. These include; Evaton and possibly Heidelburg, Walkerville and Orange Farm in Gauteng south and Kwa-Thema and possibly Duduza and Tsakane in Gauteng east. Johannesburg centre and north, south and west as well as the Eastern suburbs north of the M2 and Alberton had a lower than expected ratio of rheumatic fever/ heart disease patients seen suggesting that rheumatic fever is relatively less of a problem in those areas.(See Figure 3.1.2. page 44)

Thus we can accept the first alternate hypothesis that **there is a difference in the ratio of rheumatic fever/ heart disease to congenital heart disease patients seen from different geographic areas.**

Fourteen (36,8%) of the 38 rheumatic fever/ heart disease sufferers seen from **Gauteng east** were from Katlehong and the Natalspruit Hospital. Thokosa, Eden Park, Palm Springs and Pholo Park contributed 6 (9.4%), Tsakane 5 (13.2%), Kwa-Thema 3 and Benoni, Actonville and Wattville, 3 (7.9%) rheumatic fever/ heart disease patients from this area. Katlehong and the Natalspruit Hospital also contributed most of the congenital heart disease patients seen from Gauteng east viz. 73/285 (25.6%). Twenty eight (9.8%) congenital heart disease patients presented each from Thokosa and from Boksburg. (See Table 6.1.5. page 72)

As a whole Gauteng east showed an as expected ratio of rheumatic fever/ heart disease to congenital heart disease patients seen. The analysis of its subdivisions was complicated by the fact that numbers were small in many of the areas. A significantly lower than expected ratio, was found in the combined analysis of Boksburg, Brakpan and Springs and Edenvale, Bedfordview and Germiston. When Alberton and Daveyton were added for further analysis the ratio remained significantly less than expected. Kwa-Thema showed a higher than expected ratio but the numbers were small. When combined with Duduza and then with Tsakane and Duduza the ratio remained higher than expected but the numbers remained small. With the further addition of Thokosa or Vosloorus the ratio remained significantly high. However when Thokosa was analysed alone and when Tsakane, Duduza and Vosloorus were assessed in combination, without the addition of Kwa-Thema, the ratio was as expected. Katlehong and Thokosa showed as expected ratios when analysed individually. This suggests that the priority areas for rheumatic fever intervention in the Gauteng east are Kwa-Thema and possibly Duduza and Tsakane. (See Table 3.1.3. page 35 and 38)

3.1.3. Out of South Africa

Thirty nine of the patients seen (1.9%) were from outside of South Africa. (See Table 3.1.1. page 31) Of these 5 were rheumatic fever/ heart disease sufferers. This represented an as expected ratio of rheumatic fever/ heart disease to congenital heart disease patients seen.(See Table 3.1.3. page 35) The main countries referring paediatric cardiac patients to Gauteng teaching hospitals are Lesotho (8), Mozambique (7), Zimbabwe (6) and Swaziland (5). (See Table 6.1.9. page 74)

Although the Government's Reconstruction and Development Programme has begun to improve living conditions in some areas, little progress has been made in the provision of housing.[54] Northern Province has the highest number of informal rural houses.[55] The Eastern Cape and Kwa-Zulu Natal also have high percentages of informal rural housing and impressive housing shortages. Mpumalanga, identified along with the Northern Province, as being at high-risk for both a high prevalence of rheumatic fever/ heart disease and more severe disease, has the highest percentage of informal urban housing. Gauteng has the highest percentage of formal urban housing.[55] (See Table 4.2 page 64)

Table 4.2 The housing situation in 1994 in the provinces referring rheumatic fever/ heart disease patients to three Gauteng teaching hospitals.

Province	Population 1994	Formal Urban %	Informal Urban %	Informal Rural %	Units Needed
N. Province	5 120 560	7,24	6,19	86,56	54326
Kwa-Zulu Natal	8 548 972	32,32	17,62	50,06	300423
Mpumalanga	2 838 466	36,03	29,52	34,43	24286
Eastern Cape	6 656 363	20,88	20,14	58,98	149398
Free State	2 804 599	54,03	22,34	23,63	77221
North-West	3 506 770	19,13	17,86	63,01	85912
Gauteng	6 846 969	72,67	25,19	2,14	561873

[55]

Several areas within Gauteng have been highlighted as high-risk areas. Gauteng has the second highest percentage of informal urban houses as well as the highest number of housing units needed. (See Table 4.2 above) The high-risk areas within Gauteng contain informal settlements and shanty towns. In 1987 the observation was made that there are more shacks than conventional houses in Evaton.[56] Kwa-Thema, Tsakane, Katlehong[56] and Orange Farm are also known for their shacks, squatters and congested living conditions. Sebokeng, although a relatively modern township, has been noted for its problem of overpopulation.[56] The low-risk areas within Gauteng are made up of predominantly urban housing with fewer people per house and larger properties. They are made up mainly of the previously White and more affluent areas of Johannesburg, the eastern suburbs and Sandton. Thus not only housing quality as a socio-economic indicator but also crowding appears to be related to the problem of rheumatic fever. Overcrowding has previously been recognised as an important factor in the incidence of rheumatic fever.[2,3,23,24]

The study has also looked at the severity of rheumatic fever/ heart disease seen in patients from differing geographic origins. The severity of the patients seen is highlighted by the fact that 32.9% required surgical intervention or balloon valvuloplasty. The Gauteng severity rate was 34.8% while a figure of 51% was obtained for patients originating from outside Gauteng. Previously reported severity rates in hospital admissions in South Africa were 6.5%,[42] 4.3%[43] and 21%,[20] suggesting that the disease may have become more severe. It is accepted that differing socio-political factors, changes in medical practices and expertise, timing of surgical intervention and changes in technology over the years may well make these comparisons difficult. The mortality rate for the Johannesburg and Coronation Hospitals combined was 1.94% and is probably higher than this if the Baragwanath data were added.

Areas with differing ratios of severe to non-severe rheumatic fever/ heart disease cases seen have been shown. Those with a significantly higher than expected ratio have been identified as being at high risk for more severe rheumatic fever/ heart disease. They include:- The Northern Province, Mpumalanga, Gauteng south especially Vanderbijl Park, Vereeniging, Sebokeng and Evaton, and Kwa-Thema, Tsakane and possibly Katlehong in Gauteng east. A significantly lower than expected ratio was found in Gauteng centre and especially Johannesburg centre and Eldorado Park, suggesting that less severe disease is found in these areas.

The high and low-risk areas identified above will now be examined in an attempt to find causative factors that can be remedied or minimized in the high-risk areas as a first step in the fight against rheumatic fever.

South African children experience potentially damaging circumstances that originate from the large scale social changes that have occurred in the country. Families have been disorganised secondary to the major impact of migrant labour, influx control, homeland policies and other apartheid policies, poverty, lack of housing and societal violence.[53]

The largest rural populations in South Africa are found in the Northern Province, Kwa-Zulu Natal and the Eastern Cape.[54] These areas were highlighted as rheumatic fever problem areas. Gauteng, identified as a low-risk area, has the largest urban and metropolitan population.[54] (See Table 4.2 page 64) Thus rheumatic fever and heart disease can be seen as a rural problem in South Africa. This is supported by the findings of Prinsloo[43] that 2/3 of the rheumatic fever patients seen at Kalafong Hospital were from the rural areas.

Despite these limitations this study does give some idea of the magnitude of the problem in the referral communities.[18] A better insight into areas at high risk for a high prevalence of rheumatic fever/ heart disease and a high risk for severe rheumatic fever/ heart disease has thus been obtained. Also, as far as could be ascertained, this type of examination has not been done before in South Africa and important information regarding referral patterns has been gained. This has important financial implications in the current economic climate where the budgets of the teaching hospitals are being cut.

This study has clearly shown that a large proportion of the workload of the three paediatric teaching hospitals of the University of the Witwatersrand is derived from patients outside Gauteng's borders. Of the congenital heart disease cases seen, 17.2% were not from Gauteng and 32.7% of the rheumatic heart disease patient seen were from outside Gauteng and 51% of these required surgical intervention or balloon valvuloplasty. The non-Gauteng congenital heart disease patients seen were predominantly from the North-West Province while the non-Gauteng rheumatic fever/ heart disease patients seen were mainly from the Northern Province, North-West Province and Mpumalanga.

The study has identified areas with differing ratios of rheumatic fever/ heart disease to congenital heart disease patients seen. The following areas have been identified as being at high risk for a high prevalance rheumatic fever on the basis of a significantly higher than expected ratio:- Kwa-Zulu Natal, Northern Province, Mpumalanga, Eastern Cape, the Evaton, Walkerville, Heidelburg and Orange Farm areas in Gauteng South and Kwa-Thema, Tsakane and Duduza in Gauteng East.

A significantly lower than expected ratio was detected in Gauteng central and in Johannesburg south, west and centre and north within Gauteng central. North-eastern Gauteng north and the eastern suburbs north of the M2 and Alberton in Gauteng east also showed a significantly lower than expected ratio. This implies that these regions have relatively less of a problem of rheumatic fever/ heart disease. An as expected ratio was found in Soweto and in its subdivisions. This is in accordance with the findings of McLaren et al[24] who found no relationship between home or school area and the prevalence of rheumatic heart disease within Soweto.

Has the fact that this study was undertaken in three Government teaching hospitals affected the results? Are we not more likely to see rheumatic fever/ heart disease patients in a Government hospital in view of the socio-economic nature of the disease? As congenital heart disease is not affected greatly by socio-economic status, is not the population of congenital heart disease patients seen going to be spread across both the private and Government hospitals as some families will have medical aids or be able to afford the private medical costs? This would affect the ratio of rheumatic fever/ heart disease to congenital heart disease patients seen towards a higher ratio particularly among the patients seen from more affluent areas.

Only 60.7% of the congenital heart disease sufferers and 63.3% of the rheumatic fever/ heart disease patients had documented addresses. The information not obtained from those patients without known addresses may also have biased the results. This study looked at patients seen at three teaching hospitals of the University of the Witwatersrand only. The figures for the Free State and the Eastern Cape were small. A more complete picture of the problem within Gauteng could be obtained by studying the geographic origins and the severity of rheumatic fever/ heart disease presenting at the teaching hospitals of the University of Pretoria and Medunsa. Regarding the other provinces, data collected in all the provinces should be combined to get the true South African picture.

The Chi-Square analysis for Goodness of Fit was used and in the cases of severe disease many of the cells contained small numbers. The results from these cells are less reliable than those from cells containing more patients,[51] as discussed in section 2.5 Data Analysis pages 28 and 29. With a bigger sample more accurate results could have been obtained. This constraint applies to most statistical tests used. Alternatively the Kolmogorov test may have been preferred as it is exact even for small samples.[51]

The study is limited by the fact that it is not population based. It attempts to highlight areas with a high prevalence of rheumatic fever/ heart disease in the absence of reliable population figures. In an attempt to eliminate the need for a true population base the comparison of the ratios of rheumatic fever/ heart disease patients to congenital heart disease sufferers seen is used. A significantly higher than expected ratio is interpreted as suggestive of a relatively higher prevalence of rheumatic fever within that area. Several factors relating to differing diagnostic, therapeutic and referral practices within different centres complicate the issue, as has been discussed, and thus no conclusions about the actual prevalence of the disease in the strictest sense of the word can be drawn from the study.

The study is retrospective and referral-centre based. Hospital admission rates of a given disease usually only represent a fraction of its true prevalence in the community[6] and a whole host factors can bias hospital statistics.[6] Here every effort was made to ensure that the databases used were accurate and as complete as possible.

No information can be gained regarding the prevalence of asymptomatic disease in the areas referring to the study hospitals. Also, we have no information about the numbers of patients with rheumatic heart disease or congenital heart disease seen at medical institutions within their areas of origin.

Of the rheumatic fever/ heart disease patients seen from outside Gauteng, 51% were severe while 32.7% of those from Gauteng were severe. This suggests that more severe disease may be seen in the areas beyond the borders of Gauteng. However it is only the very sick that are likely to be referred to the tertiary academic centres. The less ill are looked after at peripheral hospitals.[42]

Surgery for congenital heart disease is complex and requires expertise. The more complicated cases are likely to be referred to the Johannesburg Hospital for surgery where surgeons experienced in congenital heart disease surgery practice. Some peripheral hospitals are able to perform closed mitral surgery[4] and would be able to manage some of their severe rheumatic heart disease patients. However mitral stenosis takes time to develop and only contributed a small proportion of the paediatric rheumatic fever/ heart disease population studied. Thus the affect of this on reducing the number of severe rheumatic heart disease patients referred would be minimal. Some referral hospitals such as Wentworth Hospital in Kwa-Zulu Natal and H.F. Verwoed Hospital in Pretoria have tertiary care facilities for mitral valve surgery. Only the less complicated congenital heart disease surgery is done in these centres. Collectively, these factors would reduce the number of severe rheumatic fever patients referred from these hospitals and from their referral bases to the study hospitals and may bias the ratio of rheumatic fever/ heart disease to congenital heart disease patients seen from the peripheral areas towards a lower ratio. It would also affect the ratio of severe to non-severe patients seen from those areas towards more severe disease.

Given all the above limitations, the incidence rate of congenital heart disease does not appear to vary significantly in different ethnic groups or from country to country,[1,52] and has not increased over the last 30 years. Also, congenital heart disease is responsible for about two thirds of all heart disease in children.[43]

Most infants born with congenital heart disease do not die in infancy. A third, or about 2.6/1000 live births have critical disease. Three decades ago the majority of these infants died within a year of life and two thirds died in the first month.[2] Within the disadvantaged areas of South Africa these patients may well die before being referred to a tertiary hospital. Examples are patients with critical aortic stenosis and severe cyanotic heart disease e.g. transposition of the great arteries.[42] As rheumatic fever affects older children, who generally do not die before referral, the data from the rural areas may well be skewed on this basis towards a higher than expected ratio of rheumatic fever/ heart disease to congenital heart disease sufferers seen.

Interestingly, only 17.2% of the congenital heart disease patients seen were from outside Gauteng while 32.7% of the rheumatic fever/ heart disease patients were not from Gauteng. Possibly less severe congenital heart disease is being picked up more easily in Gauteng with the availability of sophisticated diagnostic colour doppler echocardiography. Examples include mild pulmonary stenosis and small ventricular septal defects. In the rural areas these lesions would probably not be detected, or if detected would not be referred to a tertiary hospital as the children would be asymptomatic. This may partially explain the higher ratio of rheumatic fever/ heart disease patients to congenital heart disease seen from the areas outside of Gauteng.

Some diagnoses are more obvious e.g. hyper-cyanotic spells or cardiac failure and so patients with these problems are more likely to be detected in the rural areas. The medical staff referring patients with congenital heart disease and rheumatic heart disease from the different areas are the same however. Thus the quality of the referral, appropriate or not so, would have been controlled for to some extent.

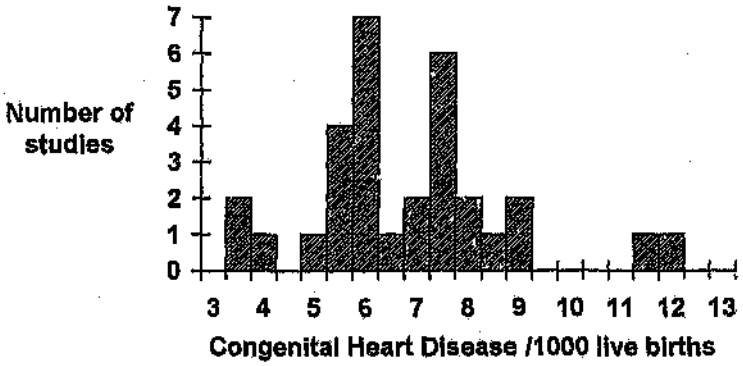


Figure 4.1 Histogram of the incidence of congenital heart disease per 1000 live births taken from the data in Table 4.1[1,52]

The method of detection and diagnosis[52] used and who makes the assessment will also affect incidence figures, (cardiac catheterisation and echocardiography by an experienced paediatric cardiologist being the gold standard). By virtue of how and when they present, some lesions are more likely to be detected than others. This is particularly important in South Africa as the first care giver may be a traditional healer, a primary health care sister, a general practitioner or a paediatrician or a child in a rural area may die before receiving any medical attention at all.

Unfortunately the incidence of congenital heart disease in underdeveloped countries is not known.[52] There is little data on the relative incidence of congenital heart disease in indigenous racial groups in Australia, Asia, North America, Greenland and Africa as intensive population studies have not been done in these areas. A study done in Guadeloupe is an exception and reported an incidence of 6.08/1000 live births. (See Table 4.1 page 57) In 1981 Professor S. E. Levin[42] published a study done over 10 years where he calculated the incidence of congenital heart disease at 7.5/1000 live births for Johannesburg.

Table 4.1 Incidence of congenital heart disease in live born infants continued.

Years of birth	Place of study	Total live births	Total CHD	CHD/1000 live births
1976-80	Czechoslavakia	203 000	1 279	6,30
1976-85	Oviedo, Spain	53 578	279	5,21
1979-83	Tyrol, Austria	41 726	341	8,17
1979-8[illegible]	Bas-Rhin, France	105 374	80[illegible]	7,60
1980	Czechoslovakia	91 823	589	6,41
1981	Sweden	94 778	853	9,00
1981-82	Baltimore, Washington	368 889	1 494	4,05
1981-84	Alberta, Canada	103 411	573	5,54
1981-87	Czechoslovakia	61 420	480	7,82
1982-88	Vestfold Co, Norway	15 307	138	9,02
1986-87	Hainaut, Belgium	17 647	13[illegible]	7,48
1988-90	Guadeloupe	22 855	139	6,08

CHD=Congenital Heart Disease (1,52)

Table 4.1 Incidence of congenital heart disease in live born infants.

Years of birth	Place of study	Total live births	Total CHD	CHD/1000 live births
1941-50	Gothenburg, Sweden	58 105	363	6,25
1946-53	New York City	5 628	43	7,64
1950-69	Olmsted, Minnesota	32 393	186	5,74
1951-60	Gothenburg, Sweden	58 314	450	7,72
1952-61	Uppsala, Sweden	48 800	291	6,00
1956-65	United States	54 765	420	3,99
1958	Leiden, Netherlands	1 817	15	8,25
1957-71	Blackpool, England	56 982	338	5,95
1959-66	Northern California	19 044	163	8,56
1960-69	Liverpool, England	160 480	884	5,51
1963-73	Denmark	854 886	5 249	6,14
1963-65	Budapest, Hungary	52 982	373	7,10
1963-65	Szolnok, Hungary	5 644	67	11,87
1955-69	Pecs, Baranya, Hungary	97 482	744	7,63
1969-77	New England, USA	179 697	664	3,70
1971-84	Dallas, Texas	379 561	2 509	6,61
1975	Switzerland	78 464	494	6,30
1975-84	Florence, Italy	46 895	579	12,35

CHD = Congenital Heart Disease

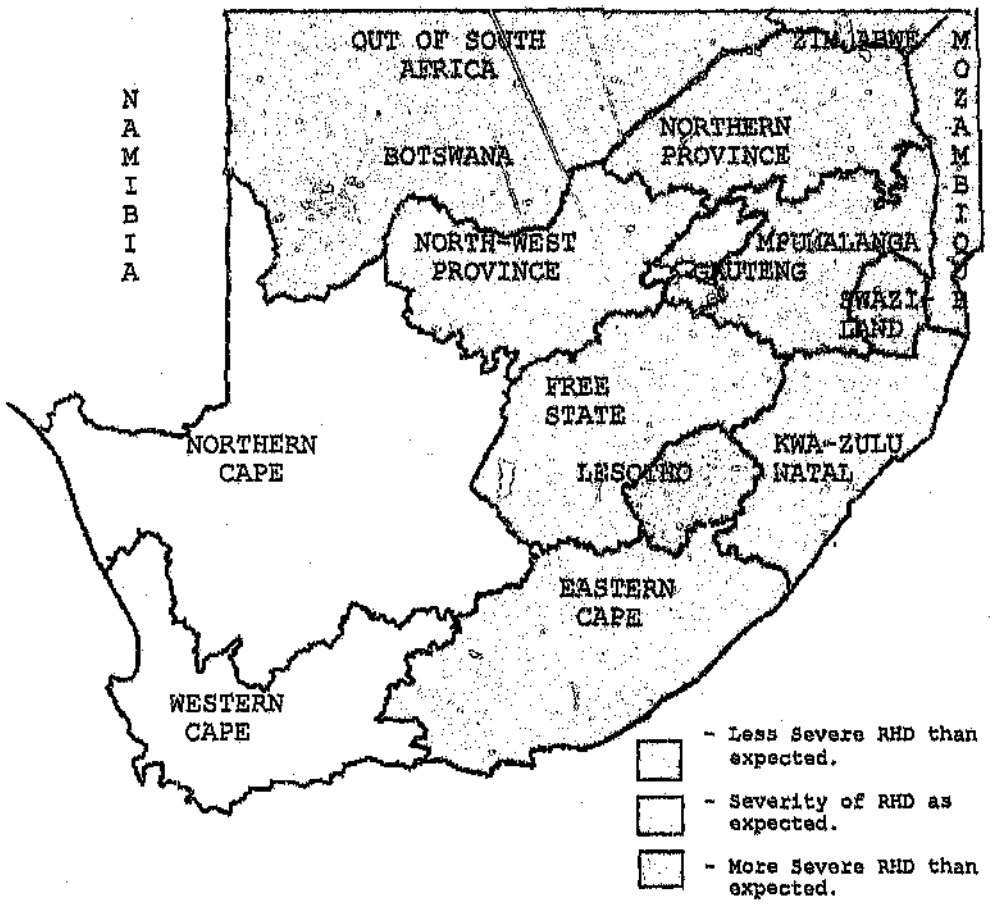
4. DISCUSSION:

This study was undertaken in an attempt to document the problem of rheumatic fever/ heart disease seen in three paediatric teaching hospitals of the University of the Witwatersrand. A profile of the geographic origins of the patients with rheumatic fever/ heart disease and those with congenital heart disease, as the control group, has been presented. An attempt to highlight areas with a high risk for a high prevalence of rheumatic fever/ heart disease or for more severe disease has been made.

The highlighted areas will be examined in an attempt to identify causative factors. First, however, we must consider the validity of the study design and draw attention to interfering variables that may be affecting the results.

Areas with a problem of rheumatic fever/ heart disease were identified on the basis of a significantly higher than expected ratio of rheumatic fever/ heart disease patients to congenital heart disease patients seen. This was based on the premise that "the prevalence of congenital heart disease has been remarkably constant throughout the world and over the years."[1] How valid is this premise? Hoffman[b2] and Flyer[1] have looked at the incidence of congenital heart disease in several world-wide studies. The details of some of these studies and their reported incidences of congenital heart disease are shown in Table 4.1 page 56 and 57. The histogram derived from the data in this table is shown in Figure 4.1 page 58. Hoffman[b2] concluded that in the Western World the true incidence of congenital heart disease is about 10/1000 live births, with a range from 3-5/1000 in earlier studies, to 4-12/1000 in later studies. Most of the lower incidence figures noted on Table 4.1. pages 56 and 57 were obtained before specialised paediatric cardiologists were trained and before the advent of echocardiography with colour doppler flow measurements made it possible to diagnose minor or asymptomatic lesions.

For accurate assessment of these incidences there has to be an efficient medical system in place allowing equipped paediatric cardiologists access to the whole population.[b2] Obviously there are countries or regions, e.g. the rural areas in South Africa, where this cannot be achieved.



RHD = Rheumatic fever/ heart disease

Figure 3.2. Map of South Africa showing the areas of origin of the rheumatic fever/ heart disease patients seen related to the observed severity of disease seen from those areas.

Four, (30.8%), of the 13 rheumatic fever/disease patients from **Gauteng north** were severe. This accounted for 5.5% of the severe patients that presented from Gauteng. Two of the severe patients from Gauteng north were from the Honeydew area and Hammanskraal and Tembisa each contributed one severe patient. No severe cases were seen from Randburg, Sandton and Midrand. (See Tables 3.2.1. page 46, 6.1.3 page 71 and 6.2. page 74)

The ratio of severe to non-severe rheumatic fever/ heart disease patients that presented from Gauteng north was as expected. Honeydew, Hammanskraal and Tembisa assessed together also gave an as expected ratio. The numbers are too small in all the calculations for Gauteng north to give reliable results. (See Table 3.2.2. page 48) When Gauteng was analysed with Soweto, (they have similar ratios), the ratio was also as expected.

3.2.3. Out of South Africa

Four of the 5, (80%), rheumatic fever/ heart disease patients seen from out of South Africa were severe. Two of these were from Mozambique, one from Burundi and one from Zimbabwe. The ratio of severe to non-severe patients was higher than expected but the numbers were small. (See Table 6.2. page 75 and Table 3.2.2. page 48)

3.2.4. Summary

The ratio of severe to non-severe rheumatic fever/ heart disease was significantly higher than expected in the patients from the Northern Province and Mpumalanga implying a problem with severe disease in these areas. (See Figure 3.2 page 54)

Within Gauteng, a higher than expected ratio was found in Gauteng south suggesting a problem of severe rheumatic fever/ heart disease in this area particularly in Vanderbijl Park, Vereeniging, Sebokeng and Evaton. Soweto, Gauteng west, north and east all showed an as expected degree of severe disease. Despite this Kwa-Thema, Tsakane and possibly Katlehong were identified as areas possibly producing more severe rheumatic fever. Gauteng centre showed a lower than expected ratio suggesting that less severe disease is seen from there, especially from central Johannesburg and Eldorado Park. (See Figure 3.2 page 54)

Thus we can accept the second alternate hypothesis that **there is a difference in the ratio of severe to non-severe rheumatic fever/ heart disease patients seen from different geographic areas.**

B. Rap song, an example of a simple and inexpensive health education method.

RHEUMATIC FEVER SUFFERERS

Rheumatic fever sufferers of the world unite
Against this disease we gonna fight
Yeah, we gonna get it right
A jab in the bum ain't such a bite
Come on guys lets get it right

It licks the knees and bites the heart
But we'll stop it now, right from the start
We'll stop it now, with this little dart
Three weekly you know, because we're smart

Hey man, we don't need no hammer
We just need this little jabber
Three weekly till we're about twenty
That'll keep us going for years a plenty

Rheumatic fever sufferers of the world unite
Against this disease we gonna fight
Yeah, we gonna get it right
A jab in the bum ain't such a bite
Come on guys lets get it right

Sally-Ann Clur 1994

Table 6.2. Severe Rheumatic fever/ heart disease patients seen from January 1993 to December 1995 with areas of origin continued.

ORIGIN	CORONATION HOSPITAL	JOHANNESBURG HOSPITAL	BARAGWANATH HOSPITAL	TOTAL
G1013	0	0	1	1
G1101	0	1	0	1
G1102	2	1	1	4
G1103	0	2	0	2
G1105	0	0	2	2
G1107	0	0	1	1
G1201	1	1	0	2
G1205	0	1	0	1
G1300	0	1	6	7
G1302	0	0	1	1
G1303	0	0	2	2
G1305	0	0	1	1
G1307	0	0	2	2
G1310	0	0	1	1
G1601	0	1	0	1
NP1401	1	5	0	6
NP1402	0	2	0	2
NP1404	0	0	2	2
NP1405	0	0	1	1
NP1406	0	0	1	1
NP1407	0	1	1	2
NP1410	0	0	1	1
NW1402	0	0	1	1
NW1403	0	0	1	1
NW1404	0	0	4	4
NW1407	0	1	0	1
NW1408	0	1	0	1
FREE STATE	0	1	1	2
MPUMALANGA	0	3	7	10
TRANSKEI	0	2	4	6
KWA-ZULU NATAL	0	5	2	7
MOZAMBIQUE	0	1	1	2
ZIMBABWE	0	1	0	1
BURUNDI	0	1	0	1
UNKNOWN	0	3	34	37
TOTAL	8	45	109	162

Table 6.1.9. Rheumatic fever/ heart disease patients and Controls seen from January 1993 to December 1995 that originated from outside South Africa.

Origin	RHD Coro	RHD JHB	RHD Bara	RHD Total	CHD Coro	CHD JHB	CHD Bara	CHD Total
Angola	0	0	0	0	1	1	0	2
Burundi	0	1	0	1	0	0	0	0
Botswana	0	0	0	0	0	2	0	2
Israel	0	0	0	0	0	1	0	1
Lesotho	1	0	0	1	2	0	5	7
Malawi	0	0	0	0	1	2	0	3
Mozambique	0	1	1	2	2	0	3	5
Swaziland	0	0	0	0	0	3	2	5
Tanzania	0	0	0	0	0	1	0	1
Zaire	0	0	0	0	1	0	1	2
Zambia	0	0	0	0	0	1	0	1
Zimbabwe	0	1	0	1	0	3	2	5
Total	1	3	1	5	7	14	13	34

RHD=Rheumatic fever/ heart disease, CHD=Congenital Heart disease, Coro=Coronation Hospital Bara=Baragwanath Hospital and JHB=Johannesburg Hospital.

Table 6.2. Severe Rheumatic fever/ heart disease patients seen from January 1993 to December 1995 with areas of origin.

ORIGIN	CORONATION HOSPITAL	JOHANNESBURG HOSPITAL	BARAGWANATH HOSPITAL	TOTAL
G0600	1	0	1	2
G0800	3	2	1	6
G0902	0	0	1	1
G0903	0	0	6	6
G0904	0	2	1	3
G0907	0	0	1	1
G0908	0	1	2	3
G0909	0	1	3	4
G0910	0	0	5	5
G1005	0	1	1	2
G1006	0	2	5	7
G1009	0	0	1	1
G1012	0	1	2	3

Table 6.1.7 Rheumatic fever/ heart disease patients and Controls seen from January 1993 to December 1995 that originated from the North-West Province.

Area Code	RHD Coro	RHD JHB	RHD Bara	RHD Total	CHD Coro	CHD JHB	CHD Bara	CHD Total
NW1400	1	0	3	4	0	1	33	34
NW1401	0	0	0	0	2	4	6	12
NW1402	2	0	1	5	1	4	1	6
NW1403	0	0	3	3	1	5	12	18
NW1404	0	0	7	7	1	16	17	34
NW1405	0	0	0	0	0	0	2	2
NW1406	0	0	0	0	0	1	0	1
NW1407	0	2	0	2	0	4	1	5
NW1408	0	1	0	1	1	2	6	9
NW1409	0	0	0	0	0	0	1	1
Total	3	3	14	20	6	37	79	122

Table 6.1.8 Rheumatic fever/ heart disease patients and Controls seen from January 1993 to December 1995 that originated from the Northern Province.

Area Code	RHD Coro	RHD JHB	RHD Bara	RHD Total	CHD Coro	CHD JHB	CHD Bara	CHD Total
NP1400	0	1	0	1	0	1	0	1
NP1401	2	7	2	11	0	3	2	5
NP1402	1	2	0	3	0	1	1	2
NP1404	0	0	4	4	0	1	1	2
NP1405	0	0	2	2	0	0	0	0
NP1406	0	1	1	2	0	1	8	9
NP1407	0	1	1	2	0	1	4	5
NP1408	0	0	1	1	0	2	0	2
NP1409	0	0	2	2	0	1	0	1
NP1410	0	0	0	0	0	1	0	1
NP1411	0	1	0	1	0	0	0	0
NP1412	0	0	1	1	0	0	4	4
Total	3	13	14	30	0	12	20	32

RHD=Rheumatic fever/ heart disease, CHD=Congenital Heart disease, Coro=Coronation Hospital, Bara=Baragwanath Hospital and JHB=Johannesburg Hospital.

Table 6.1.5. Rheumatic fever/ heart disease patients and Controls seen from January 1993 to December 1995 that originated from Gauteng East.

Area Code	RHD Coro	RHD JHB	RHD Bara	RHD Total	CHD Coro	CHD JHB	CHD Bara	CHD Total
G1001	0	0	0	0	2	11	0	13
G1002	0	0	0	0	2	1	4	7
G1003	0	0	0	0	1	17	1	19
G1004	0	1	[illegible]	1	0	13	1	14
G1005	0	1	5	6	0	1	27	28
G1006	0	2	12	14	0	2	71	73
G1007	0	1	1	2	0	2	10	12
G1008	0	0	0	0	7	16	5	28
G1009	1	1	1	3	0	15	2	17
G1010	0	0	0	0	0	14	1	15
G1011	0	0	0	0	1	11	1	13
G1012	0	1	2	3	0	4	0	4
G1013	0	0	2	2	1	9	14	24
G0904	0	3	2	5	0	8	6	14
G0905	0	0	2	2	0	2	2	4
Total	1	10	27	38	14	126	145	285

Table 6.1.6. Rheumatic fever/ heart disease patients and Controls seen from January 1993 to December 1995 that originated from Gauteng West.

Area Code	RHD Coro	RHD JHB	RHD Bara	RHD Total	CHD Coro	CHD JHB	CHD Bara	CHD Total
G1100	0	0	0	0	4	0	0	4
G1101	2	2	0	4	6	8	7	21
G1102	3	1	1	5	7	16	3	26
G1103	3	2	1	6	8	10	1	19
G1104	0	0	1	1	12	2	11	25
G1105	0	0	2	2	3	1	5	9
G1106	0	0	0	0	0	1	1	2
G1107	0	0	1	1	1	2	11	14
Total	8	5	6	19	41	40	39	120

RHD=Rheumatic fever/ heart disease, CHD=Congenital Heart disease, Coro=Coronation Hospital, Bara=Baragwanath Hospital and JHB=Johannesburg Hospital.

Table 6.1.3. Rheumatic fever/ heart disease patients and Controls seen from January 1993 to December 1995 that originated from Gauteng North.

Area Code	RHD Coro	RHD JHB	RHD Bara	RHD Total	CHD Coro	CHD JHB	CHD Bara	CHD Total
G1201	3	1	0	4	12	3	4	19
G1202	2	1	0	3	9	11	0	20
G1203	0	1	0	1	1	17	0	18
G1204	.	1	0	1	0	2	0	2
G1205	0	1	1	2	1	5	5	11
G1206	0	0	0	0	2	17	1	20
G1207	0	0	0	0	0	0	0	0
G1208	0	0	0	0	0	1	1	2
G1209	0	0	0	0	0	1	1	2
G1600	0	0	0	0	0	7	2	9
G1601	0	2	0	2	0	3	.	3
G1602	0	0	0	0	0	5	0	5
G1603	0	0	0	0	0	0	2	2
G1604	0	0	0	0	0	1	0	1
G1605	0	0	0	0	0	3	0	3
Total	5	7	1	13	25	76	17	117

Table 6.1.4 Rheumatic fever/ heart disease patients and Controls seen from January 1993 to December 1995 that originated from Gauteng South.

Area Code	RHD Coro	RHD JHB	RHD Bara	RHD Total	CHD Coro	CHD JHB	CHD Bara	CHD Total
G0901	0	0	0	0	0	1	2	3
G0902	0	0	4	4	0	1	9	10
G0903	0	0	10	10	0	0	19	19
G0906	0	0	0	0	1	4	3	8
G0907	0	0	3	3	1	0	4	5
G0908	1	1	2	4	1	12	17	30
G0909	0	1	4	5	0	6	8	14
G0910	0	0	9	9	1	1	40	42
G0911	0	0	0	0	12	1	2	15
G0912	0	0	2	2	1	0	3	4
G0915	0	0	0	0	0	0	3	3
Total	1	2	34	37	17	26	110	153

RHD=Rheumatic fever/ heart disease, CHD=Congenital Heart disease, Coro=Coronation Hospital, Bara=Baragwanath Hospital and JHB=Johannesburg Hospital.

6. APPENDICES:

A. Tables of raw data referred to in the text.

Table 6.1.1 Rheumatic fever/ heart disease patients and Controls seen from January 1993 to December 1995 that originated from Gauteng Central.

Area Code	RHD Coro	RHD JHB	RHD Bara	RHD Total	CHD Coro	CHD JHB	CHD Bara	CHD Total
G0100	7	0	0	7	69	25	0	94
G0200	0	0	2	2	7	1	0	8
G0300	1	0	0	1	8	2	0	10
G0500	12	0	0	12	42	3	1	46
G0600	3	1	0	4	23	6	5	34
G0700	2	5	1	8	33	106	27	166
G0800	3	8	1	12	4	47	9	60
G0900	0	1	0	1	2	28	4	34
Total	28	15	4	47	188	218	46	452

Table 6.1.2 Rheumatic fever/ heart disease patients and Controls seen from January 1993 to December 1995 that originated from Soweto.

Area Code	RHD Coro	RHD JHB	RHD Bara	RHD Total	CHD Coro	CHD JHB	CHD Bara	CHD Total
G1300	0	1	25	26	0	11	95	106
G1301	0	0	4	4	2	0	16	18
G1302	0	0	2	2	0	0	12	12
G1303	0	0	5	5	0	2	29	31
G1304	0	0	1	1	0	0	12	12
G1305	0	0	2	2	0	0	18	18
G1306	0	0	1	1	0	0	5	6
G1307	0	0	6	6	1	1	34	36
G1308	1	0	4	5	0	0	37	37
G1309	0	0	0	0	0	0	18	18
G1310	0	0	2	2	0	1	1	2
G0100	1	0	1	2	15	3	7	25
Total	2	1	53	56	18	18	284	320

RHD=Rheumatic fever/ heart disease, CHD=Congenital Heart disease, Coro=Coronation Hospital, JHB=Johannesburg Hospital and Bara=Baragwanath Hospital.

5.CONCLUSIONS:

"Rheumatic heart disease remains a formidable health challenge" in South Africa.[24] The disease is severe and often requires surgical intervention at a young age. This study has documented the referral patterns to the paediatric teaching hospitals of the University of the Witwatersrand and has shown the workload these hospitals carry.

It has also highlighted areas with differing ratios of rheumatic fever/ heart disease to congenital heart disease patients seen and differing ratios of severe to non-severe rheumatic fever/ heart disease sufferers seen. From these, areas at high risk for a high prevalence of rheumatic fever and for severe disease were identified. Poverty, rural existence, inadequate housing, social disruption and poor availability of health care appear to be related to rheumatic fever prevalence and severity. Further studies are needed to confirm the problem within the identified priority areas and to evaluate the relative roles of these associated factors within these areas.

Effective preventative programmes need to be initiated urgently to combat the disease. These programmes will be cheaper in the long run than the surgical and medical treatment of those patients who have established rheumatic heart disease. However, South Africa has an immediate and considerable number of severe rheumatic heart disease sufferers in need of academic/tertiary care. Effective preventative programmes take time to initiate and implement. Once functional, referrals to second and third tier hospitals may well increase secondary to earlier and better detection of disease. Also more congenital heart disease is likely to be detected and so the need for tertiary care will be ongoing. Thus, funds must be available to sustain primary, secondary and tertiary care for these patients in the foreseeable future.

Regarding rheumatic fever and heart disease alone, the Gauteng health budget should not be cut. The allocation of funds for tertiary care should be based on the number of patients seen in an area and the services offered, rather than simply on the basis of a per capita expenditure per province. The latter could be the basis for primary health care funding. Alternatively the Government must decide to accept the less desirable, much higher morbidity and mortality from rheumatic heart disease and prevent referrals from outside Gauteng to the Gauteng tertiary hospitals.

Sally-Ann Barker Clur

The root causes of rheumatic fever need to be addressed to combat the disease.[14] Reduction of poverty, job creation and social upliftment takes time to happen.[12,14] Few developing countries can expect much immediate change in socio-economic conditions.[4,12] Thus, **the emphasis must be on direct medical approaches to rheumatic fever.**[9,14] A comprehensive primary health care system is urgently needed in South Africa to deal with primary and secondary prophylaxis of rheumatic fever to reduce the incidence of the disease in communities affected and to reduce an individual's susceptibility to further attacks. Unfortunately rheumatic fever has to compete for limited resources with other more immediate and urgent health care needs such as HIV, malnutrition, gastroenteritis and Tuberculosis.[18]

A national plan for action is needed[9,14] co-ordinated by a multidisciplinary advisory committee with specific targets, activities and ongoing self-evaluation. Objectives should be time based, focusing on identified priority areas first and working through existing primary health care facilities.[9,17] Activities can be extended in realistic stages until national cover is achieved.[9] Improved communication between the different level caregivers is essential.[9,11,14]

The lack of patient compliance continues to plague most secondary prophylaxis programmes.[9,14,38] This problem has been clearly shown in the works of Van Dyk and Tranfic,[18] Edginton and Gear,[20] and Ransome and Rhoode[32] In the last two studies mentioned, only 17% and 48% of patients respectively, complied with prophylaxis, when an ideal of 70-75%[9,20] is needed. Methods to overcome compliance problems have to be initiated. This can be achieved through the establishment of a central patient register[9,12,13,14,26,28] and the use of patient identity/record cards.[6,14,26] Defaulting patients can then be identified and efforts made to motivate compliance. This was suggested in 1983[14,26] but secondary to a lack of State co-operation,[14] remains long overdue.

The Government has to balance primary health care, second tier services and tertiary care into a coherent system. Emphasising one of these levels to the detriment of the others will be counter-productive. In the past the over-emphasis on tertiary care resulted in a neglect of primary care. An over-emphasis on primary health care will also be deleterious. In fact, good primary health care will lead to a higher number of referrals to second and third tier hospitals because of earlier and better detection of disease. A reduction in the incidence of rheumatic fever may be balanced by an increased referral of patients with congenital heart disease,[12] a condition grossly under-diagnosed in South Africa at present.

with secondary prophylaxis poor in their series from Coronation Hospital. They suggested that full and co-ordinated use of peripheral primary health care clinics be made to improve this. Eldorado Park has a functional primary health care clinic system and possibly the low severity rate of the disease seen from this area attests to their success with secondary prophylaxis.

In the past the public health services have been biased towards curative hospital-based care with 81% of Government expenditure going to hospitals, 44% of this to tertiary and academic hospitals.[54] Health care expenditure per person was not distributed equitably between the provinces with richer regions getting on average 3.6 times more than the poorer districts.[54]

Primary health care has to be extended and the ANC's health plan[60] makes this a priority, so that basic health services are available to all who need them. To do this some of the funds allocated to hospitals, especially tertiary and teaching hospitals are being re-allocated to primary health care. Dr Zuma, the Minister of Health, has drawn up the National Health Budget according to a formula with population size as the main criterion; the provinces with the highest per capita incomes will receive proportionally less than the provinces with lower per capita incomes to establish a more equitable allocation over a five year period.[54]

This will not help the problem of rheumatic fever and heart disease in the short or long-term. Of the rheumatic fever/ heart disease patients seen in Gauteng, 32.7% were from outside the province and 51% of these were classified as severe. Of those seen at Baragwanath Hospital, 70.2% of rheumatic fever/ heart disease sufferers were not from Soweto. These findings are supported by those of Edginton and Gear[20] who found in their Baragwanth series that 21% of the rheumatic fever/ heart disease patients admitted required invasive intervention and 73% were not from Soweto.

The large number of patients seen at Baragwanath Hospital that were not from Soweto was partially influenced by a directive issued on the 5/3/95 detailing the referral routes to Gauteng's tertiary hospitals. Also, all the outpatients seen in Gauteng make up more than 50% of all outpatients seen in South Africa.[55] This demonstrates the extent to which the Gauteng teaching hospitals support their neighbouring provinces and attests to the virulent nature of rheumatic heart disease in South Africa's young patients. Thus the academic units managing rheumatic fever and its sequelae need adequate, ongoing funding.

Table 4.3. The economic situation and availability of medical treatment points in the provinces referring rheumatic fever/ heart disease patients to three Gauteng teaching hospitals.

Province	GGP/head 1993	Kids in poverty 1993	Unemployment 1995	Fixed Rx points 1992	Rx Pnts /1000 1992
N.Province	R 1761	74,1%	47,0%	849	0,2
Kwa-Zulu Natal	R 4243	55,9%	32,2%	782	0,1
Mpumalanga	R 6835	52,1%	36,4%	391	0,1
Eastern Cape	R 2740	70,2%	45,3%	586	0,1
Free State	R 5365	57,1%	24,4%	453	0,2
North-West	R 3776	49,2%	36,6%	457	0,1
Gauteng	R13233	24,7%	28,7%	1167	0,2

Rx = Treatment, Pnts=points (54,55,57,58)

Only 23% of South Africa's population had access to medical care on a regular basis even though R30 billion (8.5% of the gross domestic product) was spent on health in 1992/3.[54] About 22% of the country's poor seek no medical treatment at all, citing the high costs of treatment and transport as the reason.[59]

Gauteng, as a whole, was shown to be at low risk for rheumatic fever/ heart disease. Gauteng central was highlighted as at low risk for severe disease. Although Gauteng is only the second most populous province it had the most clinics, hospitals and hospital beds per person in 1992. (See Table 4.3. above) One must remember, however, that Gauteng not only cares for its community but also supports the tertiary medical care needs of its neighbouring provinces and countries as this study has clearly shown.

Within Gauteng central, Johannesburg was shown to be a low-risk area for rheumatic fever and severe disease. It is richly provided for with several hospitals, both private and Government owned, and a functioning clinic system. Eldorado Park came up as a low-risk area for severe disease. All 12 of the rheumatic fever patients from this area were seen at Coronation Hospital and made up 42.9% of the Coronation Hospital rheumatic fever/ heart disease patients seen. (See Table 6.1.1. page 70) Ransome and Roode[32] found compliance

North-West Province was not highlighted as a problem area, yet it has the second highest percentage of informal rural housing.[55] Thus other factors must be balancing out the effect of a rural existence in this Province. Possibly the rheumatic fever/ heart disease patients are being referred to other hospitals, such as Ga-Rankuwa, H. F. Verwoed or hospitals in Kimberly. As discussed previously, the more complicated congenital heart disease patients may be being sent preferentially to Gauteng as their surgery may be better managed there. (Of note, 5 patients with congenital heart disease and 2 with rheumatic heart disease were referred from Ga-Rankuwa to the study hospitals.)(See Table 6.1.7 page 73)

Interestingly also, the North-West Province, after the Western Cape and Gauteng, had the third lowest percentage of children in poverty in 1993.[54,57] (See Table 4.3 page 66) Perhaps this has influenced the prevalence of rheumatic fever within this Province.

The Human Sciences Rese ouncil found that in 1995 more than 9 million children were living in poverty in South Africa.[54] Of these, 24% each were from the Eastern Cape and Kwa-Zulu Natal and 21% were from the Northern Province. The unemployment rate was 32.6%[58] in 1994. The highest figure, 47%, was found in the Northern Province and 45.3% was found in the Eastern Cape.[54,58] The Provinces with the lowest gross geographic product (GGP) per capita had the highest unemployment rates and percentages of poor children.[54,55,57,58] Most of these Provinces were highlighted as rheumatic fever problem areas. Gauteng, identified as a low-risk area, had the highest GGP, one of the lowest unemployment figures and the lowest percentage of children in poverty suggesting that these factors are related. (See Table 4.3 page 66)

Violence remains an ongoing problem in South Africa. This is particularly serious in Kwa-Zulu Natal. A high incidence was also reported from the eastern townships of Gauteng.[54] With violence comes social disruption and this may be related to these areas being highlighted as being at high risk for a high prevalence of rheumatic heart disease. It is pleasing to note that the Katorus Project was launched in October 1994[54] to redevelop Katlehong, Thokosa and Vosloorus. A few of the aims of this project are to repair housing damaged during pre-election violence, repair street lights, upgrade sports centres, clear accumulated garbage and to establish SOS communication centres.

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E. PROTOCOL ACCEPTANCE CERTIFICATE:

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

7 York Road, Parktown, 2193 South Africa • Telegrams 'Witsmed' • Telephone (011) 647-1111 • Fax: (011) 643-4318

Dr SB Clur
83 Queen Street
Kensington, 2094

31 May 1996

Dear Dr Clur,

APPROVAL OF PROTOCOL ENTITLED "A PROFILE OF RHEUMATIC HEART DISEASE CASES THAT PRESENTED AT THE TEACHING HOSPITALS OF THE UNIVERSITY OF THE WITWATERSRAND FROM 1993 TO 1995"

I should like to advise you that the protocol that you have submitted for the degree of MSc (in the field of Child Health) has been approved by the Postgraduate Committee at its recent meeting, for continuation of candidature, subject to ethics approval being obtained.

Dr J du Plessis, Head of the Department of Paediatric Oncology has been appointed as your supervisor. You are asked to maintain regular contact with your supervisor who must be kept advised of your progress.

Please note that all candidates for higher degrees must make reference in their research reports to the clearance number of the relevant ethics committee. The final title should comply with the above approved title, and a signed declaration, noting that the work has been your own and not submitted to any other University, must also be included.

Yours sincerely,

Mrs G Z Gabriel
Faculty Officer (Postgraduate)
FACULTY OF HEALTH SCIENCES

patients with congenital heart disease will thus act as a control group. As the medical staff referring patients with congenital heart disease and rheumatic heart disease are the same, some control of multiple variables affecting referrals is built in to the study.

Areas of high rheumatic heart disease prevalence and severity can then be identified. These areas can be further investigated for possible reasons, e.g break down of existing Primary Health Care, inadequate Primary Health Care, socio-economic factors or some combination of these. Once problems have been identified action can be initiated to control them.

HYPOTHESIS:
Ho(1): There is no difference in the geographic referral patterns of congenital heart disease and rheumatic fever/ heart disease.
HA(1): There is a difference in the geographic referral patterns of congenital heart disease and rheumatic fever/ heart disease.
Ho(2): There is no difference in the severity of rheumatic heart disease coming from different geographic areas.
HA(2): There is a difference in the severity of rheumatic heart disease coming from different geographic areas.

ETHICAL CLEARANCE: This will be obtained from the Univers[illegible] of the Witwatersrand Ethics Committee.

METHOD: A retrospective analysis of patients seen or admitted with rheumatic fever/ heart disease and congenital heart disease in 1993, 1994 and 1995 will be undertaken using the computer databases in the J.G. Strijdom/ Coronation, Baragwanath and Johannesburg Hospitals.

INCLUSION CRITERIA: All patients with rheumatic fever/ heart disease and congenital heart disease seen at the paediatric cardiac clinics or admitted to the wards of the 4 mentioned hospitals from the beginning of January 1993 until the end of December 1995, who have a documented address or area of origin, will be included. The need to perform surgery or balloon valvuloplasty will be used as a marker of disease severity.

DATA ANALYSIS: Comparative analysis between the control and study group will be done using the Chi-Square Test for Goodness of Fit.

D. RESEARCH PROTOCOL: MSc (Med) in Child Health

TITLE: A geographic profile of Rheumatic Fever and Heart Disease cases seen at three teaching hospitals of the University of the Witwatersrand from January 1993 to December 1995.

RESEARCHER: Dr Sally-Ann Clur of the Department of Paediatrics Coronation Hospital and the University of the Witwatersrand.

SUPERVISOR: Dr J. Du Plessis Head of Paediatric Cardiology Baragwanath Hospital.

RESEARCH PROBLEM: The prevalence of rheumatic fever/ heart disease appears anecdotally to have increased recently. Patients presenting at the teaching hospitals of the University of the Witwatersrand, appear to have more severe disease, often requiring surgical intervention. Rheumatic fever has long been recognised as a social disease related to factors such as overcrowding, poverty and poor availability of health care. The social disruptions secondary to political and nonpolitical unrest in 1993, 1994 and 1995 may also be related to this apparent increase in prevalence and severity of this disease. Streptococcal sore throats may not have been treated and penicillin prophylaxis was omitted as clinics were closed and patients afraid to venture out. An increase in rheumatic heart disease has been documented recently in the United States of America. (A shift in the streptococcal antigen load was sited as the cause[9].) This increase appears to have been mirrored locally by an increase in the prevalence of cases presenting to hospitals.

The last study to look at the prevalence of rheumatic heart disease in South Africa was performed in 1976 by McLaren M. et al. They found an overall prevalence of 6,9 per 1000. 92% were asymptomatic [11]

AIMS: To identify areas of high prevalence of rheumatic fever/ heart disease and areas where rheumatic heart disease is more severe in the districts that refer to the teaching hospitals of the University of the Witwatersrand. It is known that the census figures for our population are extremely unreliable due to a variety of factors. But the prevalence of congenital heart disease is fairly static in different areas (2-4/1000 live births)[1] and not significantly affected by socio-economic factors. This fact will be used to define our normal geographic referral area and negates the need for accurate population data. The

C. ETHICS CLEARANCE CERTIFICATE:

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Division of the Deputy Registrar (Research)

COMMITTEE FOR RESEARCH ON HUMAN SUBJECTS (MEDICAL)
Ref: R14/49 Clur

CLEARANCE CERTIFICATE — PROTOCOL NUMBER M 960302

PROJECT: A profile of Rheumatic heart disease cases that presented at the teaching hospitals of the Univ of Witwatersrand from 1993 to 1995

INVESTIGATORS: Dr S A Clur

DEPARTMENT: Paediatrics, Coronation Hospital

DATE CONSIDERED: 960329

DECISION OF THE COMMITTEE *

Unconditionally approved

DATE: 960411

CHAIRMAN. .....Russane.....pp (Professor P E Cleaton-Jones)

c c Supervisor: Dr J Du Plessis
Dept of Paediatrics, Baragwanath Hospital

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DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and ONE COPY returned to the Secretary at Room 10001, 10th Floor, Senate House, University.

I/~~we~~ fully understand the conditions under which I am/~~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.

DATE...25/4/96.....SIGNATURE .....Clur.....

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES