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COMMUNITY INFECTION RATIO AS AN INDICATOR FOR TUBERCULOSIS CONTROL IN ZAMBIA

GRACE MUZYOKA KALENGE

A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF MASTERS OF PUBLIC HEALTH OF THE UNIVERSITY OF ZAMBIA

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A CASE-CONTROL STUDY OF PURIFIED - PROTEIN DERIVATIVE REACTIVITY AMONG HOUSE-HOLDS CONTACTS OF CONFIRMED PULMONARY TUBERCULOSIS AND CONTROL HOUSES.

DECLARATION

: declare that this dissertation has never been submitted fo
liploma or a degree in any other University.

ate: ..05.-.01.-..96.. Candidate's Signature: ....Chalunge....

have read this dissertation and approved it for examinatic

ate: 29.4.96 ..... Signature: .....

UPERVISOR: PROFESSOR PETER SIMS

ate: ..... Signature: .....

O- SUPERVISOR

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Candidate's Signature: .....Chalenge.....

DEDICATION

dedicate this piece of work to my beloved husband for h
olerance, encouragement and support when I was at my lowe
uring the study and research period.

APPROVAL

THIS DISSERTATION OF GRACE M. KALENGE has been approved as fulfulling the requirement for the award of the degree of Master of Public Health by the University of Zambia.

Signature	Date
	2nd Dec. 1996

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- Mrs. R. Soko for her generous help in typing the thesis within such a short notice.

Candidate' Signature: .....Chalunge.....

SUMMARY

he epidemiology of tuberculosis in Zambia is poorly tood. The study investigated the relative importance of nsmission within the household and in the community among en aged 2 years to 12 years living in the shanty-townships aka, Zambia.

he prevalence of Mycobacterium tuberculosis exposure among ntact children (living in a household where there was a med case of pulmonary TB) and 183 control children (living ses nearby free of active tuberculosis) was defined as the tion of children with a positive tuberculin skin test.

3 (22%) contact children and 48(36%) controls were ulin positive. Living in a contact household, was not a actor for tuberculin positivity (OR 0.33; 0.06 - 1.84; 95% However, age was a risk factor for tuberculin positivity 40; 0.24 - 0.95, 95%) C1).

mount of bacilli in the sputum was a risk factor for ulin reactivity (OR 5.63; 1.59 - 21.78; 95% C1). ional status was also a risk factor for tuberculin vity (OR 2.13; 1.03 - 4.40; 95% C1).

he community infection ratio (CIR) was calculated as the atio of tuberculin controls to tuberculin contacts (2):

$$CIR=\frac{\text{Prevalence in controls}/(1-\text{Prevalence in controls})}{\text{Prevalence in contacts}/(1-\text{Prevalence in contacts})}$$

A low CIR therefore suggests mainly household spread of
tion, whereas a high value suggests frequent transmission
le the household . The adjusted CIR (for age, sex, sputum
nutritional status and household size) was 1.4 (95% C1;
2.37) compared with values of 0.18 - 0.40 in other studies

urrently recommended tuberculosis control strategies are
le for areas with low CIR. Different strategies may be
for areas such as ours, with high values.

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MMUNITY INFECTION RATIO AS AN INDICATOR FOR TUBERCULOSIS NTROL IN ZAMBIA

CHAPTER 1

1 Tuberculosis is one of the most widespread communicable diseases, and unlike most diseases it has a very long period of infectivity in addition to being the most chronic and the most persistent.

1.7 billion people or one third of the world population are infected with mycobacterium tuberculosis. Each year 8 million of these develop tuberculosis and 2.9 million currently die of it. About 10.2 million cases of tuberculosis are expected to occur by the year 2000. (1)

Zambia has an area of 752,600 km^2 and recent evaluation puts the population at 9.1 million. The total cases of Tb in Zambia for 1994 was 36,776. Lusaka, which is the capital of Zambia with a population of 1.3 million had 8,180 cases of Tb. This is 22.2% of all Tb cases in Zambia. (2)

When chemotherapeutic drugs became available, eradication of tuberculosis appeared to be in sight. However,

reduction has been slow, and most authorities believe that it is going to take decades if not centuries, to achieve. (1)

It is a known fact that a positive correlation exist between tuberculosis and social stratification. Poverty has always been associated with tuberculosis. (1) Masses of people crowded into substandard housing, reduced financial resources and insufficient medical care provides milieu for increase of the disease. The social factors involved usually affects the community and the facilities of the health departments are unable to resolve them as they mainly provide curative measures.

HIV has also been seen to contribute to the increase of the number of TB cases in Sub Saharan Africa. (1)

Unfortunately tuberculosis has a social stigma and affected people may delay examination and diagnosis. This attitude towards the existence of infection may lead to delay in examination or to neglect in following the prescribed therapy. The efforts of the nurse to teach the patient or family how to prevent the spread of infection may be regarded lightly or ignored. Efforts to develop new habits and attitudes may prove a difficult task and delay may carry the patient beyond the point where cure may be achieved.

Control programmes world-wide have relied on case detection and treatment plus chemoprophylaxis of young (< 5 years) contacts with positive tuberculin skin test. Chemoprophylaxis is given to young children who test positive because they often develop clinical symptoms in the first year after being infected. If a child is found to be tuberculin positive, the source of infection may be the index case within the household or in the community.

Control measures could be divided into two:-

(a) Controlling the spread of infection. This is done by early detection of people in the community who have the disease and efficiently treating them.

(b) Halting the progression of the disease. This can be done by giving chemoprophylaxis to people who are Tuberculin test positive, people who are HIV positive or otherwise immunosuppressed, and all individuals with conditions that may predispose them to tuberculosis e.g. diabetic patients and patients with inactive tuberculosis who become pregnant.

This strategy while successful in western countries has had limited success in most developing countries. therefore, new strategies must be explored to improve tuberculosis control in Zambia.

PROBLEM STATEMENT:

The prevention and control of tuberculosis has long been centred on the long term follow-up and surveillance by health departments and health workers of high risk groups. However, if eradication of tuberculosis is to be achieved emphasis must be placed on the complete elimination of the disease, not merely reducing the incidence through control measures e.g. BCG, good nutrition and prophylaxis.

Thus, the new philosophy is centred about preventing the occurrence of disease and rendering the infectious patient non infectious as quickly as possible.

Despite persistently high rates of tuberculosis in most towns of Zambia, the epidemiology of the disease is poorly understood. The importance of the household as the main source of tuberculosis infection is suspected but has not been proved. Sources of tuberculin infection in shanty-townships in Lusaka will be studied by comparing tuberculin reactivity in child contacts living with a person with active tuberculosis and in children without such a contact.

CHAPTER 2

LITERATURE REVIEW

Many serial tuberculin surveys have been conducted among selected groups especially of children and young adults. The rationale underlying these surveys is to provide a means of surveillance of the infection status among these groups. Although infection rates among young children are usually very low, surveillance of such populations was done in order to detect potential sources of infection in house holds (3)

The epidemiology of tuberculosis was investigated in Peru by doing a tuberculin test on children aged between 6 months and 14 years living in Peruvian shanty town. The prevalence of mycobacterium tuberculosis exposure among 175 contact children and 382 control children was defined as the proportion of children with a positive tuberculin-skin-test.

The community infection ration (CIR) was calculated and found to be 0.40. This was quite high suggesting frequent transmission outside the household (4).

Similar studies were done in Bedfordshire, UK 1948-1952, where the community infection ratio was found to be 0.19. In Leeds, UK 1953 the CIR was found to be 0.18. A study

done in British Columbus and Saskatchewan, Canada 1966 - 71 came up with a CIR of 0.22. Studies done in Tumkure district, South India, 1960 and New Orleans and Birmingham USA 1971, came up with community infection ratios of 0.20 and 0.37 respectively (4)

The current recommended tuberculosis control strategies are suitable for areas with low CIR. Different strategies may be needed for areas with high CIR in order for the control strategies to be effective.

.2 JUSTIFICATION FOR THE STUDY

This study will thus elicit information which will help the policy makers to:-

(a) Understand the epidemiology of tuberculosis in Lusaka and Zambia as a whole.

(b) To investigate the relative importance of within household and community transmission of TB infection in Zambia.

(c) Know the Community Infection Ratio (CIR). This will in turn determine whether the currently recommended tuberculosis control strategies are suitable for this country or whether new strategies should be recommended.

.3 HYPOTHESIS:

Most of the transmission of tuberculosis in children takes place in the community and not within the households.

.4 AIM:

To compare the prevalence of tuberculosis infection (tuberculin positivity) among children aged 2 years to 12 years living in household where there is a smear positive TB patient and in control households where there has been no confirmed TB patient in the past twelve years.

.5 OBJECTIVE (GENERAL)

To find out the community Infection Ratio (CIR) in the shanty townships in Lusaka.

2.5.1 Specific Objectives

1. To find out if living in a contact household is a risk factor for tuberculin reactivity

2. To find out if age is a risk factor to tuberculin reactivity.

3. To find out if HIV status had any influence on tuberculin reactivity of contact children.

4. To find out if there is an association between HIV status and the number of bacilli in the sputum.

2.5.2 Study Design:

This was a case - control study that was comparing the tuberculin-reactivity in contacts living among households of confirmed pulmonary tuberculosis and control households where there had been no case of TB in the past twelve years.

.6 TARGET POPULATION

2.6.1 The target population consisted of contacts of adult TB patients with positive sputum smear living in the shanty-townships of Lusaka and presenting at the Chest Clinic of the University Teaching Hospital and those who were on their intensive phase of treatment. (i.e the first two months of treatment).

The age group of the contacts was between 2 years and 12 years

2.6.2 Study Population:

The study population were contacts aged 2 to 12 years living with positive sputum smear TB patients living in three compounds chosen randomly namely: Chawama, Kanyama and Mtendere, in Lusaka and presenting at the chest clinic of the University Teaching Hospital.

2.6.3 Sampling Method:

To calculate the sample size, statcalc was used. The confidence interval chosen was 95%.

The power of the study was 90%.

The estimated rate of disease in the control contacts=20% (4)

Two controls were matched for each case giving a Ratio of 2:1.

The possible risk ratio to be detected was 1.5.

That meant we needed approximately 300 children in the case houses and 600 children in the controls.

Taking into consideration that an average Zambian family has not less than 3 children in the house. This meant that to get our 300 children 100 patients were needed.

However, due to lack of time, 50% of the intended number of patients were recruited into the study.

$$\frac{50}{100} \times \frac{100}{1} = 50$$

CHAPTER 3

ETHOD AND SUBJECTS

.1 STUDY AREA:

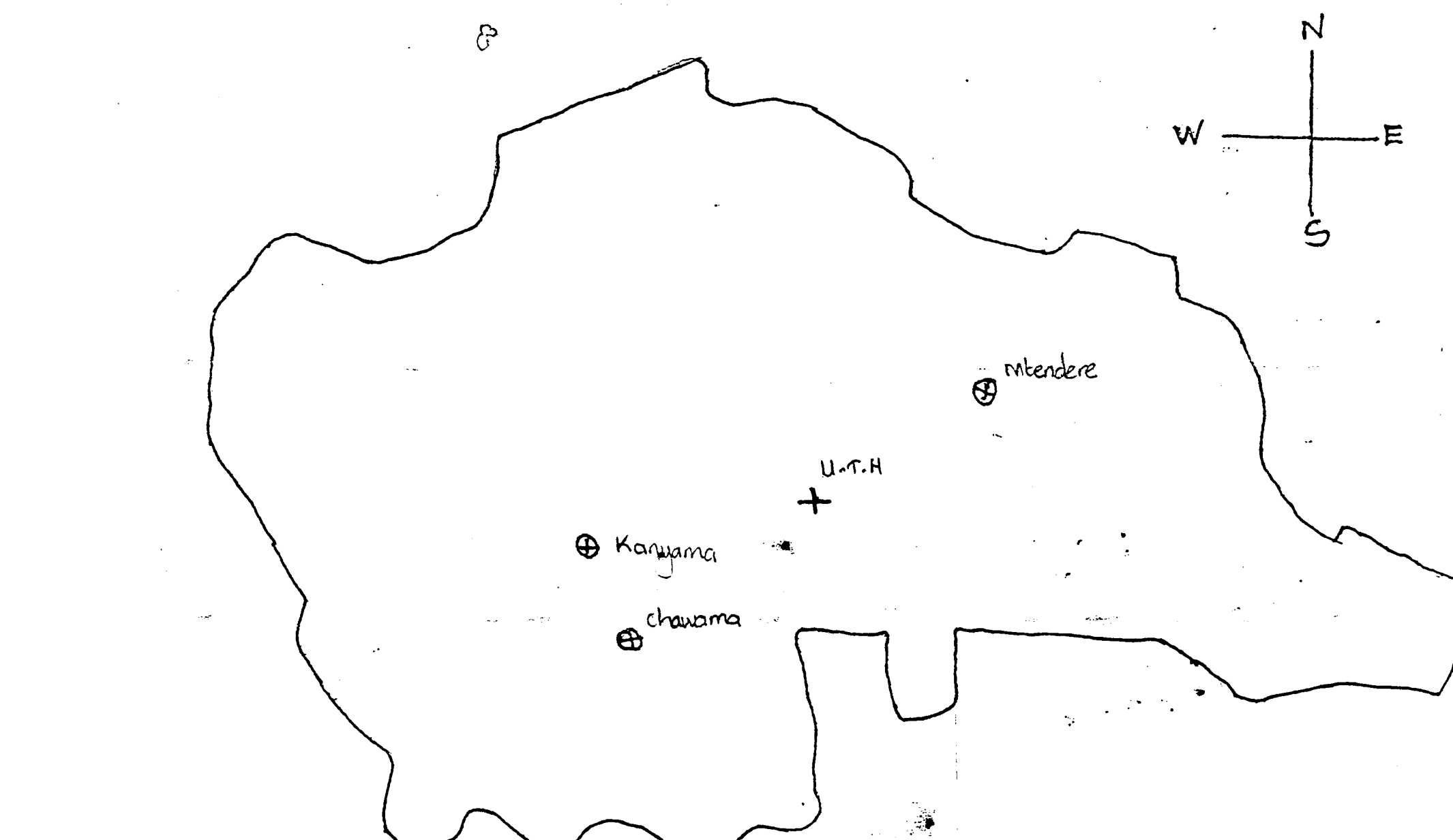
The research was carried out in three compound of Lusaka Urban

Lusaka is the capital city of Zambia comprising a population of 1.3 million people. It is located in the Lusaka province of Zambia. A lot of shanty - townships have developed here due to large migrant population from rural areas within Zambia and immigration from our neighbouring countries. At present there are 103 compounds in Lusaka Urban.

Lusaka Province is divided into two districts, Lusaka rural and Lusaka urban

This study was conducted in three compounds namely Mutendere, Chawama and Kanyama.

1. Mtendere: The compounds lies to the northeast of the city centre. It has a population of 35,915. The houses are built by the owners without proper planning and are therefore of different quality. People of mixed social-economic status live here.


N
W
E
S
Mtendere
U.T.H
Kanyama
Chawama

2. **Chawama:** It is found to the South West of the city centre. It is densely populated with a population of 48,000.

There is old Chawama and New Chawama which is called Kuomboka. Even here the type of houses differ but most of them are of low quality.

3. **Kanyama:** Kanyama lies to the South-West of city centre. it consists of Old and New Kanyama. The houses are not much different from those in Chawama or Mtendere and the people are of mixed social-economic status. It's population is 50,500.

THE TUBERCULOSIS PATIENTS:

6,000 TB patients were notified at the chest clinic of the University Teaching Hospital from January to November this year. This number is a minimum estimate as some of the TB patients go to private clinics for treatment. However even those who are diagonised in the private clinics end up at U.T.H. in order to get free medication.

Between October and November 1995, 50 adult cases of TB presenting to the chest clinic of the University Teaching Hospital, Lusaka Zambia, and those currently on their intensive phase of treatment in their respective clinics were recruited into the study. Patients were self-referred

or referred from another health facility. Index cases underwent a chest radiography and also had to have a positive sputum smear in order to confirm pulmonary TB. All TB patients are supposed to be counselled and offered an HIV test.

Field-workers recruited to help in the study talked to the patients and explained the purpose of the study. A written informed consent was obtained from all those who agreed to take part in the study. The patients had to come from either Chawama, Kanyama or Mtendere compound in order to be recruited into the study as these three compounds were the ones chosen randomly for our Data Collection.

HIV STATUS OF INDEX CASES;

Coded blood samples from the consenting index cases were taken so that their HIV-status could be determined. All the index patients consented to having their blood tested for HIV. The blood sample was taken by venepuncture. The reason for coding the blood samples was to make sure that the field-workers could not know which blood belonged to who. The serum were analysed by Wellcozyme enzyme-linked immunosorbent assay (Elisa); If the results were positive, the serum was analysed again using a different HIV-kit called Capillus HIV 1 & 2 Those wishing to know their-HIV-status were referred to Kara-counselling and other centres which deal with counselling.

PROCEDURE FOR HOUSEHOLD VISITS

Four interviewers and the principal investigator (myself) were involved in the study. The assisting interviewers were nurses by profession who were already trained in giving tuberculin test. However, the procedure was rehearsed to remind them on administrative procedure and reading of the results of the tuberculin test.

The questionnaire was discussed and the interviewers were coached on how to approach the occupants of the households. The interview was in a form of a structured questionnaire (see app. 1) which was pre-tested prior to the start of the study.

Household visits were carried out between the beginning of November and the end of November by the field - workers. The households members of 30 of the confirmed cases of TB and 60 households members of the control households were included in the study.

Two control houses were paired with a contact house. The control houses were chosen randomly using a spin pointer. From the contact house a pointer was spun and when it stopped, 5 metres were counted in the direction of the pointer and the first house encountered was taken as control house one. The procedure was repeated, this time from the first control house in order to chose the second

control house. If the chosen control house refused to take part in the study another house had to be chosen. *Households without children were excluded from the study.*

ield workers visited each subject and even those from ontrol houses had to sign a consent from (see App.2).

hen the occupants of the household were not present on the irst visit two more visits were made and if they were still absent on the third visit, this was recorded as a non-respondent.

Occasional checks of the addresses covered by the assistants were made to ensure that the procedure for data collection was being followed.

At the end of each day, the questionnaires were checked and a brief meeting was held with the interviewers to discuss problems encountered during the day and ideas were shared on how to overcome them.

The shanty-townships in Lusaka have little variation in income, but do vary in family size, housing quality, water sources and household possessions. Social economic and demographic details were recorded for each household. For each individual contact details on age, sex, presence of Bacilli Calmette-Guerin (BCG) scar, and degree of

intimacy (whether sharing the same living room only, or bedroom, or bed) with the index case were recorded.

The weight, height and middle upper arm circumference (MUAC) of each child was also measured.

Each contact was given a Mantoux test with 2 tuberculin unit of tuberculin RT 23 SSI. An intradermal injection of 0.1 ml of solution was given on the volar surface of one arm. Skin - tests were read 48 - 72 hours later by the field-workers. Induration was measured in two dimensions - the long axis of the arm and the transverse plane. Children with induration of 5mm or more were taken to be tuberculin reactive.

All the children in this study group had received BCG vaccine at birth or a few months later for those who were delivered at home. 95% had a BCG scar and 5% had a history of having had BCG vaccine. BCG given at birth does not decrease the sensitivity or specificity of the tuberculin skin test when tested 6 months later so is unlikely to have affected our results (5,6). The tuberculin response to BCG may, however, vary with the type of BCG given (unpublished, Dr. George Comstock, Johns Hopkins School of Hygiene and Public Health, USA).

Sputum smear results were reported qualitatively,

1-10 acid-fast bacteria in the whole slide = +

1-10 acid-fast bacteria per microscopic field (X 1000) = ++

>10 acid-fast bacteria per microscopic field = +++

CRITERIA FOR EXCLUSION

- Households without children were not included in the study.
- Sputum smear positive patients who had been on treatment for more than 2 months were not included in the study.
- Households with one child were not included in the analysis

DEFINITION OF TERMS

(a) Index case was a pulmonary tuberculosis patient identified by a positive sputum smear at the chest disease clinic.

(b) Contacts were defined as individuals sleeping in the same household with the index case.

(c) A contact household was defined by the presence of an index case.

(d) A control household was defined as a household where there had been no person with confirmed tuberculosis in the past 12 years.

(e) Crowding was defined by number of adults plus half the number of children divided by the number of rooms.

ETHICAL CONSIDERATION

- Permission to conduct the study was sought from the ethical committee at U.T.H.
- The rights of the subjects were protected by seeking permission from them to participate in the study. Those who volunteered were asked to sign a consent from.

- The blood samples for HIV-test were coded to protect the individuals identity.

DATA ANALYSIS:

Odds ratios were used as measures of association. Baseline distributions of variables in contact and control households were compared, and associations between tuberculin reactivity and the baseline variables were investigated by odds ratios. X^2 tests were used as measures of statistical significance.

We investigated the association between tuberculin reactivity and nutritional status since malnutrition reduces tuberculin reactivity (7). MUAC was used as an index of nutrition status.(8).

We calculated the community infection ration (CIR) (and 95% C1) as an index of relative importance of within-household and community spread of infection. The Crude CIR was defined as the odds ratio of tuberculin-positive controls to tuberculin-positive contacts.(4)

$$CIR = \frac{\text{Prevalence in controls /(1-prevalence in controls)}}{\text{Prevalence in contacts/1-prevalence in contacts)}}$$

All this data entry and analysis were performed by using the statistical package, EPI-INFO.

VARIABLES

Variables	Indicators
Age	(a) Children
	Age group A = 2-3 yrs
	Age group 2 = 4-5 yrs
	Age group 3 = 6-8 yrs
	Age group 4 = 9-12 yrs
	(b) Index cases
	20-30 yrs = young
	> 30 yrs = old
Sex	
BCG Status	- Scar
	- History
Serology	- Positive
	- Negative
Smear	- Sputum grade +
	- Sputum grade ++
	- Sputum grade +++
Education	- None
	- Primary
	- Secondary
	- Tertiary

Nutrition	- Middle upper arm circumference .Group 1 = <13.5 cm = thin .Group 2 = >13.5 cm = big - Weight - Height
acy	- Sharing bed - Sharing bedroom - Sharing living room
ing	1 per room = not crowded > 2, per room = crowded
-economic Status	(a) Income - poor = K29,000-49,000 - average = K50,000-70,000 - rich = > 70,000 (b) Household possessions poor = no radio, water or electricity Average = owned Radio and Bicycle rich = either TV or Car or fridge.

Water sources	- Inside the house
	- Outside the house
Electricity	- Present
	- Absent

CHAPTER 4

PRESENTATION OF DATA AND ANALYSIS

50 subjects with positive sputum smears for acid-fast bacilli were recruited into the study. The addresses of 10 could not be found, 5 had no children and the other 5 had changed their mind after talking to their spouses. The remaining 30 subjects and their household members aged between 2 to 12 years were included in the study. This gave the response rate of 60%. This could however, have not affected the results as the social-economic status of the respondents and none respondents were the same. The mean age of the index was 33 (range 20-56 years). The cases came from the three compounds namely Chawama, Kanyama and Mtendere.

The following table shows the breakdown of the index cases according to compounds.

Table 1: Showing number (%) of index cases per compound

COMPOUNDS	NO (%) OF INDEX CASES
CHAWAMA	6 (20)
MTENDERE	14 (46.7)
KANYAMA	10 (33.3)
TOTAL	30 (100)

Out of the 30 index cases, 14(46.7%) were female and 16 (53%) were male. The mean age for females was 31.0 (range 20-42 years). The mean age for males was 35 (range 29-56 years). The median family size was 6 and the median number of children per household was 4.

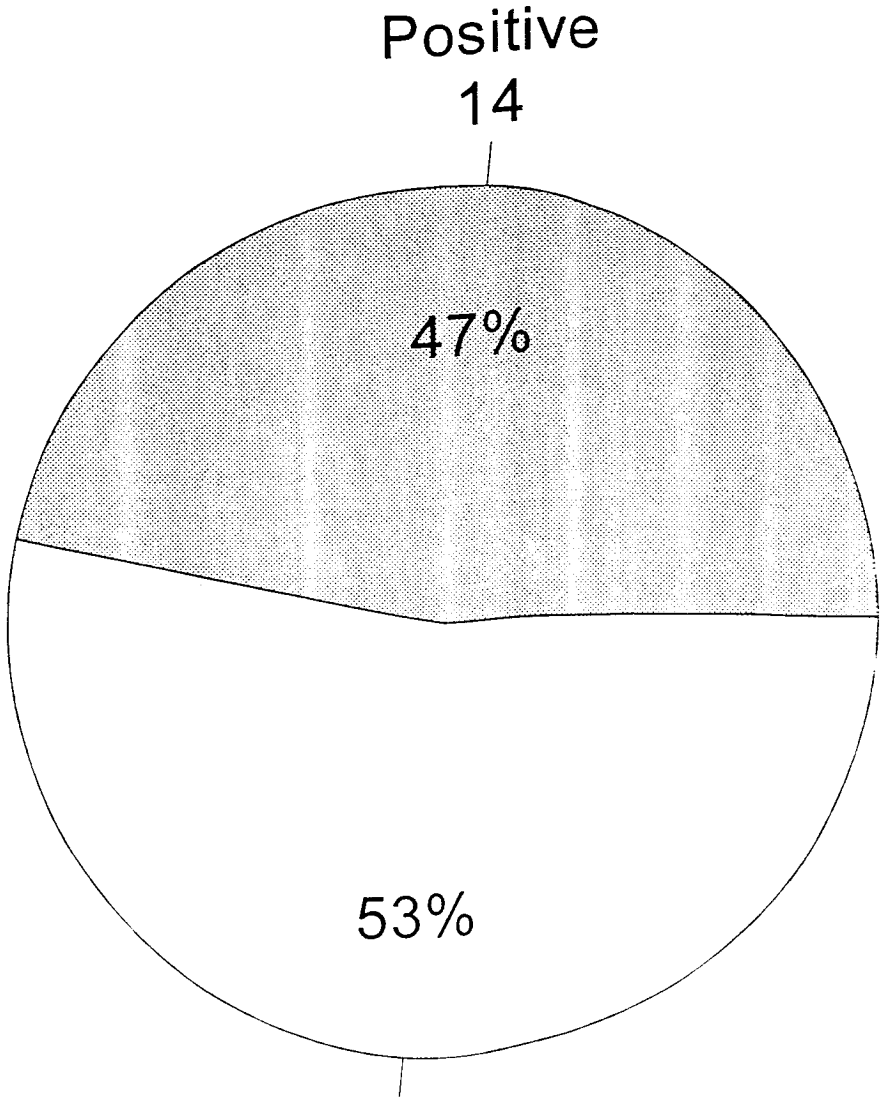
Of the 30 positive sputum smears, 4(13.3%) were graded as + 10 (33.3%) had grade ++ sputum smear, and 16(53.3%) were graded as +++.

The serology results (HIV test) of the 30 index cases showed that 16 (53.3%) were negative and 14 (46.7%) were positive (see fig. 2). Of the 16 who were negative 8(50%) were female and 8(50%) were male. Of 14 who were positive 6(42.9%) were female and 8(57.1%) were male.

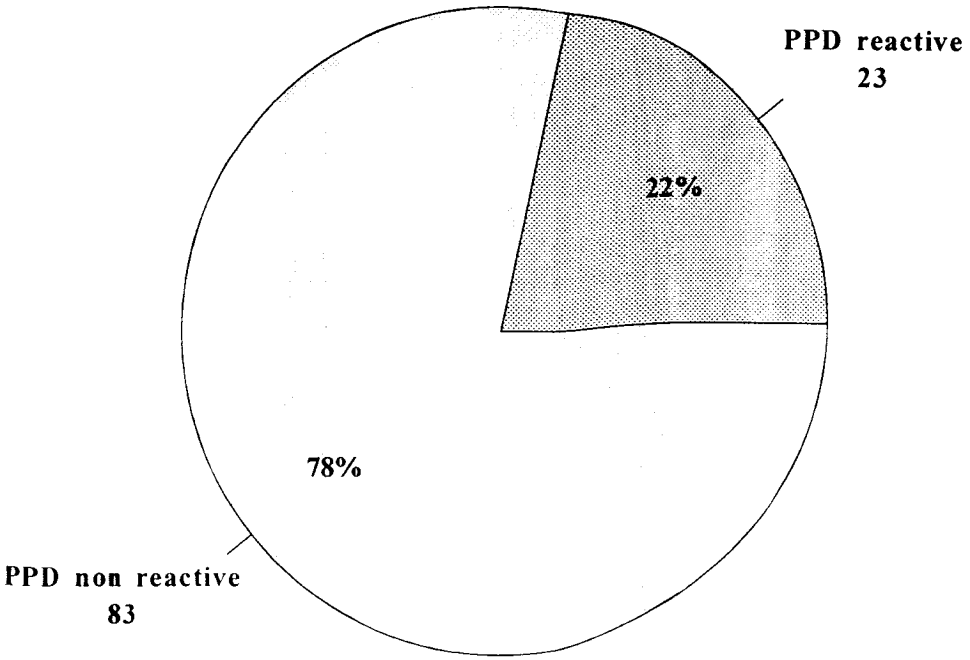
There were 289 children distributed among the 90 households. The contact and control households were similar in age sex distribution, people per household, number of children per house family income and BCG status. Of the 289 children, 106 (36.6%) were from the index households and 183(63.3%) were from the control households. Among the 289 children 149 (51.6%) were females and 140 (48.4%) were males. The mean age was 6.33 (range 2-12 years) and the median was 6.00.

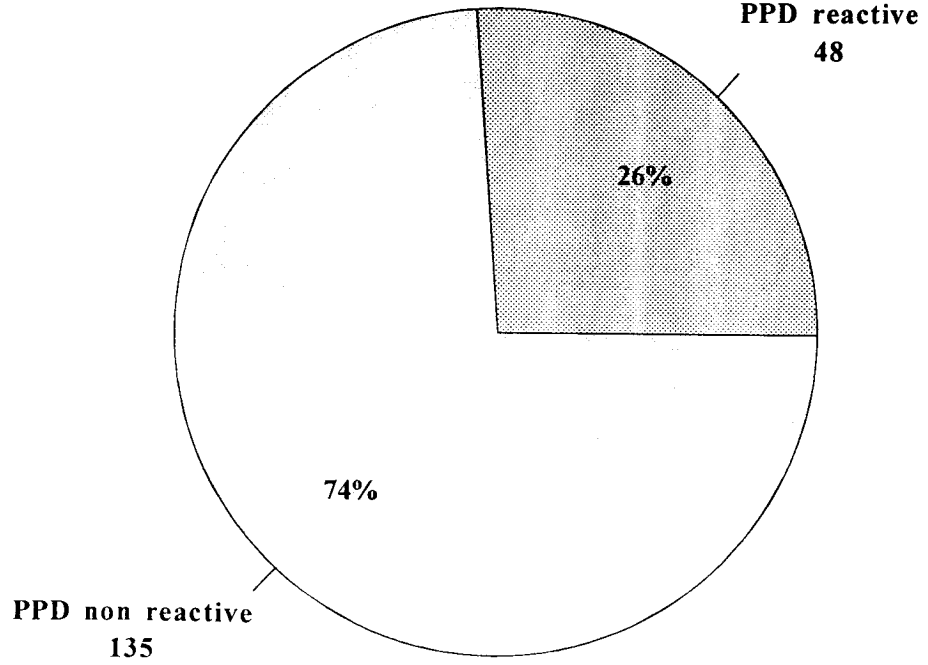
From the 106 children from the contact households 23(22%) were tuberculin reactive and 83 (78%) did not react to tuberculin test. Among the 183 children from the control households 48 (26%) were tuberculin reactive while, 135 (74%) were not (see Table 2 and App. 4). The mean tuberculin size was 3.0mm (range 2 to 20).

Pie showing HIV status of index cases



Pie chart showing PPD reactivity in cases and control households





ble 2: showing tuberculin reactivity in case and control children

useholds	PPd reactive	PPd Non-reactive	Total
ntacts	23	83	106
ntrols	48	135	183
tal	71	218	289

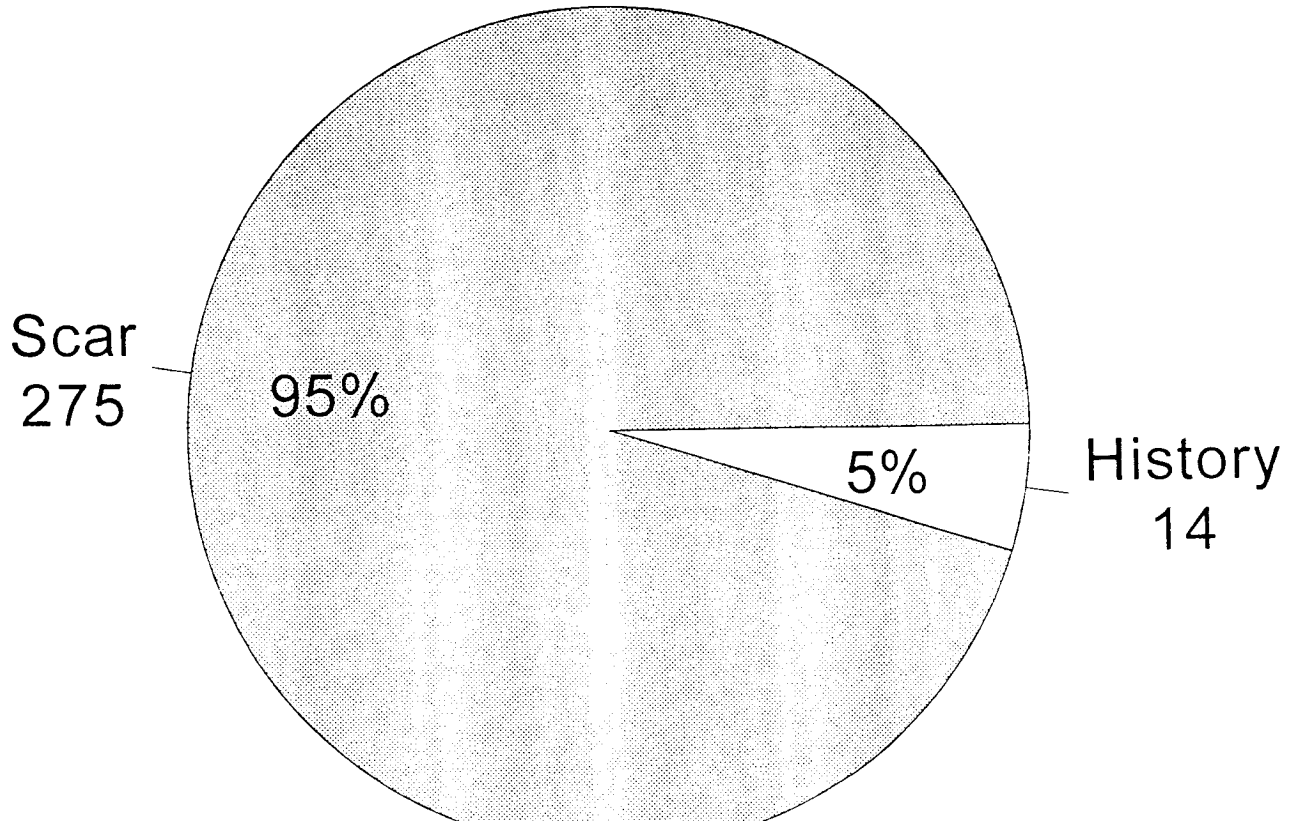
There were more tuberculin-positive children in the control household than in the cases. However, the difference was not statistically significant. (X^2 = 0.52; P = 0.47; 95% C1, OR 0.78; 0.42 - 1.42).

In the 289 children, 275 (95%) of them had a BCG scar and 14 (5%) had a history of BCG. Of the 275 who had a BCG scar 99(36%) came from contact households and 176 (65%) came from control households. Of the 14 who had a history of BCG 7(50%) came from contact households, while 7(50%) came from control households (see Table 3 and fig.4)

ble 3: showing BCG status of control and contact children

G Status	Contact	Control	Total
ar	99	176	275
story	7	7	14
otal	106	183	289

Pie chart showing BCG status



Of the 90 households 29(32.2%) belonged to the low income group with a mean income of K45,800 and a median of K43.000. 31 (34.4%) belonged to the middle income group with a mean income of K50,591 and a median of K48,500. 30 (33.3%) belonged to the high income group with a mean of K56,226 and a median of K40,000.

Looking at the social-economic status by household possessions, 15 (16.7%) belonged to the poor group, 44 (48.9%) belonged to the average group while, 31(34.4%) belonged to the rich group.

43(47.8%) households were not crowded, 18(20%) were said to be average and 29(32.2%) were said to be crowded. Crowding was defined by number of adults plus $^{1/2}$ number of children divided by the number of rooms. 24 (26.7%) households were said to be poor ventilated in terms of number of windows per room. 44 (48.9%) were said to be of average ventilation, while 22(24.4%) were said to have good ventilation.

Information on nutritional status was noted by measuring the weight and height of the children and taking the measurements of middle upper arm circumference. However the index used to define the nutritional status of the children in this study was MUAC (8). 67 (23.2%) of the children were said to be malnourished while 222 (76.8%)

were said to be well nourished. The mean for MUAC was 15.8 cm (range 10.0cm - 31.0cm). The median was 16.0cm.

The HIV status of the index cases and their sputum smear results were compared. 3(21.4%)of the HIV positive cases had grade + sputum smear 6 (42.9%) had grade ++ sputum smear and 5(35.7%) had grade +++.

le 4 - Showing HIV status of index cases and smear results

V Status	Sputum Smear +	++	+++	Total
egative	1	4	11	16
ositive	3	6	5	14
otal	4	10	16	30

When tested statistically, there was a significant difference between HIV status and smear results (OR = 2.25, 95% C1; 0.04 -1.47; X_2; P=0.04). The results seem to suggest that HIV positive cases had less bacilli in the sputum than HIV negative cases.

Among contacts of cases with sputum smear grade of +; ++, and +++, 3,1 and 19 respectively had a positive tuberculin reaction.

There was an association between smear results and tuberculin positivity when 5 mm was taken to be positive (X^2 = 8.40. P = 0.003). This was highly significant. The association persisted even when 10 mm was taken to be

positive (OR = 8.39; 95% C1; 1.76 to 78.59; X^2 = 8.09, 1 df; P = 0.004). Even when standardized for age there was still a significant difference meaning that age was not a confounding factor.

There was however, no association between HIV status and age of index case (X^2 = 1.896; 1df, P=0.16).

The association between tuberculin positivity and HIV status of index cases was also tested when a 5mm reaction was taken to be positive (see Table 5).

Table 5 - Showing HIV status and tuberculin reaction when 5mm was defined as positive

HIV Status	PPd Reaction -ve	+ve	Total
Negative	37	22	59
Positive	46	1	47
Total	83	23	106

A significant difference existed between HIV status and PPd - positivity (OR = 0.04; 0.00 - 0.28; X^2 = 17.02; 2df P = 0.00003).

HIV positive index households only had 1 child who reacted to tuberculin, while HIV negative households had more.

There were more tuberculin-positive children in the control household than in the contact household. However, after adjusting for age, the difference was seen not to be significant suggesting that age was not a confounding factor.

There was a trend of older children having tuberculin reaction whether they were from the index houses or from the control houses.

The means of tuberculin for age group are shown below (see Table 6).

Table 6 - Showing means of tuberculin and age group

Age Group	Mean	Std. Dev.
1	2	4.704
2	2.5	5.276
3	5	6.449
4	4	6.238

There was a significant difference between age and tuberculin reaction (X^2 = 10.108, of 3 df and P = 0.017).

When tuberculin response of 5mm was defined as positive, there was still a significant difference between the age groups (X^2 = 12.95; 3 df, P= 0.004), even when 13mm was taken to be positive.

Most children tend to get infected at the age when they start school. Even though age is a confounding factor for tuberculin reactivity, it does not seem to confound with social economic status. Social - economic status had no influence on tuberculin reactivity when measured at 5, 10 or 13mm level.

Tuberculin has always been associated with nutritional status, therefore, tuberculin reactivity was compared with middle upper arm circumference (MUAC) which was the index used in the study (8). (see Table 7).

le 7 - Showing MUAC groups and tuberculin reactivity when was defined as positive

MUAC GP	PPd Reactivity		Total
	+ve	-ve	
Thin	17	80	97
Big	33	73	106
Total	50	153	203

There was a significant difference between tuberculin reactivity and nutritional status (OR = 2.13; 95% C1; 1.03 - 4.40; X^2 = 4.34; 95% C1; P= 0.037) when 5 mm was defined as positive. The association persisted even after 10 mm was defined as positive. This association persisted even after 10mm was defined as positive (OR 3.62; 95% C1; 1.44 - 9.33; X^2 = 8.50; 1df; P = 0.0035).

Although overcrowding is believed to be a risk factor for the spread of tuberculosis (9), in this study, this was not the case. In terms of social economic status, there seemed to be a tendency for poor people to be more crowded. This was apparently significant using the household possessions rather than income. 7(48%) of the poor household were said to be crowded, 17(38%) of average class were said to be crowded and only 5(16.1%) of the rich households were said to be crowded (X^2 = 9.12; 95% C1; 4 df; P=0.047).

An index to describe the ratio between the risk of transmission in the community and the risk of transmission to household contacts would be useful in tuberculosis control programmes. The CIR provides an estimate of such an index. It has no unit, that means, it can be used to compare different studies. The higher the CIR, the higher the risk that tuberculosis infection is transmitted outside the immediate household (or possibly in the household but not by the immediate family). The CIR community infection ratio found in this study was 1.4. The adjusted CIR was 1.17 (0.70 - 2.37; 95% C.1.) This was very high and could suggest that almost all infections in the community were taking place outside the household.

The community infection ratio (CIR) was calculated at 95% C1 as an index of the relative importance of within -

household and community spread of infection. The crude CIR was defined as the odds ratio of tuberculin positive controls to tuberculin positive contacts.

$$\text{CIR} = \frac{\text{Prevalence in controls}/(1-\text{Prevalence in controls})}{\text{Prevalence in contacts}/(1-\text{Prevalence in contacts})}$$

$$= \frac{\frac{26}{74}}{\frac{22}{88}} = \frac{0.35}{0.25} = 1.4$$

CHAPTER 5

DISCUSSION

In this study, the prevalence of tuberculin-reactivity in contacts of confirmed pulmonary TB patients and those in control houses without confirmed TB cases was examined.

The index cases were derived from patients with confirmed pulmonary TB by sputum smear recruited to the study, using a recruitment procedure designed to obtain as a representative a sample as possible of TB cases. It was of some concern however, that the proportion of the index cases for whom the contacts were seen was much less than the proportion originally intended. Although the similarity between patients for whom the contacts were seen and not seen in relation to age sex, sputum smear results and social economic status existed, the small samples size could have influenced the results of the study.

The principle finding of the study was a lower prevalence of positive tuberculin response among the contacts of TB patients (22%) than the contacts of the non-TB patients (26%). This result is similar to the one found in the study done in Peru (2). However, the result is contrary to the results found in the other studies done elsewhere (10,11,12,13,14) where the CIR ranged from 0.19 - 0.37. Two possibilities could maybe explain this:-

(a) It could be due to the fact that there were some unidentified cases of TB in the control households.

(b) Another reason could be that, there was a high number of HIV in the case houses than in the controls i.e. some of the children could also have had HIV, hence they were unable to react to tuberculin test.

It has been proved in other studies that HIV infection may lead to anergy to tuberculin (15,16)

Among the contacts of HIV positive index households, only one child reacted to tuberculin, while the HIV negative households had 22. The findings correlates with those found in the study done in Zambia, where contacts of HIV patients were seen to be less reactive than those of HIV negative patients to tuberculin test (17)

This could be explained by the fact that HIV positives were less likely to infect contacts as they have less bacilli in the sputum than their HIV-negative counterparts. This was highly significant even after adjusting for smear suggesting that there was another explanation for HIV contacts not being positive.

An increase in the number of bacilli present in the sputum smear also increased the proportion of contact children who had a positive tuberculin reaction. This result was contrary to the one found in the peruvian study (4).

TB has always been associated with social economic status of the individual. However, in this study, the index cases came from a better social-economic class than the controls. This could be explained by the fact that it was very difficult to define social-economic status. Defining social-economic status by income alone or household possessions alone could not give a true reflection of ones social-economic status. This was because some people who had a high income had next to none in terms of household possessions and others who earned very little had a lot of household possessions.

Ones nutritional status can influence tuberculin positivity. In the peruvian study, there was no association between wasting or stunting with tuberculin positivity. In this study however, association was seen between middle upper arm circumference and tuberculin positivity. This could be explained by two factors.

(a) That bigger MUAC meant better nourishment.

(b) That bigger MUAC were more likely to be older children and therefore, more likely to react.

The tuberculin test has several limitations as an indicator of infection with mycobacterium tuberculosis (18). Prior BCG vaccination may result in a positive response, and a high proportion of children in this study (95%) had a BCG scar and (5%) had a history of BCG; current policy in Zambia is to vaccinate children at birth.

On this study, there was a high frequency of BCG scar and history of BCG. This could have been a source of bias in that 100% respondent rate is usually impossible. However, this could not have affected our results as no association was seen to exist between BCG status and tuberculin positivity. However, the tuberculin response induced by BCG wanes with time (19,20).

The age specific response to tuberculin is typical of a population in which children are given BCG at birth.

There is a high frequency of positive response in the early years of life, attributed to BCG, declining in older children as the response to BCG wanes, there after there is an increase in tuberculin response rate with age which is attributed to infection with M.tuberculosis. In our study, it could be suggested that all the tuberculin response of

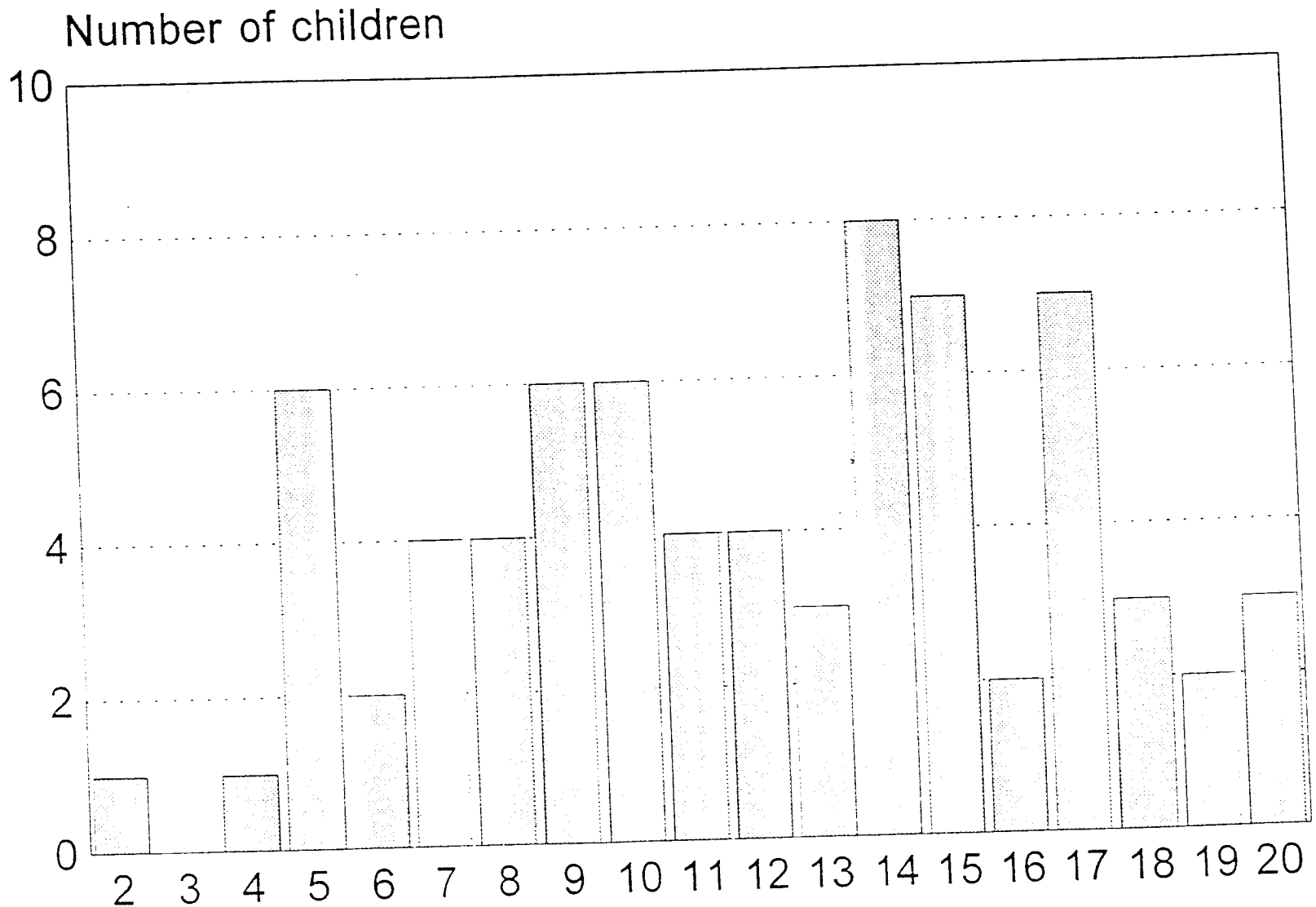
12 mm or less were due to BCG reaction and all those above 12 mm were due to M. tuberculosis infection (see graph 1).

In this study, we deliberately choose children between 2 years and 12 years in the hope that by 2 years most children born with HIV could have died and that by 12 years the children were not yet sexually involved. However, the results obtained in this study could have been influenced by the fact that some children born with HIV have been known to survive for a longer time. This could have meant that, we had underplayed the HIV status of children in the contact houses, hence getting less tuberculin positive contacts from the index households. Our sample size was also very small and this could have affected the results as well.

The selection of our study sample could have been bias in that some TB patients prefer to be treated by private practitioners and therefore do not attend the chest clinic at University Teaching Hospital. This could have underestimated the number of TB positive sputum smear hence underestimating our intended sample size of 100.

The study could have been improved by doing HIV-test on both the index cases and the control cases and the children could also have been offered an HIV test.

Graph showing number of children and the size of



A larger sample size could have also improved our results and another thing which could have been done differently could be to include data of the duration of the illness as this could also have influenced the tuberculin positivity.

There could have been some Bias in the reading of the tuberculin reaction. The reading was supposed to be done to the nearest half millimetre but there was a tendency by the interviewers to read the results to the nearest mm.

The results of the study suggests that almost all the transmission of TB is being done in the community. This would mean that, the present strategies which are centred on contact tracing, treatment, plus prophylaxis for tuberculin positive children less than 5 years old would have little effect in reducing the spread of infection. This strategy has already had limited success in developing countries, including Zambia and therefore, new ones should be sought.

Other conclusions which could be drawn from the results are that:

(a) Tuberculin reactivity is influenced by Age.

(b) There is a relationship between HIV status and amount of bacilli in the sputum.

(c) That HIV status had influence on tuberculin-reaction.

ECOMMENDATIONS:

Since the results suggest that most children acquire the infection in the community, the government should increase its effort on TB awareness campaign through out the country in order to reduce the stigma associated with TB. This would encourage the people with active TB hiding in the community to seek treatment and hence reduce the spread of TB.

Tuberculosis Control strategies should include chemoprophylaxis programmes that targets all infected children rather than just households contacts.

Since prophylaxis is recommended for developed countries and not for developing countries (23), instead of the government wasting money on prophylaxis of contacts children, the money could be utilized in carrying out tuberculin sensitivity surveys in preschool and Grade ones to find out which children are infected, and then giving prophylaxis to those.

CONSTRAINTS

1. Some of the people in the study sample could not be located as the house numbers given could not be traced.

2. The study was supposed to start in October but due to lack of funds the study was delayed by a month.

3 Lack of transport made movement in the compounds very difficult and limited finances also contributed.

4. Due to the HIV and AIDS epidemic in Zambia, most parents tended to be suspicious and rather uncooperative when they realised that we had to give an injection to their children.

5. Limited time to carry out the research meant that a small sample size was used and this could in turn have affected the results.

QUESTIONNAIRE

1. Patients's name: _____

2. Study No: _____ Age: _____

3. Address: _____

_____

_____

4. Case ☐ Control ☐

5. Smear Results

	++	+++

6. Blood Sample Results

+ve ☐ -ve ☐

Study No: _____

Case _____ Control ☐

_____

If control;

- case of TB in the past 12 years: YES ☐ NO ☐

- Any deaths in the family: YES ☐ NO ☐

- If Yes, from what ? _____

Number of people sleeping in the same house:-

children ☐ adults ☐

Date when Tuberculin was given: _____

Date when tuberculin was read: _____

Number of rooms in the house: _____

Number of windows: _____

Income K _____

Water supply:

- Inside the house ☐

- Outside the house ☐

. Electricity:- YES ☐ NO ☐

. Radio :- YES ☐ NO ☐

. Television Set :- YES ☐ NO ☐

. Bicycle :- YES ☐ NO ☐

Car :- YES NO

Fridge :- YES

Level of education attained:-

None

Primary

Secondary

Tertiary

			B C G									SCHOOLING			
	PAR	SEX	SCAR	HISTORY	MUAC	HEIGHT	WEIGHT	BED	BED-ROOM	LIVING-ROOM	PPD RESULTS	YES	NO	AGE	SEX
1															
2															
3															
4															
5															
6															
7															
8															

COMMUNITY INFECTION RATIO AS AN INDICATOR FOR TUBERCULOSIS CONTROL IN ZAMBIA

CONSENT FORM

I_____ have been asked to voluntarily participate in a research study entitled "Case Control Study of Community Infection Ratio as indicator of TB Control in Zambia" conducted by Grace Kalenga, Department of Community Medicine, University Teaching Hospital of Zambia.

The purpose of this study is to determine where the children get their TB from. Specifically, the research will determine whether the children get TB from someon who has TB in the house or just from the community. My participation in this project will be for a period of about Two and half months.

The procedure for this project involves collecting information on my residential address, number of children in the house, Age of children. Sex, BCG status and doing a mantoux test on all my children aged between 2 and 12 years. The risk or pain involved will be slight discomfort.

A total of 300 subjects are expected to participate in this project, both people with and without TB.

I understand that this study may not help me/my children personally but the result may help determine new ways to control TB. The people with positive results will be referred to UTH for further investigations.

Me/my children's participation in this study is voluntary and my refusal to paticipate will have no penalty or loss of medical care. I/my children may withdraw at any time without any penalty.

In all publications resulting from this research project, me/my children names will not be disclosed.

If I suffer any physical injury as result of this study, medical treatment is available at the local clinic.

Patient/parent/Guadian/Initial_____

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