SEROLOGICAL EVIDENCE OF INFECTION WITH *RICKETTSIA TYPHI* AMONG INMATES IN JOS PRISON, NIGERIA.

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ABSTRACT
Background: *Rickettsia typhi* a *gram negative obligate intracellular bacterium* has been described as the etiological agent of murine typhus an infectious disease associated with febrile illnesses and wide range of non-specific clinical signs. It can be transmitted by the rat flea, *Xenopsylla cheopsis*.
Aim: The aim of the study is to determine the prevalence of *R. typhi* among inmates in Jos prison.
Methodology: Sera from 93 prison inmates were examined for *R. typhi* IgM antibodies using enzyme immunoassay. Age, residence area prior to incarceration, sanitary conditions/ personal hygiene, history of fleabite/contact with animals and numbers in cell were surveyed.
Results: Overall *Rickettsia typhi* seroprevalence was 71.1%. *Rickettsia typhi* was present in 77.6% and 60.0% from subjects resident in urban and rural areas prior to incarceration. The age group of 42-60 years had the highest prevalence of 87.5%. 59/78 (75.6%) reported very poor sanitary conditions. All the inmates were exposed to fleabite and had contact with animals. Poor sanitary conditions/personal hygiene, history of fleabite/contact with animals and overcrowding in the prison were found to be significantly associated with the infection in this population ($p< 0.05$). Our data seem to reveal the presence of *Rickettsia typhi* among prison inmates in Jos.
Conclusion: Rodent and flea control programmes need be intensified as well as improvement of sanitary conditions in our prisons is necessary to reduce the incidence of the disease. We urge that serologic testing be also considered for R. typhi in cases of febrile illnesses of unknown origin in our environment.

KEYWORDS: *Rickettsia typhi* , Prison inmates, Jos-Nigeria

INTRODUCTION:
The *Rickettsiae* are a diverse collection of obligately Gram-negative bacteria found in ticks, lice, fleas, mites, chiggers and mammals[1].*Rickettsia* is endemic in rodent hosts, including mice and rats and spreads to humans through mites, fleas and body lice. *Rickettsiae* normally enter the body through the bite or feaces of an infected arthropod vector and organism in the feaces enter the host through irritated abraded skin[2] They are disseminated through the bloodstream then hematogenously spread and ultimately invade endothelia cells by induced phagocytosis[2]. Transmission can also occur via inhalation of aerosolized feacal particles .The insects often flourish under conditions of poor hygiene, such as those found in prisons or refugee camps, amongst the homeless or until the middle of the 20th century, in armies in the field.[3] Typhus refers to a group of infectious diseases that are caused by rickettsial organisms and results in an acute febrile illness.[3] Murine typhus one of the oldest recognized, most common but least reported arthropod –transmitted zonooses is a rickettsial infectious disease transmitted to humans by fleas[4,5,6]. *Rickettsia typhi* is the etiological agent of Murine typhus[6].The disease occurs worldwide

especially in areas of high rats infestation[7]. Until recent years, Murine typhus was associated with the presence of rats and their fleas. Nevertheless, it could occur in places where these are absent, thus, the classic rat-flea-rat cycle seems to have been replaced in some regions by the peridomestic animal cycle involving cats, dogs, opossums and their fleas[1] *R. Typhi* is found worldwide, but the number of reported cases does not reflect the current prevalence. The mild and non-specific features of infection suggest that its incidence is probably largely underestimated in tropical countries[8]. Murine typhus disease is usually acute and mild, with a skin rash and fever but is could sometimes be fatal and its severity has been associated with old age and delayed diagnosis[5,6]. It occurs in epidemics or with high prevalence, is often unrecognized and substantially under-reported; and although it can be clinically mild, it can cause severe illness and death[9,10]. Since, murine typhus mostly presents with symptoms associated with pyrexia of unknown origin or febrile illnesses, it is important to understand its distribution within populations especially the prison environment due to the conditions that may predispose to the disease. This study aims at determining the prevalence of *R. typhi* among prison inmates in Jos.

MATERIALS AND METHODS:

Ethical issue:

Permission for this study was obtained from the ethical committee of the Plateau State Specialist Hospital and the Jos Prison authorities.

Study Area:

The study was undertaken in the Jos prison located along the Joseph Gomwalk road in Jos metropolis of Plateau State, middle belt of Nigeria. The prison inmates were drawn from different cells of the male prison yard with a capacity of 742 inmates.

Study population:

Informed consent was sought for and only 93 prison inmates consented to participate in this study. Then a structurally designed questionnaire to get information regarding each participant with the following variables registered: Age, occupation before incarceration, place of residence before incarceration, contact with animals (rats/cats), history of fleabite, sanitary condition/personal hygiene, number in cell and duration of stay in prison was administered. The study population was stratified by age (18-24, 25-30, 31-36, 37-42, 43-60years) and by residential area before incarceration: Rural and Urban. The mean age was 59 years. 58(62.4%) and 35 (37.6%) subjects lived in the Urban and Rural areas before incarceration respectively.

Collection of Samples:

Blood samples from the 93 prison inmates were collected aseptically into sterile plain containers. The samples were centrifuged after clotting and the sera separated into clean serum containers and stored at -20^0c prior to analysis. The collection of samples took place within 2 days in the month of June, 2007. The samples were taken from adult males in the different cells of the prison.

Serological Techniques:

Human serum samples were evaluated by indirect enzyme immunoassay (EIA). We used a commercial *Rickettsia typhi* EIA IgM Antibody kit (Fuller Laboratories, Fullerton, California 92831, USA) to determine antibodies to *Rickettsia typhi*. Serum samples were first diluted 1:10 in an IgM serum prep and then a final 1:100 dilution was performed both for the serum and the controls and cutoff calibration in sample diluent before testing for the *R. typhi* antibodies. All reagents and sera were allowed to reach ambient temperature before commencement of the assay procedure. 100 µL each of diluted serum samples, controls and cutoff calibrator were dispensed into appropriate microwells (*R. typhi* 96 – well EIA module). The micro wells were covered to minimize evaporation and incubated for 60 minutes at ambient temperature (20-25^{0}c). The contents of the

microwells were washed four times with the prepared wash Buffer (PBS- Tween 20). Subsequent addition of the enzyme conjugate comprising of peroxidase-labeled goat anti-human IgM after washing of microwells resulted in the labeling of the bound antibody. The wells were covered and incubated for 30 minutes at room temperature in the dark and then washed four times using the wash Buffer. 50µL of TMB substrate solution was added to each well and the reaction was allowed for 10 minutes in the

dark.The reaction was finally stopped by addition of 100µL of stop solution and the microwells were assessed immediately both visually and spectophotometrically.

RESULTS:

Out of the 93 samples screened for *Rickettsia typhi IgM* antibodies 66 were positive giving an overall prevalence of 71.1%. *R. typhi* was recorded among all prison inmates screened. All age groups studied recorded presence of *R. typhi* infection with highest prevalence 85.5% among the age group of 42 – 60years.*R. typhi* seroprevalence rates were 77.6% in urban and 60.0% in rural areas before incarceration respectively. A high prevalence was found among those living in the urban areas before incarceration. However, this was not found to influence the rate of *R. typhi* infection in the inmates considered (Table1). The parameters considered to be likely risk factors for *R. typhi* infection among the inmates studied were poor sanitary conditions/personal hygiene, history of flea bite/contact with animals in the prison, numbers in the cell and duration of stay in the prison.Of these, poor sanitary conditions/personal hygiene fleabite/contact with animals and numbers in the cell (or overcrowding) were found to be significantly associated with the infection ($P < 0.05$). Residential area before incarceration, and duration of stay in the prison, were not found to be significantly associated with *R. typhi* transmission ($P>0.05$) (Table2).

STATISTICAL ANALYSIS:

The software application SPSS Version 13 was used. A univariate analysis was performed to determine possible risk factors. Confidence interval at 95%, $P<0.05$ was considered significant.

Table 1: *R. typhi* infection among prison inmates in Jos in relation to age.

Age groups	No. screened	No. Positive	Percentage (%) positive
18-24	21	14	66.7 %
25-30	40	29	72.5 %
31-36	21	14	66.7 %
37-42	3	2	66.7 %
42-60	8	7	87.5 %
TOTAL	93	66 (71.1 %)	

X^2 = 1.511 P > 0.05

Table 2: *R. typhi* infection among prison inmates Jos by risk factors.

Risk factor	n	No. Positive	(%) positive	X^2	P -Value
Residential area					
Prior to incarceration					
Urban	58	45	77.6	3.277	P > 0.05
Rural	35	21	60.0		
Sanitary conditions/personal hygiene					
Poor	15	17	46.7	5.126	P < 0.05
Very Poor	78	59	75.6		
History of Fleabite/ Contact with animals					
Yes	93	66	71.1		P <0.05
No	0	0	0.0	10.464	
Numbers in cell					
1 - 10	20	9	45.0	9.025	P <0.05
10 - 20	15	11	73.3		
20 - 30	38	29	76.3		
30 – 100	20	17	85.0		
Duration of stay in prison					
6 Months	17	13	76.5	1.479	P > 0.05
1 year	35	23	65.7		
2 years	11	7	63.6		
Above 2 years	30	23	76.7		

DISCUSSION:

This study represents evidence of IgM antibodies to *Rickettsia typhi* among prison inmates in Jos. The prevalence of 71.1% of *R. typhi* infection among the prison inmates studied is somehow coherent with those of the outbreak of febrile diseases among Khmer adults in Thailand where 14(74%) of 19 patients studied had elevated or rising antibody titres against *R. typhi* (11). These results show a higher

seroprevalence compared to those in the general population of other developed countries such as; 53% (of 47) in Hawaii[12]; 6.8% in Madrid, 12.8% in Salamanca and 8.8% (of 217) in human population of Catalonia, North east of Spain[6,13]. These are however, reports from general population studies and not among prison inmates. The differences in prevalence rates of *R. typhi* antibodies among these population groups may be due to difference in study population and the predisposing conditions obtained from the different population groups.

A recent report showed that prevalence of antibodies against *R. typhi* in humans in Africa was high in coastal areas where rats are prevalent[14]. This report could suggest or indicate that Africa (including Nigeria) is likely an endemic region because of the presence of rats in these areas. It has also been reported that *Rickettsia* is endemic in rodent hosts, including mice and rats and spreads to humans through mites, fleas and body lice, also that these insects flourish in conditions of poor hygiene such as those found in prisons or refugee camps (Wikipedia, 2007). From our results, the high seroprevalence of 71.1% of *R. typhi* among this population could be evident that prisoners are a high risk population for infection with R.typhi. Moreover, the fact that the area of study is a tropical and temperate region with a cold and partial semiarid climate may likely indicate that this as an endemic area. This is in relation with reports that murine typhus occurs in most parts of the world particularly subtropical and temperate regions and in environments ranging from hot and humid to cold and semiarid[3,15]. Furthermore, the infection from the inmates could spread to the general populace. Nevertheless, some cross-reaction could be possible among *R. typhi* and *R. prowazekii* the agent of Epidemic typhus. Epidemic typhus is prevalent in countries at high altitudes in Central America or Africa and interpretation of serologic results in these countries has at times been difficult. [16,17,18]

Seroprevalence in relation to age from our data showed highest rate among those within the age bracket 43-60 years and agrees with the report that Murine typhus severity is associated with old age and delayed diagnosis[6,19].

The risk factors of *R. typhi* observed in our study were poor sanitary conditions, fleabite/contact with animals and numbers in the cell. It was observed that 59 out of 78 (75.6%) subjects reported very poor sanitary conditions in the prison while 17 of 20(85%) from those within the range of more 30 in the cells were positive for R.typhi IgM antibodies. Murine typhus has been associated with poor sanitary conditions in other studies[3,18]. Overcrowding leads to close personal contact and spread of arthropod vectors like body lice and fleas among individuals. Infrequent bathing and changing of clothes on the other hand creates a flourishing environment for the vectors, when their rodent hosts (cats/rats) are prevalent. There was statistically significant association between *R. typhi* transmission and fleabite as all the prison inmates reported being bitten by fleas while in prison. However it is likely that the massive availability of the rodent hosts such as rats is also propagating this phenomenon in our environment.Duration of stay in prison from our data is not a likely risk factor associated *R. typhi* infection. Incubation of R.typhi is 8-16 days before onset of illness so few weeks' exposure in an endemic region could lead to the manifestation of the disease.

In conclusion, our data presents a preliminary report about *R. typhi* infection in prison inmates in our region. Further investigation with a larger population size to determine reservoirs and spread as well as infecting *Rickettsia to species level* are required. There is an urgent need for rodent and flea control programs in the prison and improvement of sanitary conditions among inmates to reduce the incidence of the disease and possible migration into the general city populace.

We urge that serologic testing for R.typhi be also considered in all cases of febrile illnesses of unknown origin in our environment.

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