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SPLEEN WEIGHT DISTRIBUTION IN IBADAN AND ITS RELATIONSHIP TO DISEASE

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Summary

The 5407 autopsies performed during an 8-year period formed the basis of the study; 2444 were infants and children, while 2963 were adults. The histogram of the spleen weight distribution has a fairly smooth contour with a positive skew towards the heavier spleens. The mean adult spleen weight was 271 g, and this was heavier than that of subjects in temperate climates, but comparable to the mean spleen weight of other localities in a holoendemic belt of malaria. The most frequent diagnosis at autopsy were diseases of the respiratory system, infective and parasitic diseases of which malaria is the most common, diseases of the digestive system and neoplasms. In those subjects with spleens weighing more than 500 g, neoplasms, diseases of the haematopoietic system and infectious and parasitic diseases were the most prominent.

The role of environmental stimuli in a tropical environment in the hyperplasia of the reticulo-endothelial system is discussed. The findings would prove useful in the differential diagnosis of large spleens found in this locality.

Resumé

Les 5407 autopsies faits durant une période de 8 ans constituent la base de cette étude; 2444 cas concernent les bébés et les enfants tandis que 2963 cas concernent les adultes. L'histogramme des fréquences de la distribution des poids de la rate avait un contour positif en fonction de l'augmentation du poids. La moyenne des foids de

l'adults était de 271 g, et celle-ci était supérieur à celle des sujets des pays tempérés, mais comparable au foids moyen des autres localités des zones de malaria; les plus fréquents diagnostics d'autopsie concernaient les maladies du système respiratoire, les maladies infectieuses et parasitaires dont le paludisme est le plus commun, les maladies du système digestif et néoplasme. Pour les sujets dont les foids de la rate étaient supérieurs à 500 g, les maladies dominantes étaient le néoplasme du système hématopoïetiques, les maladies infectieuses et parasitaires. Le rôle du stimulus environnemental dans l'écosystème tropical, ce rôle dans hyperplasie du système réticuloendothelial est discuté. Les résultats de ces recherches doivent être utiles pour le diagnostic différentiel pour des sujets à grosse rate trouvés dans cette localité.

Introduction

The spleen rate in the adult population in the holoendemic belt of malaria has been estimated to be 10% in a series in Lagos (Bruce-Chwatt, 1963) and also in the population of Akufu, a village near Ibadan (Edington & Gilles, 1969). The majority of the spleens were of Hackett Grades I and II (Hackett, 1944). This high spleen rate as compared with that of temperate climates is attributed not only to endemic malaria, but also to the climatic conditions which are highly suited to the profuse growth and transmission of viral, bacterial, protozoan and metazoan organisms that infect man in the tropical areas. These infections, stimulating lymphoreticular tissues, cause splenic tissue hyperplasia. The average spleen weight in the tropical environment is therefore estimated to be heavier than

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that in non-tropical areas. This study was therefore carried out to determine the local situation and the relationship of splenic weights to disease states.

Materials and methods

The autopsy records at the University College Hospital, Ibadan from 1960–67 were examined. All autopsy records were grouped according to the diagnosis at autopsy. Due to the asymmetry of the distribution of spleen weights for each age group, the mean spleen weight was calculated on the logarithmic scale, since this would correct the skew and make the distribution normal. Adult subjects were those above the age of 15 years. The causes of death were according to the International Statistical Classification of Diseases, Injuries and Causes of death (WHO, 1948).

Results

There was a total of 5407 autopsies during the 8-year period 1960–67. Of these, 2963 were adults,

of which there were 1665 male subjects (31%) and 1298 female subjects (24%). There were 2444 cases of infants and children; 1416 were male (26%) and 1028 were female (19%). In this last group 394 cases of congenital malformations, stillbirths and prematurity were included. They consisted of equal numbers of male and female subjects.

Causes of death at autopsy

The classification and frequency of causes of death in autopsy material at the U.C.H. is shown in Fig. 1. This is tabulated in order of frequency in Table 1.

The diseases of the respiratory system are rather prominent, closely followed by infectious and parasitic diseases. This is due to the large numbers of infants and children that died as a result of these diseases. The number of children dying on account of respiratory diseases amounted to 10.2% of all autopsy deaths and 22.6% of all autopsies on children. Many of these subjects may have had a respiratory disease,

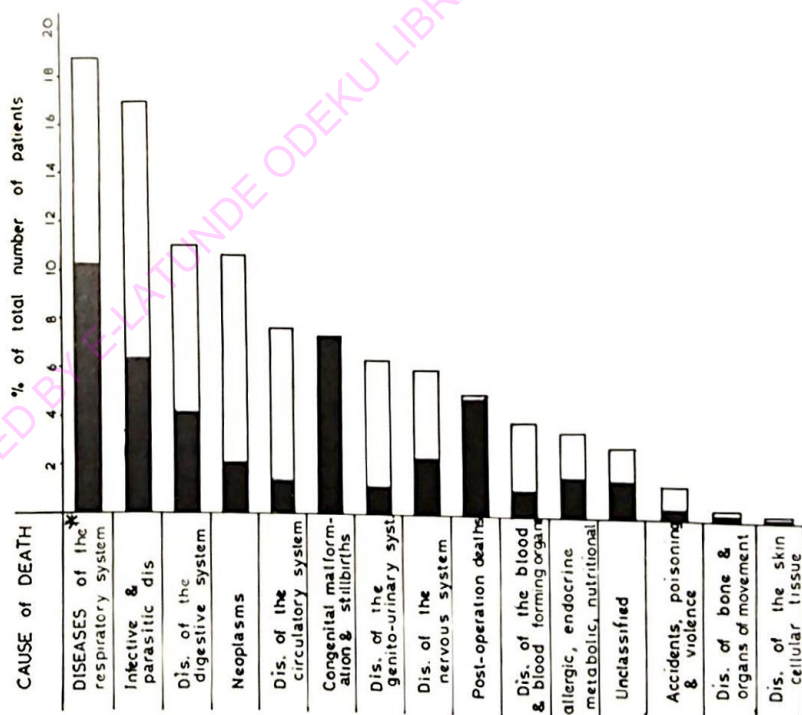


FIG. 1. Classification and frequency of the causes of death in 5407 autopsies at U.C.H. 1960–67. *Diseases of the respiratory system includes infective and primary lung diseases □, 2963 adults; ■, 2444 children; Total = 5407

notably bronchopneumonia as a terminal event, complicating other diseases, for example, measles. The autopsy diagnosis of bronchopneumonia would therefore be a diagnosis of convenience for the pathologist or he may have been misled by an inadequate medical history.

Acute malaria and acute infective fevers largely contributed to the high frequency of the infective and parasitic diseases in children. For children, this group made up 6.04% of all cases and 14.1% of causes of death in children. Tuberculosis, tetanus and typhoid fever are the foremost diseases contributing to the high percentage (10.85%) of the infective and parasitic diseases in adults.

A large number of congenital abnormalities, stillbirths and prematurity were recorded during 1960-65, during which time research was carried out on these cases.

The incidence of various diseases in male and female adult subjects had a fairly constant proportion, except in cases of diseases of the blood and blood-forming organs, where twice as many female as male subjects were seen. In children, neoplasms were seen more than twice as frequently in boys.

Distribution of spleen weights in adults

These are shown in Fig. 2 and Table 1. The histogram has a fairly smooth contour with positive skewing to the right towards the heavier spleens. The mean spleen weight for adults was calculated to be 251 g for females and 282 g for male subjects with an average of 271 g. In contrast to the findings in temperate climates, where

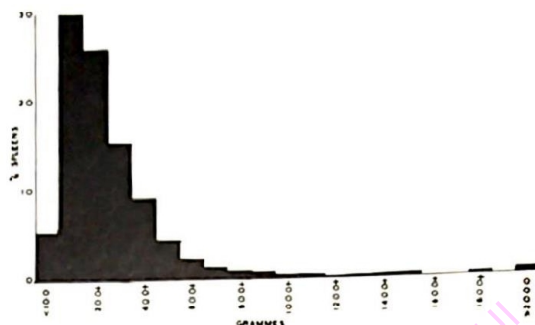


FIG. 2. Spleen weight distribution in adults showed that most spleens weighed below 500 g and there is a long tail to the histogram towards the heavier spleens.

the majority of spleens are under 200 g (Bean & Baker, 1919) only 35.5% of the spleens at autopsy in U.C.H. are under 200 g (Fig. 2). Shaper (1969) also found that in Ugandan Africans, only 26.5% of spleens had a weight less than 200 g.

Bruce-Chwatt (1956) had calculated that the palpability threshold of adult spleens was two-and-a-half times the weight of the normal organ. The weight of 500 g was therefore chosen to represent a spleen that would be just palpable. Although this figure is less than the value calculated from the mean spleen weight, it would allow for the variability from the mean figure. It was found that 409 of 2954 (13.5%) adults at autopsy in this study had spleen weights over 500 g.

Age and sex differences in mean spleen weight

The mean spleen weights in male and female subjects for different age-groups are shown in Fig. 3 and Table 2. The mean spleen weight

TABLE 1. Classification and frequency of causes of death at autopsy U.C.H. 1960-67

Causes of death	All Cases (%)*	Spleens—500 g (%)*	Spleens—1000 g (%)*
Diseases of the respiratory system	18.6	6.4	—
Infective and parasitic diseases	16.9	16.2	15.8
Diseases of the digestive system	11.0	12.8	2.6
Neoplasms	10.6	21.4	48.7
Diseases of the circulatory system	7.6	7.8	—
Congenital abnormalities, prematurity and stillbirths	7.3	—	—
Diseases of the genito-urinary system	6.3	6.8	—
Diseases of the nervous system and sense organs	5.9	4.4	—
post-operation deaths	4.9	0.4	—
Diseases of the blood and blood-forming organs	3.8	18.8	30.1
Allergic, endocrine, metabolic and nutritional diseases	3.4	0.8	—
Unclassified	2.8	—	—
Accidents, violence, etc.	1.3	1.0	—
Diseases of the bone and organs of movement	0.4	0.8	—
Diseases of the skin and cellular tissue	0.2	—	—

* Per cent incidence in each group

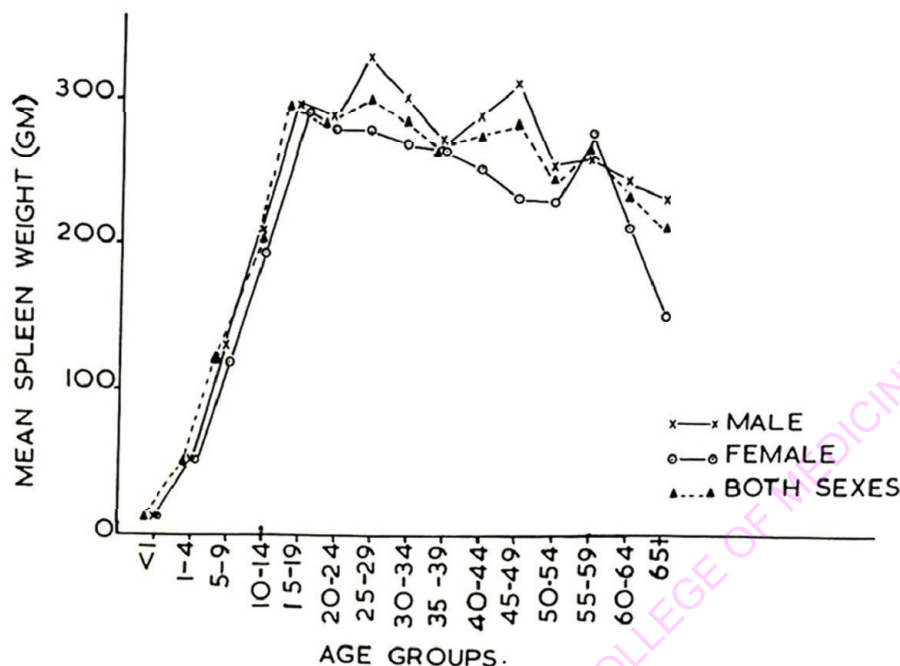


FIG. 3. Adult values are reached at the age of 15-19 years. There is a fall in mean spleen weight in older adults. Mean spleen weights were calculated on the log scale due to the uneven distribution (Fig. 2).

TABLE 2. Analysis of spleen weights in age groups at autopsy U.C.H., 1960-67 (Analysis is done on the logarithmic Scale)

Age group	Males (mean)			Females (mean)			Total (mean)		
	n	log wt.	s.e.	n	log wt.	s.e.	n	log wt.	s.e.
< 1	693	0.95	0.02	604	0.92	0.12	1297	0.94	0.01
1- 4	426	1.66	0.02	355	1.61	0.02	781	1.64	0.01
5- 9	139	2.27	0.03	140	1.98	0.04	279	2.02	0.02
10-14	167	2.27	0.03	104	2.17	0.05	271	2.23	0.02
15-19	151	2.43	0.21	112	2.40	0.04	263	2.41	0.02
20-24	139	2.44	0.02	191	2.42	0.02	330	2.43	0.02
25-29	201	2.47	0.02	274	2.42	0.01	475	2.44	0.01
30-34	205	2.44	0.02	202	2.40	0.01	407	2.42	0.01
35-39	169	2.39	0.02	117	2.41	0.02	286	2.40	0.01
40-44	161	2.40	0.03	105	2.36	0.03	266	2.39	0.02
45-49	150	2.45	0.03	79	2.33	0.03	229	2.41	0.02
50-54	157	2.37	0.02	72	2.32	0.03	229	2.35	0.02
55-59	88	2.38	0.03	39	2.40	0.05	127	2.39	0.03
60-64	134	2.35	0.03	34	2.30	0.03	188	2.33	0.02
65+	85	2.33	0.03	26	2.15	0.05	111	2.29	0.03

increases rapidly to reach a plateau at ages 15-19 years — that is young adulthood. There is a tendency for the mean spleen weight of male subjects to be greater than those of the female subjects, but due to the variation in individual values for each age group these values were found not to be significantly different from each other, their spleen weights are within the same statistical universe. The only exceptions were at

the ages of 45-49 years, and over 60 years, when the mean spleen weights of the male subjects were significantly larger than those for the female subjects.

Spleens weighing over 500 g

There were 409 adults with spleen weights over 500 g (13.5% of the total autopsy figure)

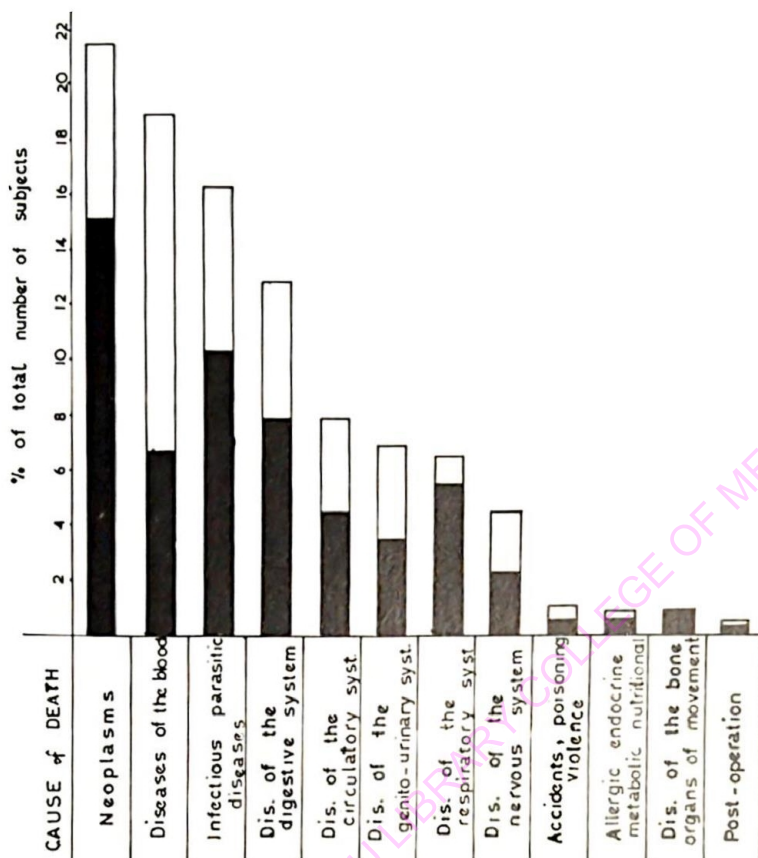


FIG. 4. Classification and causes of death in 409 adults with a spleen weighing more than 500 g. ■, male (242), □, female (167), Total = 409.

and twenty-six subjects under 15 years, with spleens weighing more than 500 g. The distribution according to the causes of death in adult subjects is shown in Fig. 4. There were 242 male subjects (59.2%) and 167 female subjects (40.8%). The proportions were similar to those in the autopsy of all cases.

All varieties of diseases were represented in this group with large spleens, but certain disease states were more frequently associated with splenomegaly, (Table 1). Neoplasms were first on the list and this included lymphoproliferative diseases, notably Hodgkins sarcoma, lymphosarcoma and other malignant lymphomas. Together with carcinomas and other sarcomas they constituted 21.4% of all cases of spleens weighing more than 500 g. Diseases of the blood and blood-forming organs were the next most common, cases of chronic myeloid leukaemia

and of acute on chronic leukaemia were prominent. The 3.9% for haemaglobinopathies recorded in this group had SC and SS genotypes and the causes of death were associated with pregnancy, sequestration crisis, acute infections or embolism.

Cirrhosis of the liver with portal hypertension and splenomegaly largely contributed to the 12.8% incidence of diseases of the digestive system. It was noticeable that diseases of the respiratory system that formed about 16% of all adult cases at autopsy now formed only 6.4% of cases with spleen weight over 500 g.

Spleens weighing more than 1000 g

There were seventy-six subjects with spleen weights over 1000 g. Clinically these patients would present with very large spleens most of

them extending beyond the umbilicus. The distribution of the causes of death is shown in Tables 1 and 3. Malignant conditions accounted for 66% of these cases and of these, 62% were tumours of the reticulo-endothelial system.

TABLE 3. Causes of death in seventy-six subjects with spleens weighing more than 1000 g at autopsy

Cause of death	No.	Percentage	
Lymphoreticular tumours			
Malignant lymphoma (unspecified)	14	18.4	
Lymphosarcoma	9	11.9	
Reticulum cell sarcoma	7	9.2	44.8
Hodgkins	4	5.3	
Leukaemia			
Chronic myeloid leukemia	7	9.2	
Acute on chronic leukemia	5	6.6	17.1
Chronic lymphatic leukemia	1	1.3	
Septicaemia	5	6.6	
Tuberculosis	4	5.3	
Haemoglobinopathy SS	3	3.9	5.2
Haemoglobinopathy SC	1	1.9	
Anaemia of pregnancy (AA Hb genotype)	3	3.9	
Abscess of spleen	2	2.6	
Cirrhosis of the liver	2	2.6	
Tropical splenomegaly syndrome	2	2.6	
Haemolytic anaemia (? cause)	2	2.6	
Seminoma, Hepatoma, Adrenal tumour (1 case each) histoplasmosis duboisii			

Discussion

A study of spleen weights in cases who died accidentally would have represented more closely the normal population. The numbers of these are very small in the U.C.H. records, and furthermore the few performed annually are usually coroner's post-mortems. Bruce-Chwatt (1956), in Lagos, was able to compare the spleen weights in Africans who died from all causes and those who died accidentally. He showed that there was no significant differences in spleen weight between these two groups, at all ages. He felt that both belong to the same statistical universe.

Previous findings, that mean spleen weights in Africans were bigger than those of Europeans, have been confirmed in this study.

In most temperate climates, the average spleen of a European is 171 g (Greenwood, 1904). This is similar to the mean figures of 160 g

for American whites. American negroes had a lower average of 100 g (Bean & Baker, 1919). Vint (1937), in East Africa, found the mean adult spleen weight of Africans to be 385 g. Bruce-Chwatt (1956), in Lagos, found the mean adult spleen weight in his cases to be 265 g for both sexes. This is similar to the findings in this study where the average spleen weight for adult female subjects was 251 g and that for adult male subjects was 282 g and for both sexes 271 g.

The possession of heavier spleens by Africans in the tropics does not seem to have a genetic basis, since spleen weights of negro Americans (children and adults) are even less than those of their caucasian counterparts (Darling, 1924) quoted by Bruce-Chwatt (1956). Other races in the tropics also have high mean spleen weights. For West Indian negroes in the Caribbean, Daniels (1894) found a mean spleen weight of 220 g, while indigenous Indians had a higher figure of 454 g and the Spanish Americans living in the Caribbean had a high average spleen weight of 600 g.

The heavier mean spleen weights found in Europeans, living in certain parts of the tropics where malaria is endemic, would correspond to the heavy spleens and high spleen rates found in children in the tropics before immunity to malaria was fully developed. Bruce-Chwatt (1956) had noticed that the spleens of Africans became smaller, later in life, due to atrophy of the organ. The results in this study bear this out. The mean spleen weight decreased after the age of 29 years. This decrease became more significant after the age of 50 years (Fig. 3).

A study of spleen weights as a ratio of total body weight of 1917 autopsies in Nigerians has shown that spleen weight indices reduced significantly after the age of 14 years, and more so by the age of 40 years (David-West, 1975). The highest index of 10.8 g/kg body weight was obtained at the ages 5-9 years and by 40 years of age it was 5.1 g/kg body weight. This was thought to be related to the intense lymphoreticular stimulation in the younger age-groups.

The high incidence of infective and parasitic diseases in the group with spleens weighing over 500 g showed that the spleen was important in the reticulo-endothelial response to external stimuli. There was also a preponderance of malignant lymphoma and chronic leukaemia among the diseases in which the spleen was enormously enlarged (Table 3). It was also

noted that miliary tuberculosis, without any evidence of an associated lymphoma, could be the cause of an enormous spleen. The tropical splenomegaly syndrome, which frequently presents with a very large spleen extending below the umbilicus, although of incidence less than 0.1% and more commonly seen in women (Sagoe, 1971), represents the tail end of a continuous spectrum (Fig. 2). The findings shown in Table 3 and Fig. 4 of diseases giving rise to large spleens should therefore be of value in the differential diagnosis of enlarged spleens in the tropics.

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