Original article

Visceral leishmaniasis in Southern Ethiopia II. Nutritional risk factors

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Abstract: A prospective nutritional assessment was conducted as part of a longitudinal study of visceral leishmaniasis (VL) in southern Ethiopia. The study showed that the nutritional status of the study population was generally poor and compared to the apparently healthy study subjects, individuals who later developed VL had poor or low nutritional status. Cured cases of VL were also found to have a compromised nutritional state. The study shows that poor nutritional status is a risk factor, predisposing to VL. Further, preceding VL was also indicated to have a profound effect in suppressing the nutritional status of victims of the disease. [*Ethiop. J. Health Dev.* 1997;11(2):139144]

Introduction

In developing countries, malnutrition and infection account for the majority of the morbidity and mortality especially in children. Both have also been shown to interact synergistically. From the epidemiological point of view, disease has a multifactorial causation and is generally the outcome of the interaction between the agent, the host and the environment. Nutritional status is among the notable host factors which play a determinant role in disease causation.

Although the synergistic effects of malnutrition and infection are well supported by evidence (13) and have been accepted as part of the clinical dogma without the critical examination or attempts to control the other variables which so often accompany malnutrition, there are reports which provide data to support the existence of the reverse phenomenon, i,e. antagonism of malnutrition to infection (4-6). A definite relationship between host nutrition and certain protozoan infections has been established (4-8), however, little information exists concerning the relation of VL to host nutritional status.

Fendall (9) reported that Kala-azar is a negative contributor to caloric and nutritional balance in humans as evidenced by the presentation of patients with marked wasting, lustreless hair, trophic skin changes, oedema and protruding abdomen. Most of these findings are quite commonly observed in kala-azar patients, but the literature on the role of nutritional status in susceptibility to infection and overt clinical disease has been very strictly limited until very recently.

Badaro *et al*.(10) suggested that among other factors, poor growth due to malnutrition contributes significantly to the occurrence of infantile VL. In another study, Harrison *et al*.(3) hypothesised that under-nutrition is associated with the development of clinically apparent VL and that the disease itself has a profound effect on nutritional status.

Jahn *et al*.(11) documented that most parameters for nutritional assessment are significantly lower in VL-affected families than in others. Cerf *et al*. (12) have indicated that malnutrition is a risk factor

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has increased the susceptibility of the subjects to the disease. The few attempts and hypotheses postulated on the association between nutritional status and VL await confirmation by further community- based studies in different ecological set-ups. In this study, nutritional status was documented prospectively in the majority of the study subjects, i.e., before the development of classical VL and in very few already cured VL cases, in the most highly endemic area of VL known

for severe VL. It was not, however, explicitly indicated in the latter report whether it is the disease which has compromised the nutritional status or the low nutritional status which

in Ethiopia (13) to examine the relationship between malnutrition and the visceral form of leishmaniasis.

Methods

Study area and population: The study was conducted as part of a longitudinal study of visceral leishmaniasis in Aba Roba Peasants' Association, Konso District (Gamo Gofa), in the Southern peoples' Administrative Region. The study population for the multidisciplinary study, which included prospective nutritional assessment of non-VL (apparently healthy individuals) and very few cured cases comprised of 730 individuals of all ages and both sexes, sampled from 141 randomly selected households in three of the six villages in the Peasants' Association. According to the census conducted prior to the start of the study, the denominator population of the entire Peasants' Association was 4625. The size of the study cohort was determined by employing appropriate statistical procedures.

VL status and follow-up of study subjects: All study subjects were initially screened for VL and their health status regarding the disease was properly established. Following the screening for visceral leishmaniasis, the nutritional status of the study population was assessed employing anthropometric and clinical techniques. Then all individuals with the baseline nutritional information were followed for about a year (13-14 months) for the development of VL. On the 4-6 monthly periodic follow-up, all suspected cases were subjected to physical and laboratory examination. Diagnosis of VL was based on the detection of parasites in smears or cultures taken from spleen or bone marrow. Finally, the association and interaction of nutritional status and VL was examined. The information regarding the census variables, VL case finding and case determination is outlined in relative depth elsewhere (13, 14).

Evaluation of Nutritional Status: Clinical and anthropometric methods were used to evaluate the nutritional status of the study population. In the clinical study, effort was made to detect, especially in children, changes in hair and skin, oedema, subcutaneous tissue loss, presence of diarrhoea, apathy, etc. Age, sex, weight and height were recorded to get anthropometric indices.

Age estimation: In the absence of birth registration, effort was made to get precise information regarding age. Parents and other study subjects were probed and guided to tell the ages of their children and of themselves by relating their ages or those of their children to certain historical events in the nation and in their locality. Sometimes ages of first children were used to estimate ages of parents and birth intervals were used to estimate the ages of siblings.

Anthropometric study: Weights and heights of children and adults were taken with standardised scales initially calibrated to zero. Clothes, just enough for privacy, were allowed during the weighing procedure. Weight was recorded to the nearest 0.1 kilogram.

For children under two years of age, their prone lengths with no foot or head wears were measured using standard techniques and measurements. For older children and adults, standing height was measured using scales fixed vertically to the wall of the field station. Height was recorded to the nearest 0.1 centimetre.

Data Management: Although only weight-for-height (for < 18 years) and body mass index (BMI) (for $\geq$ 18 years) are included in this paper, weight-for- age and height-for-age Z-scores were also calculated for the sector of the population where there is an international standard. The anthropometric software of the CDC (CASP V 3.0) which is based on the normalised NCHS/CDC anthropometric reference (15) was used to calculate the Z-scores. The BMI (16-17) was used to assess adult anthropometry and was calculated by dividing weight (Kg) by height (meters) squared. The nutritional status of study subjects was evaluated initially and the relation of the nutritional

status to parasitologically confirmed VL was investigated. The nutritional status of old cases of VL (cured before the nutritional assessment) in the cohort was also examined.

Results

Nutritional status of the study cohort: Out of a total of 4625 target population of the Peasant's Association, 730 study subjects were assessed on clinical and anthropometric parameters for their respective nutritional status.

Clinical findings: All study subjects were screened for VL prior to the start of the nutritional assessment and all were proved to be free from at least the clinical form of the disease. However, 34 of the study individuals were cured VL cases (treated 2-4 years before the start of this Study).

Table 1: **Clinical nutritional findings by age in a study cohort of 730, Aba Roba, Southern Ethiopia, 1989/90.**

Age Group	FindingS								
		Diarrhoea		Hair change		Skin change		Oedema	
		No. % pos.		No. % pos.		No. % pos.		No. % Pos.	
	N	pos.		pos		pos		pos.	
0-4	(144)	35	24.3	18	12.5	10	6.9	4	2.8
5-14	(234)	12	5.1	8	3.4	7	3.0	7	3.0
15-24	(104)	2	1.9	7	6.7	6	5.8	4	3.8
25-34	(83)	3	3.6	0	0.0	4	4.8	4	4.8
35-44	(78)	3	3.8	3	3.8	4	5.1	1	1.3
45-49	(52)	0	0.0	1	1.9	2	3.8	1	1.9
60+	(35)	1	2.9	0	0.0	3	8.6	0	0.0
Total	(730)	56	7.7	37	5.1	36	4.9	21	2.9

NB: Positive - those with stated findings

In the clinical nutritional assessment, diarrhoea, hair change, skin change and oedema were among the major clinical signs observed (Table 1). Among the study individuals 7.7% had history of diarrhoea during the initial checkup, while 5.5% had hair change, 4.9% skin change and 2.9% oedema. About a quarter of the children four years of age and under had history of diarrhoea during the examination, while about 50% of cases with hair change were in the same age group. Of all the subjects, 83.9% with diarrhoea, 70.3% with hair change, 52.4% with oedema

Table 2: **Weight for height Z-score for 301 study children in Aba Roba, Southern Ethiopia, December 1989/90.**

Z-score	No. in the group	%of the total	cumulative%
-3.9 to -3.0	5	1.7	1.7
-2.9 to -2.0	32	10.6	12.3
-1.9 to -1.0	87	28.9	41.2
-0.9 to 0	128	42.5	83.7
0.1 to 1	45	15.0	98.7
1.1 to 2	1	0.3	99.0
2.1 to 3	1	0.3	99.3
3.1 to 4.1	2	0.7	100.0
Total	301	100.0	
*	121		
Grand Total	422		

* NB. Those with height > 145 cmfor girls or < 49 cms for both sexes, but <18 years. for boys, > 137 cm

and 47% with skin change were children aged 14 years or less. The findings were relatively rare in the opposite extreme of the age groups. Furthermore, four evident cases of Kwashiorkor, six marasmic-Kwashiorkor and 20 marasmus were observed in children under five years of age.

Anthropometric Nutritional Findings: Weight and height of the study population were measured and recorded against age and sex of the respective subjects. The Z-score for weight-for-height was calculated for those with heights up to 137 cm for girls and 145 cm for boys, for those for whom there is an international standard (Table 2). The Z-score for weight-for-height ranged from -3.9 to 4.1. About 12% of the study individuals had weight for height Z-score below-2 standard deviation. The body mass index was calculated for those aged 18 years and above (Table 3).

One adult study subject had a BMI as low as 15.9, while another at the opposite extreme had a BMI of 24.6. The mean BMI was 19.84 $\pm$ 1.77. The 95% confidence interval for the BMI ranged from 16.3 to 23.4.

Relation of Nutritional Status to leishmaniasis: In the course of the observation, 10 of the study subjects developed confirmed VL. The baseline nutritional status of the ten incident cases of VL, was compared to other studies. The clinical nutritional assessment parameters showed that individuals with adverse nutritional status had a higher risk of

development of VL compared to their apparently healthy cohorts (Table 4).

Table 3: **Body mass index (BMI) for age groups $\geq$ 18 years old, Aba Roba, December 1989/90.**

Range of BMI	No.	%	Cumulative %
15.9 -16.9	7	5.5	5.5
17.0 -17.9	27	8.8	14.3
18. 0 -18.9	57	18.5	32.8
19.0 -19.9	66	21.4	54.2
20.0 - 20.9	72	23.4	77.6
21.0 -30.9	31	10.1	87.7
22.0 -40.9	21	6.8	94.5
23.0 -50.9	11	3.6	98.1
24.0 -60.9	6	1.9	00.0
Total	308	100.0	

As depicted in Table 4, individuals with history of diarrhoea and finding of hair change and oedema appeared to have a higher relative risk of developing VL. However, close to statistically significant difference was observed only with subjects with hair change. The hair change was characterised by sparsity, colour change and easy placability.

The anthropometric parameter, body mass index (BMI), was employed as a measure of thinness to assess the nutritional status of all age groups, including those who later developed VL and the rest of the cohort (Table 5). The BMI of the total study population ranged from 10.4 to 24.6. Grossly, a certain degree of thinness seemed evident in individuals who later developed VL compared to apparently healthy subjects. A statistical test was conducted by arbitrarily categorising those with BMI less than 18 as severely or moderately malnourished and those 18 and over as mildly malnourished or normal. The test showed that those with lower BMI had a relative risk of 5.9 times of developing VL compared to those with relatively higher BMI, i.e., BMI $\geq$ 18. The difference was statistically significant ($X^2 = 6.4$, $P < 0.02$).

Although not presented in the table, it was also very interesting to note that 20 of the 22 (90.9%) study subjects (< 18 years of age) who were confirmed and treated for VL over the years (before the

nutritional assessment) had weight-for-age Z-scores of less than, or just equal to, the standard median.

Table 4: **Clinical nutritional findings of 10 cases of VL prior to diagnosis, compared to their non-VL study colleagues, Aba Roba, 1988-1990.**

	Group		
Findings	Cases	non-cases	Total
Diarrhoea			
Yes	2	54	56
No	8	666	674
Relative - Risk		3.08	
Chi - square			2.17
P - value	0.175 (Fishers exact)		
Hair change			
Yes	2	35	35
No	8	688	688
Relative - Risk		4.89	
Chi - square		4.69	
P - value	0.087 (Fishers exact)		
Oedema			
Yes	1	20	21
No	9	700	09
Relative - Risk		3.89	
Chi - square		1.84	
P - value	0.255 (Fishers exact)		
Skin change			
Yes	0	36	36
No	10	684	694
Relative - Risk		0.00	
Chi - square		0.53	
P - value	0.601 (Fishers exact)		

Discussion

It is evident that the general nutritional status of the study population is far below the accepted standard. The protracted drought in the area and the prevailing poverty and ignorance could be incriminated for the unfavourable nutritional status. Further analysis of the clinical and anthropometric nutritional findings showed that individuals who later developed VL had a compromised nutritional status compared to apparently healthy study counterparts. The interpretation of the association of nutritional status with VL would be difficult in view of the controversial findings available to date on the subject. Certain animal experiments showed that there were no significant differences in the degree of infection with *L. donovani* in animals of different nutritional status (18-19) while others claimed that physiological status of the host as affected by dietary intake influences the course of VL (20).

An earlier work showed, on circumstantial evidence, Kala-azar as being rather a negative contributor to caloric and nutritional balance in humans (9). Recent studies have, however, shown that most parameters for nutritional assessment are significantly lower in VL affected families and individuals (10-12). Nevertheless, the hypothesis which highlights that under-nutrition is associated with the development of clinically apparent VL and that the disease itself has a profound effect on nutritional status resulting in loss of both muscle and fat (3) seems to be a plausible conclusion for the time being.

Twenty of the 22 treated cases of VL (90.9%) had low weight-for-age ratio. Under- nutrition, in a variety of its types and degrees, has been found to be synergistic with increased risk of morbidity and mortality (1-2,21-22). The findings in the current study could, however, be explained as either the preceding disease suppressing the nutritional status of subjects or an initial low nutritional status predisposing them to a subsequent disease.

Table 5: **Baseline body mass index in 10 incident VL cases and other study subjects, Aba Roba, 1988-1990.**

Range of BMI	Status of disease				
	VL cases		Non-cases		Total
	n	%	n	%	
10.0-11.9	1	10	3	0.4	4
12.0-13.9	1	10	66	11.9	87
14.0-15.9	5	50	202	28.1	207
16.0-17.9	1	10	137	19.0	138
18.0-19.9	0	0	143	19.9	143
20.0-21.9	2	20	109	15.1	111
22.0-23.9	0	0	34	4.7	34
24.0-24.6	0	0	6	0.8	6
Total	10	100.0%	720	100.0	730

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