

## SHORT COMMUNICATIONS

### Is cell-mediated immune response related to nutritional state, but unaffected by concomitant malarial infection?

Cell-mediated immunity is depressed in malnutrition (Chandra and Newberne, 1977). In regions where malnutrition and malaria are both present, interaction of these two factors might be suspected, as malaria has also been implicated in immunodepression. However, although the humoral response is almost certainly depressed in malaria, the cell-mediated response is possibly maintained (McGregor and Barr, 1967; Greenwood *et al.*, 1971a; Greenwood *et al.*, 1971b; Moore *et al.*, 1977). To help elucidate this point, we analysed the frequency of positive/negative reactions to the phytohaemagglutinin (PHA) skin test in groups of normal and malnourished children, in the presence or absence of a malarial infection.

We examined 293 children of both sexes, aged six to 36 months, from the savannah villages of Diabatou, Kokologo, Toudou and Koniodou (Upper-Volta), during a survey prior to a vaccination campaign against measles. The project was sponsored by the Délégation Générale à la Recherche Scientifique et Technique (Paris) and the study was conducted between December 1977 and April 1978, during the dry season, when food was most available. A series of anthropometric measurements were performed; we considered weight to be the most reliable parameter, and we defined malnutrition as a weight for age of  $\leq 70\%$  that of the Harvard standard value (Jelliffe, 1969). Children were considered in normal nutritional state if their weight for age was  $\geq 80\%$  of the standard; values between 70% and 80% were disregarded to increase discrimination. The presence of *Plasmodium* spp. was checked by the examination of 500 fields on a thick smear; when positive, the species were determined on a thin smear. Ten  $\mu\text{g}$  of PHA (Wellcome) were injected intradermally and the maximum diameter of induration was measured, always by the same person, 48 hours later. Diameters of at least 5 mm were taken to indicate a positive response.

Simultaneous assessments of nutritional state, malarial infection and PHA skin reaction were possible in 165 children, in whom a physical examination excluded any other associ-

TABLE  
Numbers of positive or negative PHA skin tests in good and poor nutritional states, stratified by smear, positive or negative for *Plasmodium* spp.

Smear	PHA test	Weight/Age		Total
		$\geq 80\%$	$< 70\%$	
Positive	+ve	25	3	28
	-ve	58	32	90
		83	35	118
Negative	+ve	8	1	9
	-ve	21	17	38
		29	18	47
				165

ated pathology. Moreover, all serodiagnosis tests for schistosomiasis were negative. A preliminary inspection of the data supported the assumption that the frequency of positive reactions was unrelated to age or sex. The frequencies of positive and negative reactions as a function of the other two factors are shown in the Table. As an estimate of the relative probability of finding a positive PHA test in the well nourished group, compared with the malnourished group, we computed separate odds ratios for the fourfold table with smears positive for *Plasmodium* spp. ( $\psi_{m+}$ ) and for the fourfold table with negative smears ( $\psi_{m-}$ ). In order to improve precision we added  $\frac{1}{2}$  to each outcome. Odds ratios and their 95% confidence intervals (C.I.) were computed following the method described in Armitage (1971) and attributed to Woolf (1955). By the same method, we then calculated a pooled  $\psi_{m+}$ ,  $m-$  and tested the heterogeneity of  $\psi_{m+}$  and  $\psi_{m-}$  applying the appropriate  $\chi^2$  index.

$\psi_{m+}$  was equal to 4.0 (C.I.: 1.22-19.44);  $\psi_{m-}$  to 4.6 (C.I.: 0.72-29). These C.I. values are likely to be underestimated, because of the small sample sizes, mainly in the negative smear stratum (Brown, 1981). However, given the complete overlap, there is no need to be more conservative.  $\psi_{m+}$ ,  $m-$  is 4.2, closer to  $\psi_{m+}$ , as expected, since the method is biased in favour of larger samples. Obviously,  $\psi_{m+}$  and  $\psi_{m-}$  are not heterogeneous ( $\chi^2 = 0.044$ ,  $0.7 < P < 0.9$ ), i.e. a malaria-malnutrition interaction was not detected. Due to different sample sizes, the association of skin reactions and nutritional state is better shown in the positive smear group; in the negative smear group the C.I. of  $\psi_{m-}$  includes 0 (a Fisher exact test gives  $P = 0.128$ ).

Two points are worth noting. First, 71.5% of our children had malarial parasites (*P. falciparum*) in their blood, a common finding in this study area. Second, only 22.4% of all children and 29% of the children in a normal nutritional state had a positive PHA reaction, at variance with the 95% (Neuman *et al.*, 1975) or 98% (Bourrier-Reynaud, 1978) reported in other series of healthy children. There is unlikely to have been a misclassification of the nutritional states in our figures, as the use of weight for age alone can at worst overestimate acute malnutrition, and no child presented with oedema (severe malnutrition is marasmic in this region). In order to investigate cell-mediated responses, PHA testing should be preferred to tuberculin testing, as the PHA does not depend on previous exposure to the immunogen. However, the conditions of its specificity as an indicator of 'anergy' might still deserve further investigation.

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