

## A STUDY OF LIVER RESERVES OF VITAMIN A IN MALAYSIANS\*

N CHANDRASEKHARAN MBBS. MRCPath\*\*

### Summary

Liver reserves of vitamin A were estimated by analysis of liver specimens obtained at autopsy from 92 subjects. The mean concentrations of vitamin A in adult livers were as follows:

- (a) 100  $\mu\text{mol/kg}$  (29  $\mu\text{g/g}$ ) in accidental deaths
- (b) 94  $\mu\text{mol/kg}$  (27  $\mu\text{g/g}$ ) in disease related deaths

In the case of newborns it was 84  $\mu\text{mol/kg}$  (24  $\mu\text{g/g}$ ). These values are much lower than those reported from the developed countries. The significance of the findings are discussed and inadequate levels of intake of nutrients is suggested as a possible cause for the low liver reserves of vitamin A in Malaysians.

### INTRODUCTION

The liver contains more vitamin A than other organs in the body and under normal circumstances in healthy individuals 90% or more of the total body stores of vitamin A are found in the liver, whereas only 1-3% is in the circulation.<sup>1</sup> The serum and liver concentrations of vitamin A are not correlated in adequately nourished individuals, and serum levels reflect liver levels only when the liver stores are depleted.<sup>2</sup>

There are reports on the determination of liver reserves of vitamin A from some countries.<sup>3,4</sup> However no figures have been recorded for Malaysia, where vitamin A deficiency continues to be a health problem.<sup>5</sup> The present study provides baseline data on vitamin A reserves in Malaysians and thus affords a comparison with the findings from other countries.

### MATERIALS AND METHODS

Liver samples were collected from three types of autopsies:-

1. Accidental deaths - which included deaths due to motor vehicle accidents, falls, drowning, electrocution, shooting etc.,

2. Disease related deaths, including myocardial infarction, malignancy, septicemia, chronic illnesses etc.
3. Deaths in newborns - including still births, prematurity and a variety of other conditions.

Liver specimens weighing 1-2 g were collected from the right lobe at autopsy and were put in plastic bottles and screw capped. They were kept frozen till analysis. The liver specimens were weighed accurately and homogenised<sup>6</sup> and the vitamin A concentrations in liver extracts were determined by the trifluoroacetic acid procedure of Neeld and Pearson.<sup>7</sup> Information on age, body and liver weights and ethnic origin was obtained from autopsy records. The total liver content of vitamin A was calculated.

### RESULTS

The data were analysed according to the types of autopsies and ethnic groups in Malaysia. The results are summarised in Table I. In the accidental death group, the mean concentration of vitamin A for the 50 subjects was 100  $\mu\text{mol/kg}$  (29  $\mu\text{g/g}$ ). However there were considerable variations between the different communities.

\* This study was supported by research grant F88/77 from the University of Malaya, Kuala Lumpur, Malaysia.

\*\* Associate Professor, Department of Pathology, Faculty of Medicine, University of Malaya, Kuala Lumpur, Malaysia (Address for reprint requests).

TABLE I LIVER RESERVES OF VITAMIN A IN MALAYSIANS

	No. of subjects	Age (yrs)		Body weight (kg)		Liver weight (g)		Vitamin A conc. in liver (umol/kg)		Total liver content (umol)		
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
1. Adults												
a) Accidental deaths												
Malays	8	29	13	52	11	1106	215	63	59	70	62	
Chinese	22	25	17	43	12	1163	404	118	265	137	352	
Indians	20	41	18	48	12	1279	297	94	122	120	154	
b) <i>Disease related deaths</i>												
Malays	NIL											
Chinese	14	47	23	45	9	1261	328	66	73	83	110	
Indians	11	45	16	56	11	1581	437	129	185	204	304	
2. <i>Infants and newborn</i>												
<i>Disease related deaths</i>												
Malays	NIL											
Chinese	12	2.75	5	4.17	3.3	245	184	112	182	27	74	
Indians	5	0.75	1.34	3.31	3.0	120	105	27	21	4	4	

(Conversion: SI to traditional units

Liver vitamin A: 1 umol/kg= 0.29 ug/y).

The mean concentration of liver vitamin A amongst the Chinese was 119  $\mu\text{mol/kg}$  (34  $\mu\text{g/g}$ ) and this was much higher than those of the Malays and Indians. The sample size for the Malays was small, there being only 8 subjects. One Malay subject with a high level of 2457  $\mu\text{mol/kg}$  (704  $\mu\text{g/g}$ ) was not included in the results of this study.

In the disease related deaths, the mean concentration of liver vitamin A in 25 subjects was 94  $\mu\text{mol/kg}$  (27  $\mu\text{g/g}$ ). However data was available only for Chinese and Indians, with the latter group having a higher concentration than the Chinese. This was also the case with their body and liver weights.

In the newborns, the mean concentration of liver vitamin A for 17 subjects was 84  $\mu\text{mol/kg}$  (24  $\mu\text{g/g}$ ). The concentration of vitamin A in the Chinese infants was higher than those of the Indians, who had generally lower body and liver weights than the Chinese. The difference in the concentrations of the total liver content of vitamin A between the ethnic groups were not significant ( $p > 0.05$ ). The distribution of the

levels of vitamin A in the livers of the 92 subjects studied is shown in Figure 1. It is evident that the majority of the subjects (68%) had liver reserves below 70  $\mu\text{mol/kg}$  (20  $\mu\text{g/g}$ ) and that only 3% had levels above 350  $\mu\text{mol/kg}$  (100  $\mu\text{g/g}$ ).

The results of the present study on vitamin A reserves in the liver are compared with those reported from other countries in Table II. The Malaysians on the whole had a lower mean amount of liver vitamin A than those studied in other countries. In the accidental death group, the mean of 100  $\mu\text{mol/kg}$  (29  $\mu\text{g/g}$ ) is about half of that reported for Poland, a third of that reported for United Kingdom, a quarter of the U.S. figures and a eleventh of those reported from New Zealand.<sup>3</sup> Incidentally the New Zealand figures are the highest published so far.

## DISCUSSION

The use of liver samples obtained at autopsy has its limitations for the present study. The sample may not be representative of all living

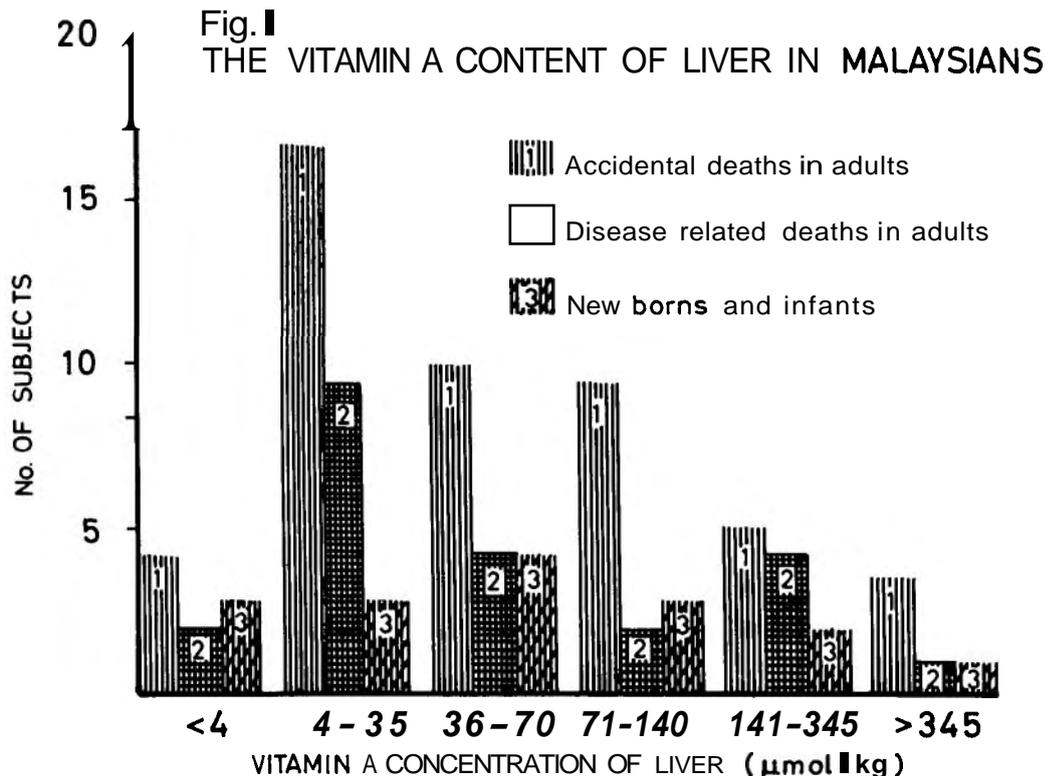


TABLE II LIVER STORES OF VITAMIN A REPORTED FROM SOME COUNTRIES  
WITH THOSE FOUND IN THE PRESENT STUDY

Country	No. of subjects	Vitamin A Concentration in Liver (umol/kg)	Cause of Death	Reference
Holland	18	49	Newborn/Stillborn	)
	78	189	Accidents	
United Kingdom	40	324	Accidents	)
United Kingdom	71	377	Accidents	
Poland	205	237	Accidents	)
New Zealand	13	1291	Accidents	
	110	1169	Any cause	)
Canada	31	436	Accidents	
U.S.A.	47	373	Accidents	)
	372	509	All causes	
Malaysia	50	101	Accidents	)
	25	94	Diseases	
	17	84	Newborns	

persons in Malaysia. However, studies on the liver reserves of vitamin A has to be confined to autopsy material, as other techniques for its measurement in the living person are unsatisfactory.

The analytical method used for the determination of vitamin A in the present study is different from that used by others elsewhere. The method of Neeld and Pearson<sup>7</sup> used in the present study is known to be a reliable one. The relatively low values for liver vitamin A in Malays may not reflect the true picture, as the sample size was small and the individual variations wide. The subjects in the accidental death group were assumed to be normal and without any pathology in the liver or other organs, other than that attributed to the accident. The values for liver vitamin A may be related to the original stores of the dietary intake.

In the disease related deaths, the values for vitamin A were generally lower than those of the accidental death group. This again may be related to the duration and chronicity of the illness. Any disease condition of short duration should not affect liver stores to any significant extent, whereas prolonged illnesses may affect

dietary intake and lead to depletion of liver reserves.

In the newborns, it is not possible to explain the differences in vitamin A values between the Chinese and Indians in the absence of nutritional histories. Newborn children generally have relatively low reserves of vitamin A, because the passage of vitamin A from the mother to the fetus is under stringent control. Because of their low body and liver weights, the Indian newborn might have been adversely affected.

Vitamin A concentrations of 70 umol/kg (20 ug/g) or higher are considered as satisfactory from birth to 10 years of age, values of 35–70 umol/kg (10–20 ug/g) as poor and 17.5 umol/kg (5 ug/g) and below very poor.<sup>1</sup> By this criteria the liver reserves of vitamin A are considered as adequate in the Chinese newborn, whereas it is definitely poor amongst the Indians. Pearson<sup>8</sup> estimated that normal human livers contain 350–450 umol/kg (100–300 ug/g) of vitamin A. By this criteria the values obtained in the present study are relatively low. With the daily requirements for vitamin A as 2.6 umol/kg (750 ug) in the adult the reserves in the Malaysians would suffice to meet about 50 days requirements on a vitamin A free diet.

This may be an underestimate as the preformed vitamin A is better utilised. In the case of the newborn the reserves are adequate to meet the requirements for a month, assuming that there is no dietary source of vitamin A.

Several factors might have contributed to the low amounts of vitamin A found in this study. As there is no *de novo* synthesis of vitamin A in the body the reserves have to be built by dietary sources. The consumption of foods rich in vitamin A – like meats, eggs, fish and milk are definitely lower in Malaysians than those reported for developed countries. A major source of vitamin A in Malaysia is from the carotenoids and as their utilisation is dependent upon adequate intakes of protein and lipids, it is possible that diets poor in these nutrients would affect the utilisation of the carotenoids and their subsequent storage as retinol esters.

#### ACKNOWLEDGEMENT

I wish to thank the staff of the Department of Pathology and the Clinical Diagnostic Laboratory for making this study possible and L.P.Y. and R.C. for secretarial assistance.

#### REFERENCES

1. Olson JA. The use of liver reserves as a measure of vitamin A status. *Xerophthalmia Club Bull* (Oxford) 1979; 19 : 2.
2. Raica N Jr, Scott J, Lowry L, Sauberlich HE. Vitamin A concentration in human tissues collected from five areas in the United States. *Am J Clin Nutr* 1972; 25 : 291–6.
3. Smith BM, Malthus EM. Vitamin A content of human liver from autopsies in New Zealand. *Br J Nutr* 1962; 16 : 213–8.
4. Hoppner K, Phillips WEJ, Murray TK, Campbell JS. Survey of liver vitamin A stores of Canadians. *Can Med Assoc J* 1968; 99 : 983–6.
5. Chandrasekharan N. Ecological assessment of vitamin A status of primary school children in Ulu Trengganu. *Med J Malaysia* 1975; 29 : 187–94.
6. Munusamy P. Effects of dietary protein and lipids on the utilisation of vitamin A and  $\beta$ -carotene in vitamin A deficient states. MSc thesis, University of Malaya, Kuala Lumpur, 1976.
7. Neeld JB Jr, Pearson WN. Macro- and micromethods for the determination of serum vitamin A using trifluoroacetic acid. *J Nutr* 1963; 79 : 454–62.
8. Pearson WN. Blood and urinary vitamin levels as potential indices of body stores. *Am J Clin Nutr* 1967; 20: 514–25.