RESULTS & DISCUSSION

CHAPTER 4

RESULTS AND DISCUSSION

The purpose of the present study was to evaluate the effect of the socio-economic factors and environmental conditions in the three types of tea plantations namely, British (B), Tea Corporation (TC) and Native (N) on health and nutritional status of male and female workers of these plantations. Hereinafter, the British plantation, the Tea Corporation plantation and the Native plantation are referred to as 'British', 'Tea Corporation' and 'Native' respectively.

In accordance with the objectives of the present study the results are presented under the following heads :

A. DESCRIPTION OF SOCIO-ECONOMIC (SE) AND ENVIRONMENTAL CONDITIONS IN THE THREE TYPES OF PLANTATIONS.

B. INFLUENCE OF PEAK AND LEAN TEA PLUCKING SEASONS ON THE FOOD AND NUTRIENT INTAKE AND ON THE HEALTH AND NUTRITIONAL STATUS OF WORKERS IN THE THREE TYPES OF PLANTATIONS.

C. EFFECT OF SOCIO-ECONOMIC AND ENVIRONMENTAL FACTORS ON THE HEALTH AND NUTRITIONAL STATUS OF THE WORKERS.

D. QUALITY OF LIFE INDEX (QLI) OF WORKERS IN THE THREE TYPES OF PLANTATIONS.

A sample of 1800 subjects, consisting of 900 male and 900 female plantation workers was selected from the three types of plantations. Information on socio-economic and environmental

factors was collected and the nutritional status was assessed using anthropometric measurements and haemoglobin estimations. The subjects were clinically examined for the deficiencies of both the micro and macro nutrients and their morbidity history during the experimental year was maintained.

Due to non-compliance on the part of the subjects, the stool examination could only be conducted on 882 male and 876 female workers. Similarly diet survey could only be conducted for 873 male and 870 female workers (Table 5).

TABLE 5

Coverage of plantation workers for various parameters

Sex of the workers	Parameters Studied						
	Socio-economic and environmental conditions	Anthropometry	Haemoglobin	Stool examination	Clinical examination	Diet survey	Morbidity
Male	900	900	900	882	900	873	900
Female	900	900	900	876	900	870	900
Total	1800	1800	1800	1758	1800	1743	1800

Plate 7:
Overview of the plantation

Plate 8:
Tea plucking in progress

Plate 9:
Weighing the plucked tea leaves at the site

The data were collected during peak and lean tea plucking seasons. The peak season lasts from June to November, when the tea plants are in full bloom and the full labour force is utilized for plucking (Plates 7 and 8). Each worker is expected to pluck a minimum of 20 kgs of tea leaves each day and an incentive in the form of extra cash is offered to him/her for every additional kg of tea leaves plucked (Plate 9). However, from the point of food availability, it is the lean season.

The lean season lasts from December to May. It is the time when the plucking is very low but other jobs like pruning, weeding, cleaning and manureing of the plants are done. From the point of food availability it is the peak season.

DESCRIPTION OF SOCIO-ECONOMIC AND ENVIRONMENTAL CONDITIONS IN THE THREE TYPES OF PLANTATIONS

The nutritional status of an individual or community is affected by socio-economic factors. Socio-economic status has a positive co-relation with the incidence of chronic and acute malnutrition. Socio-economic parameters, therefore, are likely to serve as useful indirect indicators of nutritional status.

Data presented under this heading deal with the type of family, size of the family, type of housing, source of drinking water, type of toilet used and the monthly per capita income of the workers of these three types of plantations.

The tea plantation labour is a landless population residing in 'basti' (colony) houses provided by the tea plantation authorities and in most cases both husband and wife work in the tea plantation. They receive all the basic amenities including food and firewood at subsidized rates from the tea plantation ration-shops.

Family type

The percentage of nuclear families was the highest and that of the extended and joint type of families was the lowest in the 'British'. The scenario however, was reversed in both the 'Tea Corporation' and the 'Native' where the percentage of extended and joint type of families was the highest (Table 6).

TABLE 6

Types of families among plantation workers in various plantations

Type of family	Type of Plantation		
	British (B) (%)	Tea Corporation (TC) (%)	Native (N) (%)
Nuclear	72 (431)	22 (131)	19 (117)
Joint	9 (54)	22 (135)	21 (126)
Extended	19 (115)	56 (334)	60 (357)

X^2 values between the plantations = 449.68 for df 4 significant at $p<0.001$

(Figures in parentheses indicate actual number of subjects.)

The workers reported that in the 'British', the house allotment is faster than in the other two plantation types. The early allotment of houses and the better housing facilities in the 'British' that the investigator observed might explain the significantly higher percentage of nuclear families in the 'British' than in the other two plantation types.

Bora (1985) had observed that above 81% of the families in the tea plantations of Assam were nuclear or extended nuclear. It is believed that in the nuclear families, distribution of food within the family is more equitable and well managed. This is reflected in the better nutritional status among the plantation workers and their family members in Assam (Phukan 1986).

TABLE 7

Size of the family in relation to plantation types

Size of the family	Type of Plantation		
	British (B) (%)	Tea Corporation (TC) (%)	Native (N) (%)
<3	11 (62)	1 (2)	1 (2)
4-5	75 (452)	70 (420)	69 (414)
6-7	12 (74)	25 (151)	24 (145)
>8	2 (12)	4 (26)	7 (39)
Average size of the family	4.1	5.1	5.5

X^2 values between the plantation type and size of the family significant at $p<0.001$

(Figures in parentheses indicate actual number of subjects.)

Family size

Table 7 reveals a significant association between the size of the family and type of plantation. Seventy per cent and above families in all the three plantations comprised of 4-5 members. The average family size in the 'British', 'Tea Corporation' and 'Native' was 4.1, 5.1 and 5.5 respectively. The small family size indicates the successful impact of family planning among the workers. Earlier, Unnikrishnan (1989) had reported that 50% families in South Indian tea plantations adopted family planning devices. The managements of the tea plantations provide incentives to the family planners in terms of facilities during delivery namely food items, medical facilities and maternity leave for 84 days. These facilities are restricted in the case of a third child and no facilities are provided for the fourth child.

In the present study it was observed that the facilities provided during the maternity period were better in the 'British' than the 'Tea Corporation' and the 'Native'. The 'British' management also took concrete steps in motivating the workers. Hence, the evidence of small family size in 'British' plantations.

Similar to the findings of the present study, Bora (1985) reported that 56% of the tea plantation families had less than five members per family. The remaining 44% of the families had 5 to 10 members. The author observed a better nutritional status

among those with a family size of five or less. In the present study a family constituted of 4 to 6 members.

Literacy/Educational status

The data on the literacy level of the workers are projected in Table 8.

TABLE 8

Educational status of the plantation workers in different types of plantations

Educational level	Type of Plantation		
	British (B) (%)	Tea Corporation (TC) (%)	Native (N) (%)
Illiterate*	63 (383)	90 (541)	97 (581)
Can read**	23 (136)	8 (45)	3 (19)
Can read and write***	13 (77)	2 (14)	- -
Primary pass	1 (3)	-	-
Upto middle school	3 (1)	-	-

X^2 values between the plantations = 278.54 significant at $p<0.0001$

(Figures in parentheses indicate actual number of subjects.)

* Cannot read and write his/her name.
** Can read his/her name.
*** Can read and write his/her name.

A better picture of literacy/educational status of workers was observed in the 'British' in comparison to the other two types of plantations. The 'Native' showed the worst picture with illiteracy being practically universal. These data suggest that literacy/educational status of the workers was significantly ($p<0.001$) associated with the type of plantations.

These findings are supported by those of Samarasinghe et al (1990) who had reported a low level of literacy among Tamil female plantation workers in Sri Lanka where 74% of the workers were illiterate. The authors concluded that the basic knowledge of nutrition and health care was lacking among the workers as a result of low level of literacy.

Unnikrishnan (1989) while studying the female tea plantation workers in South India reported that 50% of the women were illiterate. In two separate studies Bora (1985) and Baroova (1988) had observed zero level literacy among tea plantation workers of Assam as against 29% literacy in the State of Assam according to 1971 Census.

In a report by UNICEF (1989), a close association was established between the proportion of adults who were literate and proportion of children who were adequately nourished. Literacy rates have the advantage of measuring the spread of not only a desirable end result of development but a key means of participating in, and benefitting from all other aspects of the development process. Literacy has been proposed as the

corresponding "speedometer" of the rate of development and progress. In the present study, the literacy rate of the workers in the 'British' was higher than the other two types of plantations. Hence the indicator of progress was relatively the best in the 'British' plantations.

The level of literacy/education undoubtedly contributes much to the labourers' perceptions of their worth (Samarasinghe 1990). Improving the educational status of the labourers', has in the recent past, been increasingly appreciated for its importance as a determinant of health and nutrition. The State Government of Assam has given emphasis to primary level of education in the plantations but it does not seem to have had any noticeable impact as above 60% workers even in the 'British' were illiterate. Another reason for the poor picture of literacy/education might be the unwillingness of those who are literate or those who have a primary school education to serve as labourers although the management makes efforts to offer higher posts in the plantations to the slightly better educated ones. The vast majority of the labourers being completely illiterate might be a legacy of the colonial era. It was against the interests of the capitalist management structure during the late 19th and early 20th centuries to offer educational facilities to the plantation labourer. This sentiment has not changed much over the years from the worker's point of view. The adverse effect of illiteracy on health and nutrition is well established (Leslie et al, 1988).

Housing facilities

The housing facilities are provided by the plantation management. As per the rules of the plantations, the workers are entitled to get a single unit house with two rooms, one small kitchen and a front varandah; this unit is generally allotted to one family. There is also a double unit house with three rooms, front varandah and a back varandah (Appendix VI). These double unit houses are for two families. In the original plan of these two types of houses there was no provision for a toilet. But in 1983, an Act was passed to provide toilet facilities to the workers. The toilet facilities however are not modern or sanitary in these plantations except in the 'British'. There should be an individual toilet for each family in each unit. Even in the case of the 'British', 4/6 units share a sanitary toilet.

There was a significant association ($p<0.001$) between the type of housing and the type of plantation, with the 'British' (Plates 10 and 11) being significantly superior to the 'Tea Corporation' (Plates 12 and 13) or the 'Native' (Plates 14 and 15) (Table 9). Except for the 'British' plantations, the other two types of plantations did not reveal details of housing when questioned.

As was to be expected, the 'Tea Corporation' and the 'Native' plantations not only have greater earth floor dwelling units (Kutcha, Semi Pukka) but also have larger sized families living in such units. Hence congestion and poor environmental conditions aggravated the health and nutritional status of workers to a greater degree in the 'Tea Corporation' and the 'Native'.

Plate 10: A housing unit (double) on the 'British' plantation

Plate 11: A housing unit (single) on the 'British' plantation

Plate 12: A housing unit (double) on the 'Tea Corporation' plantation

Plate 13: A housing unit (single) on the 'Tea Corporation' plantation

Plate 14: A kutcha house on the 'Native' plantation

Plate 15: A semi-pukka house on the 'Native' plantation

TABLE 9

Influence of the type of plantation on the type of house of workers in the three plantations

Type of house	Type of Plantation		
	British (B) (%)	Tea Corporation (TC) (%)	Native (N) (%)
Hut*	-		4 (20)
Kutcha**	-	42 (240)	94 (565)
Semi pukka***	98 (588)	58 (358)	2 (15)
Pukka****	2 (12)	-	-

X^2 values between the plantations and type of houses = 1525.08 for df 6 significant at $p<0.001$

(Figures in parentheses indicate actual number of samples.)

* Small dwelling with thatched roof, bamboo walls plastered with mud, and floor of plain earth.

** Slightly bigger dwelling with thatched roof, walls made with concrete pillars and bamboo walls, plastered with mud and floor is of plain earth.

*** Both roof and walls are of galvanized tin sheets, concrete or cement and floor is of plain earth.

**** Roof is of galvanized tin sheets, concrete or cement walls and floor is of concrete and cement viz. a permanent construction.

Samarasinghe et al (1990) had reported that the housing facilities in general, in Sri Lankan plantations were not satisfactory. The workers were provided with one room and a varandah but no kitchen and in some cases just two small rooms. These line houses are again shared by the relatives of the legitimate workers and become even more over-crowded and congested.

Primitive and erratic water supply, lack of toilets and sanitation problems surrounding the house contribute to poor hygiene and environmental conditions leading to diarrhoea and worm infestations.

Rahamathullah (1987) reported that the plantation workers of South India reside on the estate in a colony, which houses clusters of families. These colonies comprise of line houses provided by the plantation. According to the authors, in general, housing in South Indian plantation was not good. On the other hand, the environmental health related aspects of the gardens which were financially assisted by United States Agency for International Development (USAID) were found to be impressive. In the USAID assisted gardens 85% of the plantation workers were provided with chlorinated water. Forty two per cent of the households in these gardens were provided with attached latrines and bathrooms. Further, 18% of these households were using smokeless chulhas as cooking units. The health status of these workers was better than the workers of the rest of the South Indian plantations. The incidence of morbidity was reduced among the workers in this project as compared to that in the past.

Unnikrishnan (1989) reported that the housing conditions of South Indian plantations were below standard. Lack of habitable shelter with proper sanitation and hygiene was common in all plantations. The author stated that the balance between growth of labour population and housing facilities is not maintained properly hence, line houses become over-crowded.

Bora (1985), while studying the plantation workers of Assam reported housing facilities with poor hygiene and environmental sanitation. Phukan (1986) also reported poor housing facilities among plantation workers of Assam. Her studies, however, were limited to the 'Native' type of plantations in Assam.

The critical analysis of various studies indicate that housing in general, among the plantation workers is not of a minimum acceptable standard to attain a good state of health. But in the present study relatively better housing facilities were observed in the 'British' plantations in Assam. It can therefore be hypothesized that workers in the 'British' were in a better state of health. This has been borne out as can be seen in Section C of this Chapter.

Water supply

There was a close association ($p<0.001$) in relation to type of water used and the type of plantations with a relatively better situation in the 'British' plantation (Table 10).

TABLE 10

Drinking water source in different plantations

Sources of drinking water	Type of Plantation		
	British (B) (%)	Tea Corporation (TC) (%)	Native (N) (%)
*Unsafe	2	2 (10)	98 (589)
**Safe	99.8 (599)	98 (590)	2 (11)
Total	100 (600)	100 (600)	100 (600)

X^2 Values between the gardens = 1702.66 for df 2 significant at <0.001

(Figures in parentheses indicate actual number of samples.)

* Water from open tanks and wells.

** Water from tap.

It was encouraging to note that almost everyone in the 'British' (Plate 16) (99.8%) used safe water followed by the 'Tea Corporation' (Plates 17 and 18) (98%). However the picture was almost opposite in the case of the 'Native' (Plates 19, 20 and 21) plantation, where 98% used unsafe water. The water facilities are provided in all types of plantations. In the 'British' plantations every four households share a water tap. Similarly, there is a water tap in every lane of the 'Tea Corporation'. The 'Native' plantation also provides community water supply at a central place to the labourer. In the 'Native' plantation, workers use water from nearby unsafe water sources such as tanks or ponds as safe water is not available closeby.

Plate 16: Source of water on the 'British' plantation

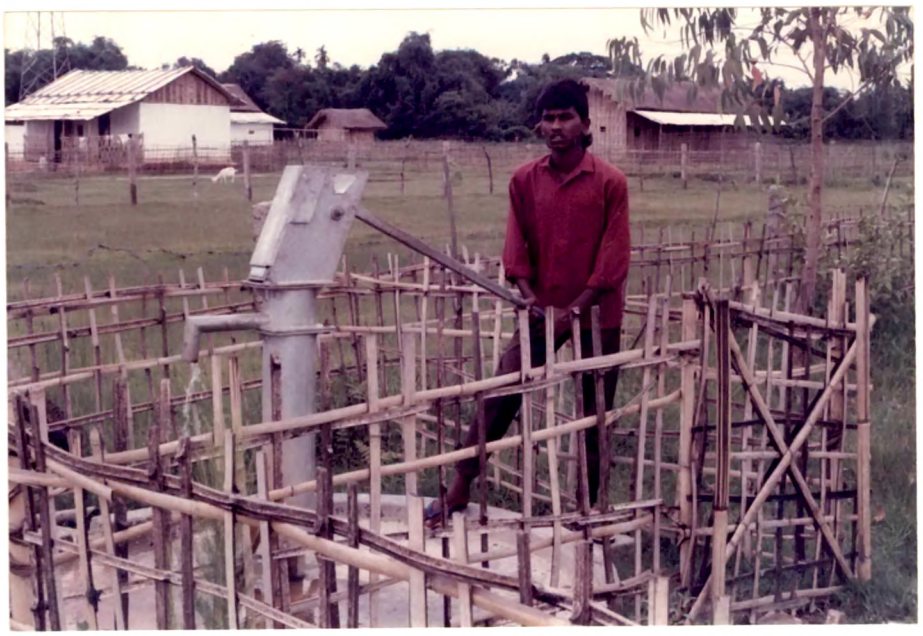


Plate 17: Source of water on the 'Tea Corporation' plantation

Plate 18: Source of water on the 'Tea Corporation' plantation

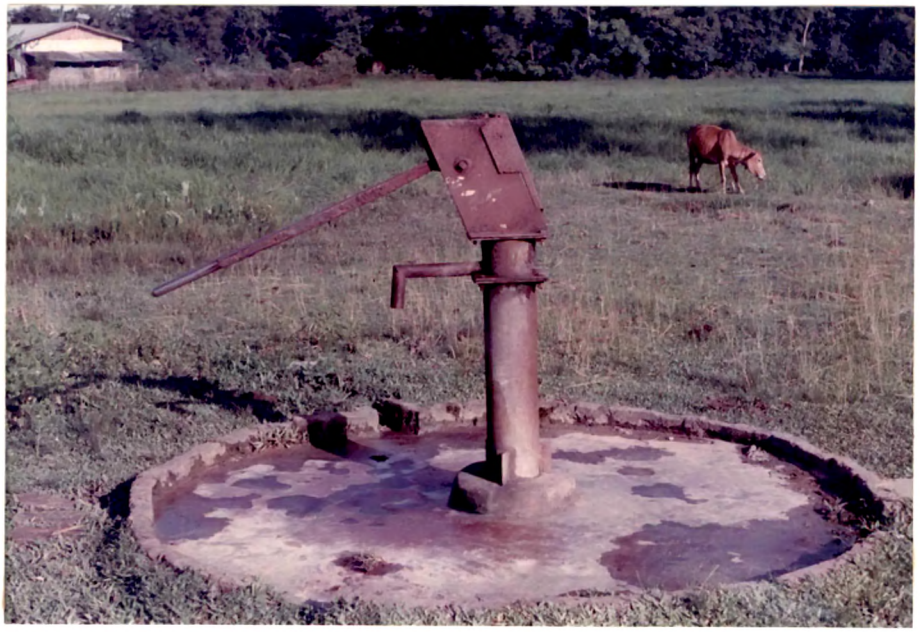


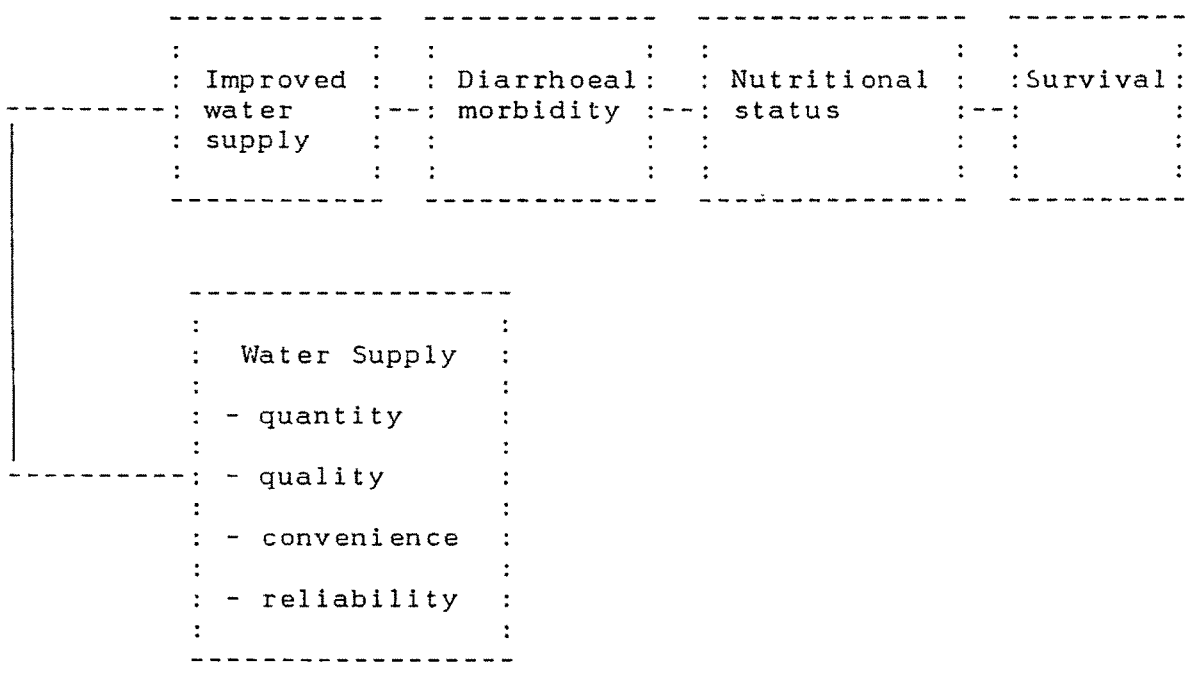
Plate 19: Source of water on the 'Native' plantation

Plate 20:
Source of water on the 'Native' plantation

Plate 21:
Source of water on the 'Native' plantation

Source of water has a positive co-relation with the incidence of chronic and acute undernutrition. Ameresekere (1984) reported a high incidence of under-nutrition among Sri Lankan families with poor water facilities. Sai (1983) studied the agricultural communities in Thailand in relation to the influence of water and sanitation on health. He stated that due to unsafe sources of water, infectious and communicable diseases and helminthic infestations were very common. He further added that water management was a very important consideration for agriculture as well as for general health and nutrition of the communities.

Isely (1982) also reported an association between the type of water and diarrhoeal morbidity. The flow diagram of his concept is presented below:



From the flow diagram it is evident that improved water supply is a composite of quantity of water available and quality of the water. The water source should be convenient to the people. A close association between the source of water and diarrhoeal morbidity has been reported. It is well known that morbidity directly affects the nutritional status and ultimately affects the survival of the population (Ameresekere 1984). Morbidity declines as a consequence of providing safe drinking water (Unnikrishnan 1989, Rahamathullah 1987).

The result of the present study highlighted the fact that 'British' and 'Tea Corporation' enjoy better or improved water supply. In contrast, the 'Native' plantations are deprived of improved water supply in all aspects like quality, quantity, convenience and reliability as listed by Isely (1982).

Use of toilets

Table 11 reveals that most of the labourers in the 'British' plantation used sanitary toilets. The reason was that there was a sanitary toilet between every two households in the 'British' plantations and the management strictly ordered them to use it. But in caseof the'Tea Corporation' sanitary toilets were on a community basis. In case of 'Native' the sanitary toilets were practically absent.

Provision of toilet facility by the plantation management and its proper use by the workers have been associated with

enormously improved nutrition and health status of the plantation workers (Ameresekere 1984 and UNICEF 1989).

In the present study, 82% of the workers in the 'British' were using sanitary toilets while 76% of 'Tea Corporation' and 88% of 'Native' used non-sanitary and 'open air' respectively. Samarasinghe et al (1990) reported that 50% of the Tamil plantation workers in Sri Lanka used toilet facilities while the other 50% go to the fields or use the hillside for defecation purposes.

TABLE 11

Toilet facilities used by the plantation workers in different types of plantations

Toilet facilities used	Type of Plantation		
	British (%)	Tea Corporation (%)	Native (%)
Open air	2 (13)	24 (141)	88 (592)
Non-sanitary* toilet	16 (97)	76 (457)	11 (70)
Sanitary** toilet	82 (490)	0.3 (2)	0.2 (1)
Total ...	100 (600)	100 (600)	100 (600)

X^2 values between the plantations = 2051.20 for df 4 significant at $p<0.001$

(Figures in parentheses indicate actual number of subjects.)

* Crude toilet without septic tank.

** Modern sanitary toilet with septic tank.

TABLE 12

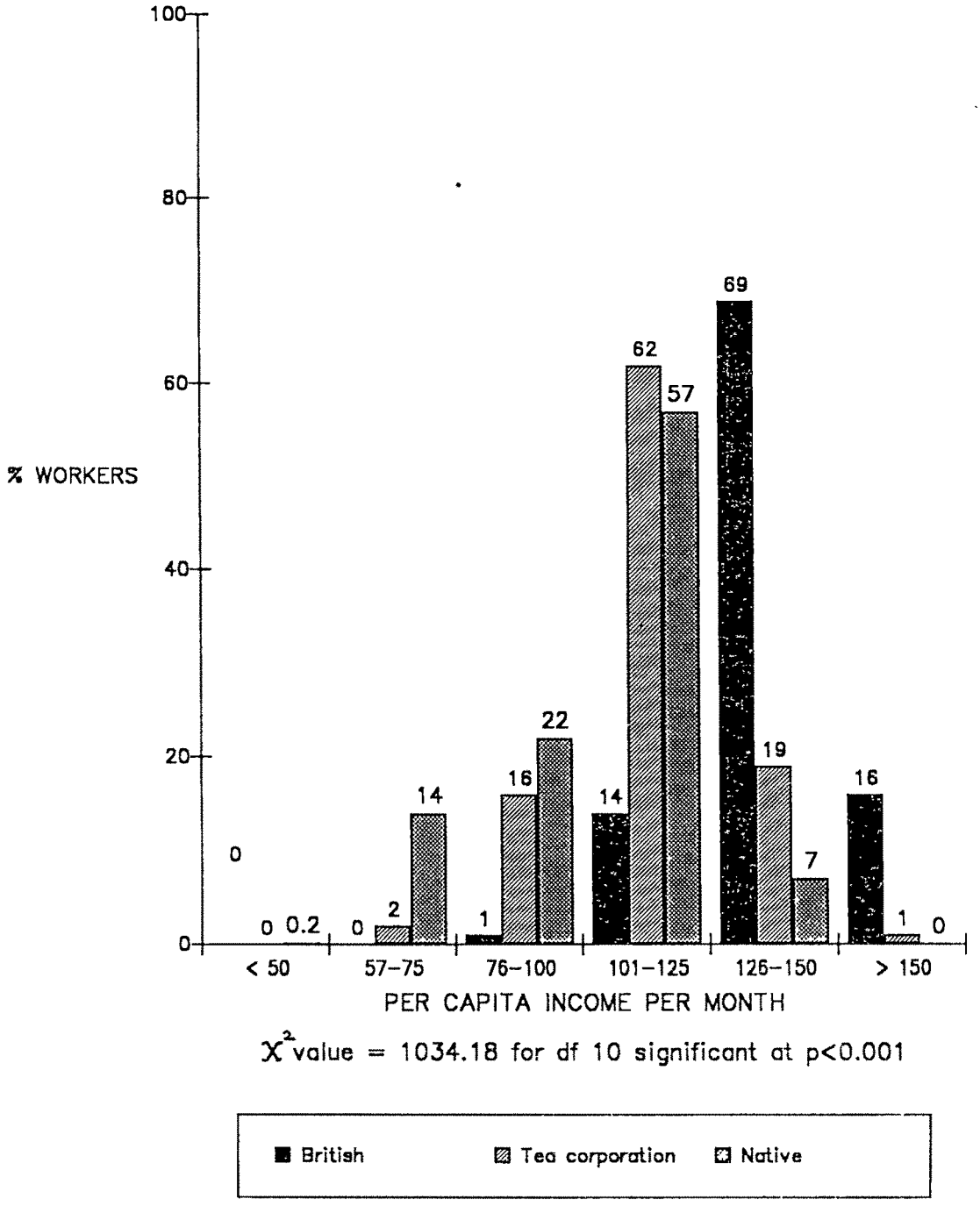
Influence of type of plantation on the income level of the plantation workers

Per capita income/month (Rs.)	Types of Plantations		
	British (B) (%)	Tea Corporation (TC) (%)	Native (N) (%)
Per capita income			
Mean ± SE	136±0.82	109±0.64	100±0.63
F values	773.17***		
't' value	B vs TC = 26.32***		
	B vs N = 35.36***		
	TC vs N = 10.17***		

*** Significant at p<0.001.

FIGURE 2

INFLUENCE OF TYPE OF PLANTATION ON THE INCOME LEVELS OF THE WORKERS



χ^2 value = 1034.18 for df 10 significant at $p<0.001$

While studying the facilities provided to South Indian plantation workers, Rahamathullah (1987) commented that 42% of the families under the USAID project area had attached latrines and bathrooms.

Unnikrishnan (1989) reported that due to lack of toilet facilities in South Indian plantations, the labourers used the nearby hillsides. She also observed reduced morbidity among the workers who used the sanitary toilets.

All the studies listed above showed a close association between parasitic infections and the types of toilet used. These studies also showed high incidence of hookworm infections among the labourers who did not use other than sanitary toilets. Intestinal parasitic infections lead to anaemia and hence poor nutritional status which ultimately lead to poor productivity and hence to low levels of income.

It is recommended that the managements of 'Tea Corporation' and the 'Native' should pay immediate attention to toilet facilities for their workers because it is a severe limiting factor to the health and nutrition of the labour (Ameresekere 1984).

Per capita monthly income

Table 12 and Figure 2 show clearly that the per capita income is highest in the 'British' and lowest in the 'Native' plantations. By law (1983), the labourers are entitled to get equal wages without discrimination between the various types of plantations.

Now the question arises why labourers in the 'British' plantations earn more? It might be due to (a) better management and (b) large size of the 'British' plantations. The tea production in the 'British' plantation is substantial. Consequently the profits are high. From the total profits, labourers get a cash bonus twice in a year. In the other two types of plantations, the bonus is not fixed and the amount of bonus if given, is also very small.

Morris and McAlpin (1982) commented that income is one of the major determinants of health and nutritional status of the population. The UNICEF (1989) report on 'Measuring real development' also clearly stated that income is a key determinant of health and nutritional status of any population. It is also known that low income leads to poor health. Thus, it is to be expected that nutrition and health status of the workers of the 'Tea Corporation' and the 'Native' would be inferior to that of the 'British' workers, as the per capita income in the 'British' was Rs.136 vs Rs.109 in the 'Tea Corporation' vs Rs.100 in the 'Native'.

TABLE 13

Influence of type of plantation on the mean food intake of the male plantation workers

Type of plantation/ season	N	Food item/F value							
		Cereal (g) Mean±SE	F values	Pulse (g) Mean±SE	F values	Green leafy vegetables (g) Mean±SE	F values	Other vegetables (g) Mean±SE	F values
Total (a+b)									
British (B)	296	742±4.22	Type of plantation 35.49^{***}	35±1.80	Type of plantation 2.98^{*}	1±0.66	Type of plantation 2.27^{NS}	37±2.70	Type of plantation 12.34^{***}
Tea Corporation (TC)	294	718±5.86		33±1.08		-		26±2.34	
Native (N)	292	719±5.46		30±1.41		1±0.69		17±1.89	
a) Peak[1]									
British	149	727±6.91	Season 91.47^{***}	35±1.96	Season 2.0^{NS}	3±1.32	Season 14.22^{*}	40±4.18	Season 0.53^{NS}
Tea Corporation	148	693±6.30		30±1.33		-		23±3.12	
Native	145	677±7.56		29±2.31		1±1.37		21±2.83	
b) Lean[1]									
British	147	756±4.61	Type of plantation 7.28^{***}	35±3.00	Type of plantation 3.45^{*}	-	Type of plantation 1.31^{NS}	35±3.44	Type of plantation 18.28^{***}
Tea Corporation	144	741±9.47		36±1.67		-		30±3.48	
Native	147	762±6.08		30.6		-		13±2.48	
RDA		475		65		125		75	
't' test		't' values							
B vs TC		3.33^{***}		1.02^{NS}		NS		2.99^{**}	
B vs N		3.27^{***}		2.37^{**}		0.57^{NS}		6.04^{***}	
TC vs N		0.18^{NS}		1.84^{NS}		NS		3.07^{**}	
Peak									
B vs TC		3.58^{***}		2.22^{*}		NS		3.18^{**}	
B vs N		4.89^{***}		2.11^{*}		0.61^{NS}		3.64^{***}	
T vs N		1.69^{NS}		0.43^{NS}		NS		0.47^{NS}	
Lean									
B vs TC		1.36^{NS}		0.28^{NS}		0.00^{NS}		0.98^{NS}	
B vs N		0.76^{NS}		1.30^{NS}		00^{NS}		5.04^{***}	
TC vs N		1.79^{NS}		2.33^{*}		00^{NS}		3.87^{***}	
B a) vs b)		3.56^{***}		0.1^{NS}		00^{NS}		0.92^{NS}	
TC a) vs b)		4.27^{***}		2.75^{**}		00^{NS}		1.46^{NS}	
N a) vs b)		8.81^{***}		0.53^{NS}		00^{NS}		2.06^{*}	

NS Not Significant

* Significant at $p/0.05$

** Significant at $p/0.01$

*** Significant at $p/0.001$.

[1] Tea plucking season.

contd.

Note: Milk and milk products, fruits, sugar and jaggery were totally absent in the diet.

Table 13 contd..

Influence of type of plantation on the mean food intake of the male plantation workers

Type of plantation/ season	N	Food item/F value							
		Roots & tubers (g) Mean±SE	F values	Fats & oils (g) Mean±SE	F values	Meat, Fish (g) Mean±SE	F values	Egg (g) Mean±SE	F values
Total (a+b)									
British (B)	296	41±2.16	Type of plantation 13.88^{***}	4±0.13	Type of plantation 35.22^{***}	15±1.56	Type of plantation 0.62^{NS}	1±0.23	Type of plantation 2.31^{NS}
Tea Corporation (TC)	294	34±1.92		2±0.09		17±1.83		0±0.17	
Native (N)	292	25±1.82		2±0.12		14±1.63		0±0.20	
a) Peak [1]									
British	149	47±3.40	Season 9.11^{**}	4±0.24	Season 23.82^{***}	19±2.54	Season 0.38^{NS}	1±0.45	Season 5.84^{**}
Tea Corporation	148	32±2.95		2±0.13		14±2.53		0±0.15	
Native	145	31±2.80		2±0.18		15±2.45		1±0.4	
b) Lean [1]									
British	147	34±2.56	Type of plantation 16.39^{***}	3±0.14	Type of plantation 41.22^{***}	11±1.77	Type of plantation 0.75^{NS}	0±0.31	Type of plantation 0.56^{NS}
Tea Corporation	144	36±2.45		2±0.13		20±2.64		-	
Native	147	20±2.24		1±0.4		13±2.14		-	
RDA		100		40		30		30	
't' test		't' values							
B vs TC		2.33^{**}		6.04^{***}		0.92^{NS}		1.05^{NS}	
B vs N		5.66^{***}		7.80^{***}		0.22^{NS}		0.46^{NS}	
TC vs N		3.36^{***}		2.72		1.11^{NS}		0.5^{NS}	
Peak									
B vs TC		3.52^{***}		6.87^{***}		1.48^{NS}		1.92^{*}	
B vs N		3.82^{***}		5.84^{***}		1.08^{NS}		0.49^{NS}	
TC vs N		0.25^{NS}		0.63^{NS}		0.42^{NS}		1.43^{NS}	
Lean									
B vs TC		0.60^{NS}		1.07^{NS}		3.64^{***}		0.0^{NS}	
B vs N		4.34^{***}		5.86^{***}		0.99^{NS}		0.0^{NS}	
TC vs N		5.08^{***}		5.01^{***}		2.04^{*}		0.0^{NS}	
B a) vs b)		3.16^{**}		5.06^{***}		2.69^{**}		0.0^{NS}	
TC a) vs b)		1.17^{NS}		1.45^{NS}		1.81^{NS}		0.46^{NS}	
N a) vs b)		3.17^{**}		3.64^{***}		0.85^{NS}		0.0^{NS}	

NS Not Significant

* Significant at p/0.05

** Significant at p/0.01

*** Significant at p/0.001.

[1] Tea plucking season.

TABLE 14

Influence of type of plantation on the mean food intake of the female plantation workers

Type of plantation/ season	N	Food item/F value							
		Cereal (g)	F values	Pulse (g)	F values	Green leafy vegetables (g)	F values	Other vegetables (g)	F values
		Mean±SE		Mean±SE		Mean±SE		Mean±SE	
Total (a+b)									
British (B)	295	691±5.55	Type of plantation 168.42^{***}	34±1.11	Type of plantation 1.16^{NS}	3±1.03	Type of plantation 4.84^{**}	46±3.23	Type of plantation 29.89^{***}
Tea Corporation (TC)	291	635±6.3		34±0.98		4±1.09		38±2.56	
Native (N)	290	637±6.43		35±1.14		2±0.75		21±2.27	
a) Peak[1]									
British	148	661±8.97	Season 423.03^{***}	36±1.70	Season 3.21^{NS}	6±1.84	Season 13.40^{***}	55±4.97	Season 42.29^{***}
Tea Corporation	145	568±9.55		34±1.37		5±1.86		50±3.81	
Native	146	559±8.66		30±1.22		4±1.55		30±3.70	
b) Lean[1]									
British	147	721±5.48	Type of plantation 41.73^{***}	32±1.41	Type of plantation 0.13^{NS}	1±0.86	Type of plantation 0.55^{NS}	37±4.00	Type of plantation 23.58^{***}
Tea Corporation	146	704±2.36		34±1.39		2±1.12		27±3.15	
Native	144	714±2.79		40±1.85		-		11±2.42	
RDA		350		55		125		75	
't' test		't' values							
B vs TC		6.55^{***}		0.02^{NS}		0.09^{NS}		1.89^{*}	
B vs N		6.37^{***}		0.45^{NS}		0.91^{NS}		6.39^{***}	
TC vs N		0.11^{NS}		0.45^{NS}		0.98^{NS}		5.11^{***}	
Peak									
B vs TC		7.12^{***}		0.87^{NS}		0.30^{NS}		0.9^{NS}	
B vs N		8.15^{***}		2.98^{**}		0.61^{NS}		4.05^{***}	
TC vs N		1.64^{NS}		2.36^{**}		0.28^{NS}		3.67^{***}	
Lean									
B vs TC		2.92^{**}		1.04^{NS}		0.77^{NS}		1.93^{*}	
B vs N		1.14^{NS}		3.30^{***}		0.0^{NS}		5.42^{***}	
TC vs N		2.84^{**}		2.45^{**}		0.0^{NS}		3.90^{***}	
B a) vs b)		5.73^{***}		1.68^{NS}		2.42^{**}		2.90^{**}	
TC a) vs b)		13.84^{***}		0.09^{NS}		1.41^{NS}		4.59^{***}	
N a) vs b)		17.02^{***}		4.60^{***}		0.0^{NS}		4.24^{***}	

NS Not Significant

* Significant at p/0.05

** Significant at p/0.01

*** Significant at p/0.001.

[1] Tea plucking season.

contd..

Table 14 contd..

Influence of type of plantation on the mean food intake of the female plantation workers

Type of plantation/ season	N	Food item/F value							
		Roots & tubers (g) Mean±SE	F values	Fats & oils (g) Mean±SE	F values	Meat, Fish (g) Mean±SE	F values	Egg (g) Mean±SE	F values
Total (a+b)									
British (B)	295	37±2.15	Type of planta-	3±0.15	Type of planta-	16±1.70	Type of planta-		Type of planta-
Tea Corpora-(TC) tion	291	34±1.88	14.41***	3±0.14	69.92***	19±1.82	3.11*		
Native (N)	290	24±2.15		2±0.11		12±1.43			
a) Peak									
British	148	42±3.43	Season	4±0.22	Season	16±2.51	Season		Season
Tea Corpora- tion	145	38±2.97	21.29***	4±0.22	130.54***	19±2.61	0.65NS		
Native	146	32±3.69		3±0.17		10±1.87			
b) Lean									
British	147	33±2.53	Type of planta- tion	3±0.17	Type of planta- tion	15±2.29	Type of planta- tion		Type of planta- tion
Tea Corpora- tion	146	29±2.24	10.95***	2±0.17	39.42***	20±2.54	4.34***		
Native	144	17±2.04		1.2		15±2.14			
RDA		75		40		30		30	
't' test		't' values							
B vs TC		1.37NS		0.61NS		1.37NS		2.35**	
B vs N		4.33***		7.73***		1.58NS		0.25NS	
TC vs N		3.24***		7.12***		2.99**		2.14*	
Peak									
B vs TC		0.91NS		0.73		0.64		0.00NS	
B vs N		1.98*		5.54***		1.95*		0.26NS	
TC vs N		1.24NS		6.20***		2.63**		0.00NS	
Lean									
B vs TC		1.07NS		2.17*		1.32NS		0.00NS	
B vs N		5.00***		6.39***		0.28NS		0.00NS	
TC vs N		4.17***		4.75***		1.62NS		0.00NS	
B a) vs b)		2.10*		5.33***		1.22NS		2.15**	
TC a) vs b)		2.27*		8.45***		0.34NS		0.00NS	
N a) vs b)		3.61***		6.18***		1.52NS		1.92*	

NS Not Significant
* Significant at p/0.05
** Significant at p/0.01
*** Significant at p/0.001.

[1] Tea plucking season.

B. INFLUENCE OF PEAK AND LEAN TEA PLUCKING SEASON ON DIETARY INTAKE AND THE HEALTH AND NUTRITIONAL STATUS OF WORKERS IN THE THREE TYPES OF PLANTATIONS

Dietary intake:

Nutritional status depends upon several factors and the relationship between these factors and health is complex. Nutrition is one of the crucial components of health. Health and nutritional status are generally evaluated through data on dietary intake, anthropometric indices, clinical signs of nutritional deficiencies, and through biochemical or biophysical parameters. In this section of results,an attempt has been made to focus attention mainly on dietary intake, anthropometric indices (height and weight), haemoglobin status, clinical evaluation, morbidity and parasitic status. These parameters are considered as direct indicators of nutritional status (Jelliffe 1966).

The dietary intakes of male and female plantation workers as compared to the recommended allowances are presented in Tables 13 and 14 respectively. The major components of the diet were found to be cereals among both male and female workers. While the cereal intake was one and half times to twice the RDA (ICMR 1989), the pulse intake remained just about 50% of the RDA (ICMR 1989).

Within the plantation type, the pattern of food intake did not change appreciably but the intake of cereals, pulses and

other foods was significantly higher in the 'British' than in the 'Tea Corporation' and the 'Native'. This might be due to the fact that workers in the 'British' plantation enjoy a higher monthly per capita income due to many more nuclear families and such nuclear families with a small familiy size (Please refer Section A of this Chapter), which would directly affect the availability of the food per family member.

The high intake of cereals by male and female workers of all the three types of plantations might be explained on the basis that the workers are provided cereals on subsidized rate of 54 paise/kg. Every adult worker is entitled to a weekly ration of 3.26 kg of cereal, in the form of wheat or rice, his dependent upto 10 years of age to 2.24 kg, and dependent upto 2 years of age to 1.2 kg of the same. This may be the basic reason of more than adequate consumption of cereals by the workers.

The striking feature of the dietary consumption is that some food groups like milk and milk products, fruit, sugar and jaggery are totally lacking in their diet. The complete absence of milk and sugar in the diets of these workers is dictated by a long standing tradition and practice among the plantation workers of Assam. The workers consume tea without sugar and milk, but with the addition of a little salt.

The effect of seasons was observed only on the amount of cereals consumed. During the peak tea plucking season the intake of cereals by both male and female workers of all the three

plantation types, was significantly lower than the intake during the lean tea plucking season. This was attributed to the greater availability of food during the lean tea plucking than during the peak tea plucking season. Further, during lean tea plucking season, the workload of the workers is fairly low and they are able to come back home for lunch. The lunch at home is generally better both in quality and quantity than the lunch carried to the work-site during the peak tea plucking season.

From these findings it emerges that the diet of these plantation workers lacked variety. There existed a homogenity in their dietary pattern. Also, the diets were found grossly deficient in all the essential food items. Perhaps not only due to economic hardship but also due to indulgence of spending whatever little money they had on non-food items such as tobacco, betel leaf and nut, alcohol etc. Similar results have been reported by Bora (1985) and Baroova (1988).

Ward and Amoni (1980) studied the migrant workers in Northern Brazil and reported that grains and cereals constituted 40% of the diet consumed by these workers.

The dietary data of the present study indicate that the plantation workers consume a cereal dominated diet which lacked in all the other food groups.

Nutrient Intake:

The nutrient intake of the male and female workers are presented in Table 15 and 16 respectively. The intake of key

nutrients was calculated from workers' daily dietary intake.

A scrutiny of the nutrient profile showed that the mean energy intake of male workers fell short by 4 to 8% of the RDA in all the plantation types. Surprisingly the energy intake of female workers met the RDA.

There was a significant ($p<0.001$) difference in mean dietary energy intake in the three plantation types with a significantly higher intake by both male and female workers of the 'British'. However, no difference was observed in energy intake between the workers of the 'Tea Corporation' and the 'Native'.

Seasonal variations in food energy intake were observed with the intake being significantly low during the peak rather than the lean tea plucking season in both male and female workers.

The protein intake of both male and female workers of all the three plantation types met the RDA. As a matter of fact, the protein intake of these workers was one and a half times the RDA. However, the major sources of protein in their diet were cereals followed by pulses. The consumption of fleshy foods was negligible.

Within the plantation types, the protein intake of male and female workers of 'British' was significantly ($p<0.001$) higher than the 'Tea Corporation' and the 'Native'. The 'Native' workers consumed relatively less protein than the workers of the 'Tea Corporation'.

TABLE 15

Influence of type of plantation on the mean nutrient intake of the male plantation workers

Type of plantation/ season	N	Nutrient/F values					
		Energy (Kcal) Mean±SE	F values	Protein (g) Mean±SE	F values	Fat (g) Mean±SE	F values
Total (a+b)							
British (B) ..	296	2762±15.46	Type of plantation 36.556^{***}	81.0±0.77	Type of plantation 7.68^{***}	12.0±0.21	Type of plantation 19.57^{***}
Tea Corporation (TC) ..	294	2554±21.13		80.0±0.86		11.0±0.16	
Native (N) ..	292	2631±18.76		77.0±0.81		10.0±0.19	
a) Peak[1]							
British ..	142	2728±24.53	Season 78.554^{***}	83.0±1.16	Season 9.80^{***}	11.0±0.22	Season 10.72^{***}
Tea Corporation ..	148	2531±22.30		78.0±1.09		11.1±0.23	
Native ..	145	2495±26.95		73.0±1.13		10.0±0.25	
b) Lean[1]							
British ..	147	2795±18.63	Type of plantation 15.22^{***}	80.0±0.99	Type of plantation 6.54^{***}	13.0±0.33	Type of plantation 24.16^{***}
Tea Corporation ..	144	2756±33.9		82.0±1.33		11.0±0.22	
Native ..	147	2769±21.32		81.4±1.03		10.0±0.30	
RDA		2875		60		20	
't' test	't' values						
B vs TC ..		4.15^{***}		0.88^{NS}		3.58^{***}	
B vs N ..		5.34^{***}		3.54^{***}		6.33^{***}	
TC vs N ..		0.80^{NS}		2.48^{**}		3.41^{***}	
Peak							
B vs TC ..		5.33^{***}		2.95^{**}		5.92^{***}	
B vs N ..		6.38^{***}		6.25^{***}		7.11^{***}	
TC vs N ..		1.60^{NS}		3.47^{***}		2.15^{*}	
Lean							
B vs TC ..		1.00^{NS}		1.58^{NS}		1.40^{NS}	
B vs N ..		0.92^{NS}		1.59^{NS}		2.44^{**}	
TC vs N ..		0.31^{NS}		0.21^{NS}		2.71^{**}	
B a) vs b) ..		2.18^{*}		2.41^{**}		6.44^{***}	
TC a) vs b) ..		5.05^{**}		2.13^{*}		0.86^{NS}	
N a) vs b) ..		7.94^{***}		5.70^{***}		0.44^{NS}	

NS Not Significant

* Significant at $p<0.05$

** Significant at $p<0.01$

*** Significant at $p<0.001$.

[1] Tea plucking season.

contd..

Table 15 contd..

Influence of type of plantation on the mean nutrient intake of the male plantation workers

Type of plantation/ season	N	Nutrient Intake/F value							
		Beta carotene (mg) Mean±SE	F values	Thiamine (mg) Mean±SE	F values	Riboflavin (mg) Mean±SE	F values	Niacin (mg) Mean±SE	F values
Total (a+b)									
British (B)		303±41.99	Type of plantation 4.223**	2.3±0.06	Type of plantation 2.618*	1.0±0.02	Type of plantation 4.009**	29.2±0.56	Type of plantation 2.670*
Tea Corporation (TC)		209±6.23		2.2±0.06		0.9±0.02		28.4±0.54	
Native (N)		194±10.4		1.9±0.06		0.8±0.02		25.2±0.56	
a) Peak[1]									
British		203±8.32	Season 3.19*	2.0±0.04	Season 0.33NS	0.9±0.01	Season 0.88NS	27.1±0.36	Season 0.949NS
Tea Corporation		225±8.81		2.1±0.06		0.9±0.02		28.2±0.61	
Native		198±5.47		2.2±0.06		0.9±0.02		28.9±0.53	
b) Lean[1]									
British		252±21.37	Type of plantation 4.777***	2.1±0.03	Type of plantation 3.767*	0.9±0.01	Type of plantation 5.553***	28.1±0.34	Type of plantation 3.51*
Tea Corporation		217±5.41		2.2±0.04		0.9±0.01		28.3±0.41	
Native		196±5.89		2.0±0.04		0.9±0.01		27.0±0.04	
RDA		2400		1.4		1.6		18	
't' test		't' values							
B vs TC		1.59NS		1.11NS		0.19NS		0.30NS	
B vs N		2.55**		1.67NS		3.04**		2.18*	
TC vs N		2.70**		2.54*		2.62**		2.27*	
Peak									
B vs TC		2.21*		0.37NS		1.76NS		1.08NS	
B vs N		2.53*		4.76***		5.86***		5.16***	
TC vs N		1.27NS		4.36***		4.18***		4.16***	
Lean									
B vs TC		1.86NS		2.04*		1.55NS		1.60NS	
B vs N		0.51NS		3.07**		2.13*		2.84***	
TC vs N		2.66*		0.69NS		0.32NS		0.85NS	
B a) vs b)		2.37*		4.18***		3.57***		3.31**	
TC a) vs b)		1.48NS		1.23NS		0.11NS		0.28NS	
N a) vs b)		0.32NS		3.83***		4.67***		4.79***	

contd...

NS Not Significant
* Significant at p/0.05
** Significant at p/0.01
*** Significant at p/0.001.

[1] Tea plucking season.

Table 15 contd..

Influence of type of plantation on the mean nutrient intake of the male plantation workers

Type of plantation/ season	N	Nutrient intake/F value							
		Folic acid (ug) Mean±SE	F values	Vitamin C (mg) Mean±SE	F values	Calcium (mg) Mean±SE	F values	Iron (mg) Mean±SE	F values
Total (a+b)									
British (B)		186±4.3	Type of plantation 3.367^{**}	12±1.2	Type of plantation 7.284^{***}	373±16.5	Type of plantation 1.502^{NS}	23±0.03	Type of plantation 3.301^{*}
Tea Corporation (TC)		176±3.9		6±0.6		322±15.6		22±0.63	
Native (N)		153±4.1		8±1.7		308±17.7		18±0.63	
a) Peak[1]									
British		165±2.73	Season	9±0.5	Season	309±12.6	Season	20±0.5	Season
Tea Corporation		175±4.42		9±0.5	1.502^{NS}	389±19.4	0.287^{NS}	21±0.71	0.140^{NS}
Native		176±3.8		5±0.5		336±15.02		21±0.61	
b) Lean[1]									
British		175±2.6	Type of plantation 5.050^{**}	11±0.6	Type of plantation 10.213^{***}	336±10.6	Type of plantation 2.107^{NS}	21±0.4	Type of plantation 4.887^{***}
Tea Corporation		175±2.9		8±0.4		355±12.6		21±0.47	
Native		164±2.8		6±0.9		322±11.6		20±0.45	
RDA		100		40		400		28	
't' test	't' values								
B vs TC		0.03^{NS}		3.79^{***}				0.86^{NS}	
B vs N		2.76^{**}		3.79^{***}				2.23^{*}	
TC vs N		2.64^{**}		1.31^{NS}				2.88^{**}	
Peak									
B vs TC		1.69^{NS}		4.09^{***}				0.48^{NS}	
B vs N		5.55^{***}		1.88^{NS}				4.85^{***}	
TC vs N		4.06^{***}		0.87^{NS}				4.35^{***}	
Lean									
B vs TC		1.94^{NS}		0.54^{NS}				1.73^{NS}	
B vs N		2.44^{**}		6.14^{***}				2.10^{*}	
TC vs N		0.25^{NS}		5.85^{***}				0.16^{NS}	
B a) vs b)		4.18^{***}		1.84^{NS}				3.55^{***}	
TC a) vs b)		0.24^{NS}		3.41^{***}				0.94^{NS}	
N a) vs b)		4.13^{***}		1.72^{NS}				3.58^{***}	

NS Not Significant

* Significant at $p \leq 0.05$

** Significant at $p \leq 0.01$

*** Significant at $p \leq 0.001$.

[1] Tea plucking season.

TABLE 16

Influence of type of plantation on the mean nutrient intake of the female plantation workers

Type of plantation/ season	N	Nutrient intake/F value					
		Energy (Kcal)	F values	Protein (g) Mean±SE	F values	Fat (g) Mean±SE	F values
Total (a+b)							
British (B)	295	2588±20.13	Type of plantation 157.76***	76±0.87	Type of plantation 51.91	12±0.22	Type of plantation 35.94***
Tea Corporation (TC)	291	2394±20.06		71±0.66		11±0.17	
Native (N)	290	2366±21.35		70±0.69		9±0.15	
a) Peak[1]							
British	148	2511±34.62	Season 368.64***	76±1.35	Season 107.84	13±0.36	Season 28.089***
Tea Corporation	145	2179±30.33		67±1.0		12±0.27	
Native	146	2100±27.69		63±0.82		10±0.23	
b) Lean[1]							
British	147	2667±18.47	Type of plantation 52.95***	77±1.09	Type of plantation 24.19	11±0.25	Type of plantation 39.75***
Tea Corporation	146	2609±7.19		75±0.68		10±0.19	
Native	144	2631±9.06		77±0.72		9±0.20	
RDA		2225		50		20	
't' test	't' values						
B vs TC		6.84***		4.71***		2.78***	
B vs N		7.58***		5.69***		8.33***	
TC vs N		0.96NS		1.24NS		6.44***	
Peak							
B vs TC		7.22***		5.51***		2.04*	
B vs N		9.25***		8.29***		7.08***	
TC vs N		1.91NS		3.01**		5.57***	
Lean							
B vs TC		2.91**		0.79NS		2.03*	
B vs N		1.72NS		0.37NS		4.64***	
TC vs N		1.93NS		1.52NS		3.10**	
B a) vs b)		3.95***		0.56NS		3.89***	
TC a) vs b)		13.81***		7.64***		4.31***	
N a) vs b)		18.23***		13.44***		0.63NS	

contd..

NS Not Significant

* Significant at p/0.05

** Significant at p/0.01

*** Significant at p/0.001.

[1] Tea plucking season.

Table 16 contd..

Influence of type of plantation on the mean nutrient intake of the female plantation workers

Type of plantation/ season	N	Nutrient intake/F value							
		Beta carotene (mg) Mean±SE	F values	Thiamine (mg) Mean±SE	F values	Riboflavin (mg) Mean±SE	F values	Niacin (mg) Mean±SE	F values
otal (a+b)									
British (B)		388±69.04	Type of plantation 3.377^{*}	2±0.04	Type of plantation 8.905^{***}	1±0.01	Type of plantation 23.166^{***}	26±0.39	Type of plantation 24.724^{***}
Tea Corporation (TC)		299±40.02		2±0.03		1±0.1		24±0.30	
Native (N)		296±47.61		2±0.03		1±0.1		24±0.29	
) Peak[1]									
British		555±134.18	Season 8.217^{***}	2±0.05	Season 7.124^{***}	1±0.02	Season 29.327^{***}	26±0.54	Season 39.387^{***}
Tea Corporation		308±57.92		2±0.05		1±0.01		23±0.47	
Native		385±94.63		2±0.03		1±0.01		22±0.34	
) Lean[1]									
British		220±22.97	Type of plantation $.943^{NS}$	2±0.06	Type of plantation 9.834^{***}	1±0.02	Type of plantation 20.195^{***}	26±0.56	Type of plantation 17.511^{***}
Tea Corporation		297±55.44		2±0.04		1±0.01		25±0.35	
Native		207±5.68		1.9±0.05		1±0.01		26±0.41	
RDA		2400		1.1		1.3		14	
't' test		't' values							
B vs TC		1.11^{NS}		3.55^{***}		4.64^{***}		4.40^{***}	
B vs N		1.09^{NS}		3.66^{***}		5.35^{***}		4.95^{***}	
TC vs N		0.05^{NS}		0.06^{NS}		0.80^{***}		0.50^{NS}	
Peak									
B vs TC		1.68^{NS}		3.96^{***}		5.43^{***}		4.95^{***}	
B vs N		1.03^{NS}		5.48^{***}		7.44^{***}		6.90^{***}	
TC vs N		0.07^{NS}		1.19^{NS}		1.86^{NS}		1.55^{NS}	
Lean									
B vs TC		1.19^{NS}		1.06^{NS}		0.90^{NS}		1.31^{NS}	
B vs N		0.52^{NS}		0.15^{NS}		0.28^{NS}		0.56^{NS}	
TC vs N		1.50^{NS}		1.08^{NS}		0.75^{NS}		0.89^{NS}	
B a) vs b)		2.44^{*}		0.99^{NS}		0.95^{NS}		0.11^{NS}	
TC a) vs b)		0.21^{NS}		2.10^{*}		4.75^{***}		4.75^{***}	
N a) vs b)		1.88^{NS}		4.64^{**}		7.96^{***}		7.79^{***}	

contd...

NS Not Significant

[1] Tea plucking season.

* Significant at p/0.05

** Significant at p/0.01

***Significant at p/0.001.

Table 16 contd..

Influence of type of plantation on the mean nutrient intake of the female plantation workers

Type of plantation/ season	N	Nutrient intake/F value							
		Folic acid (ug) Mean±SE	F values	Vitamin C (mg) Mean±SE	F values	Calcium (mg) Mean±SE	F values	Iron (mg) Mean±SE	F values
Total (a+b)									
British (B)		165±3.03	Type of plantation 11.066***	12±0.89	Type of plantation 13.656***	337±11.61	Type of plantation 6.608*	20±0.49	Type of plantation 8.531***
Tea Corporation (TC)		153±2.38		10±0.83		345±12.93		18±0.35	
Native (N)		148±2.13		7±0.79		293±10.35		18±0.33	
a) Peak[1]									
British		169±4.48	Season 8.970**	14±1.59	Season 21.659***	338±16.66	Season 8.279***	21±0.66	Season 2.1[NS]
Tea Corporation		147±3.70		11±1.28		321±17.42		18±0.53	
Native		138±2.70		10±1.47		258±12.47		17±0.43	
b) Lean[1]									
British		161±4.08	Type of plantation 12.159***	10±0.70	Type of plantation 9.603	336±16.23	Type of plantation 5.784***	20±0.72	Type of plantation 11.769***
Tea Corporation		159±2.92		9±1.07		369±18.96		18±0.46	
Native		159±3.04		4±0.41		328±16.04		19±0.58	
RDA		100		40		400		30	
't' test		't' values							
B vs TC		3.25***		1.49[NS]		0.47[NS]		0.39[NS]	
B vs N		4.52***		4.27***		2.81**		3.50***	
TC vs N		1.32[NS]		2.84**		3.14**		4.76***	
Peak									
B vs TC		3.86***		1.5[NS]		0.69[NS]		1.13[NS]	
B vs N		6.01***		1.92[NS]		3.83***		1.79[NS]	
TC vs N		1.98[NS]		0.52[NS]		2.95**		1.29[NS]	
Lean									
B vs TC		0.52[NS]		0.33[NS]		1.33[NS]		0.58[NS]	
B vs N		0.39[NS]		7.27***		0.33[NS]		1.29[NS]	
TC vs N		0.15[NS]		4.80***		1.64[NS]		0.58[NS]	
B a) vs b)		1.27[NS]		2.73**		0.09[NS]		0.70[NS]	
TC a) vs b)		2.57*		1.22		1.85[NS]		1.08[NS]	
N a) vs b)		5.36***		4.26***		3.46***		2.91**	

NS Not Significant

* Significant at p/0.05

** Significant at p/0.01

*** Significant at p/0.001.

[1] Tea plucking season.

The seasonal effect on protein intake was noticeable with the intake being significantly lower in the peak rather than in the lean tea plucking season in both the sexes.

The intake of dietary fat was low, it being nearly 50% of RDA in both the male and female workers of the three types of plantations.

Within the plantation types, the dietary fat consumption of the workers of the 'British' was relatively higher than that of the 'Tea Corporation' and the 'Native'.

No appreciable seasonal effect on fat intake was recorded except that the intake of fat by male workers was higher in the lean tea plucking season and that of the female workers was higher in the peak tea plucking season.

The consumption of Beta-carotene by both male and female workers in all the three types of plantations was less than the RDA. This was not surprising as the dietaries of these workers were grossly deficient in green leafy vegetables (Table 15 and 16).

As expected, between the three plantations, the intake of Beta-carotene was significantly ($p<0.001$) higher in the 'British' than in the 'Tea Corporation' and in the 'Native'. On classifying on the basis of gender it was found that the males consumed higher amounts of Beta-carotene than the females.

Note: RDA (Indian Council of Medical Research, 1989).

Unlike energy and protein intakes, the Beta-carotene consumption was significantly ($p<0.001$) higher during the peak than the lean tea plucking season. Perhaps the decreased availability of food as discussed earlier, compelled the workers to eat more of greens to satiate their hunger. Hence,the wild greens which are available in abundance,comprise a substantial portion of the diet during the peak tea plucking season.

The intake of thiamine was adequate by both male and female workers of the three plantation types. However, the riboflavin intake was inadequate as compared to the RDA. The intake of niacin was more than adequate in both male and female workers of the three types of plantations. The intake of all the water soluble vitamins was higher in both the male and female workers of the 'British' than the 'Tea Corporation' and the 'Native'.

No appreciable seasonal variations were observed in the consumption of these vitamins, among male and female workers of the three plantations.

The intake of folic acid by both male and female workers of the three types of plantations was more than adequate as compared to the RDA (ICMR 1989). The workers of the 'British' consumed significantly more ($p<0.001$) folic acid than those of the 'Tea Corporation' and the 'Native'. There was a higher folic acid intake among the workers during the lean than the peak tea plucking season with sex or plantation types having no influence on the same.

The intake of micronutrients was inadequate. The intake of protein and energy was higher during the lean than in the peak tea plucking season. As has been mentioned before, it could be because the food availability is more in the lean tea plucking season . Besides, in the lean season the work load is relatively less. So the workers were able to go home for lunch.

Bora (1985) studied 15 tea plantation families in Assam and reported that the intake of all the nutrients was lower than the RDA (ICMR 1981). Three years later, Baroova (1988) observed that the diets of the tea gardeners were inadequate in all nutrients except protein as compared to the RDA (ICMR 1981).

Inadequate intake of calcium, vitamin A and vitamin C in coal miners in Southern Illinois has been reported by Shirley et al (1978). Similar findings were reported by Ward and Amoni (1980) among migrant workers in Northern Brazil and by Sesai (1980) among agricultural workers in Southern Brazil.

Scanty data are available on the seasonal variation of the nutrient intake among the agricultural/industrial workers. The effect of season on nutrient intake of a Senegalese sedentary farming population was studied by Rosetta (1986). Data were collected once in the middle of the dry season and at the end of the rainy season and before the first harvest (at the end of the food shortage). The intake of nutrients mainly protein and energy were lower in the first harvest than in the dry and rainy season.

Almost all the studies quoted above reported nutrient deficiencies among the various types of workers. In the present study, protein intake of both male and female workers and the energy intake of female workers were above the RDA. There might be two reasons for the above findings. Firstly, the workers receive major food commodities mainly cereals and pulses at subsidized rates from the management every week. Secondly, they have a weekly regular wage payment which enables them to buy food commodities on a weekly basis in order to meet their macro-nutrient requirements to a large extent. The nutrient intake of the 'British' was superior because the 'British' had more nuclear families with a small family size (Table 6 and 7) and they enjoyed a significantly higher monthly per capita income (Table 12) as discussed in the Section A of this chapter.

No gender related differences in food and nutrient intake were observed probably because of the fact that the food distribution pattern did not differ between male and female workers. The nutrient requirements for women being less than those for the men, the amount of food provided by the management could meet the requirements of the former. Further, in most families both husband and wife worked on the plantation and were treated alike in the receipt of amenities and food allotment.

Anthropometric indices

Anthropometric indices are the most widely used parameters for assessing nutritional status. Chronic undernutrition during infancy, childhood and adolescence is associated with stunting.

However, once adult height is reached, further deprivation would not have any impact on height.

Body weight is extensively used as an indicator of nutritional status. It is well documented that marked shifts in dietary intake, and acute starvation, result in significant weight loss in the community and in the individual. Hence, body weight provides a reliable indicator of health and nutritional status.

Mean values for height and weight of male and female workers are presented in the Table 17 and 18. Both mean height and weight of the 'British' workers showed relatively better anthropometric status in comparison to the 'Tea Corporation' and the 'Native' workers. The male and female workers of the 'British' were nearly 2 to 3 cm taller and 1 to 2 kg heavier than the workers of the 'Tea Corporation' or the 'Native'.

The mean body weight of female plantation workers of 48.1 kg reported by Rahamathullah corresponded very well with the mean body weight of 48.8 kg for female workers in the 'British' of the present study.

The relatively superior anthropometry of the male and female workers in the 'British' plantations could be attributed to their higher monthly per capita income and relatively less congestion at the household level. Other factors along with better management of food and other resources and better care of health for individual members of the family might have contributed to

the superior anthropometry of the 'British' workers. According to Satyanarayana (1977), income is one of the major determinants of the body weight of the workers. Ramachandran (1987) suggested that variation in body weight of adults indicates a change in their nutritional status.

TABLE 17

Mean anthropometric measurements of male plantation workers in three types of plantations

Type of Plantation	Height and Weight			
	Height (cms)	F values	Weight (kg)	F values
'British'	166.5±1.23 (300)		50.5±0.43 (300)	
'Tea Corporation'	164.7±0.71 (300)	30.41***	48.8±0.27 (300)	88.29***
'Native'	163.1±0.04 (300)		48.5±0.37 (300)	
't' values	B vs TC	4.96***	B vs TC	9.56***
	B vs N	7.22***	B vs N	13.33***
	TC vs N	3.64***	TC vs N	3.18***

*** Significant at $p<0.001$.

(Figures in parentheses indicate actual number of subjects.)

TABLE 18

Mean anthropometric measurements of female plantation workers in three types of plantations

Type of Plantation	Height and Weight			
	Height (cms)	F values	Weight (kg)	F values
'British'	159.4±1.20 ($\overline{300}$)		48.8±0.51 ($\overline{300}$)	
'Tea Corporation'	158.8±0.69 ($\overline{300}$)	18.11	47.3±0.65 ($\overline{300}$)	18.11
'Native'	157.3±1.30 ($\overline{300}$)		46.8±0.72 ($\overline{300}$)	
't' values	B vs TC	NS	B vs TC	***
		0.75		4.72
	B vs N	***	B vs N	***
		4.52		12.49
	TC vs N	***	TC vs N	***
		5.40		8.48

NS Not Significant.

*** Significant at $p<0.001$.

(Figures in parentheses indicate actual number of subjects.)

TABLE 19

Anthropometric status of plantation workers using Body Mass Index (BMI) *

Type of Plantation	BMI					
	Male			Female		
	BMI <18.5 (%)	BMI <18.5 (%)	Total	BMI <18.5 (%)	BMI <18.5 (%)	Total
'British' (B)	93 (278)	7 (22)	33 (300)	61 (182)	39 (118)	33 (300)
'Tea Corporation' (TC)	87 (262)	13 (38)	33 (300)	53 (159)	47 (141)	33 (300)
'Native' (N)	64 (193)	36 (107)	33 (300)	42 (126)	58 (174)	33 (300)

X^2 values for male = 90.00 significant at $p<0.001$

X^2 values for female = 21.16 significant at $p<0.001$

* BMI = Weight (kg)/Height^2 (m); BMI < 18.5 is undernourished and BMI > 18.5 is normal for adults in the developing world (Waterlow 1989).

(Figures in parentheses indicate actual number of subjects.)

Quetelet index or Body-Mass Index (BMI = weight/height^2) with weight expressed in kilograms and height in meters) is an anthropometric indicator that is being widely used to assess nutritional status of children as well as adults. BMI is an internationally accepted standard and is an objective measure. It is considered more accurate to use BMI than regional standards. FAO (1987) has suggested that BMI is one of the most accurate methods to evaluate adult anthropometry.

BMI was calculated using Waterlow's classification (1989) the cutoff point being equal to or above 18.5 indicating a normal nutritional status and below 18.5 an undernourished status for the adults of the underdeveloped and developing countries. According to FAO (1987) these cutoff points can be used for both the sexes.

The percentage of male and female workers in the normal nutritional category, according to the cutoff proposed above, was higher in the 'British'than the 'Tea Corporation' and the 'Native' plantations (Table 19). Also a larger percentage of males than female workers were in the normal nutritional category as per BMI.

According to Gopalan (1983) BMI is a positive phenomenon resulting from improved nutrition, hygiene, medical care etc. Since the 'British' workers enjoyed better housing (Table 9), medical facilities and their food intake (Table 13, 14) was significantly higher than the workers of the 'Tea Corporation' or 'Native', this could explain the superior BMI observed among 'British' workers.

FIGURE 3
DISTRIBUTION OF HAEMOGLOBIN LEVELS
OF WORKERS IN THE THREE TYPES
OF PLANTATIONS

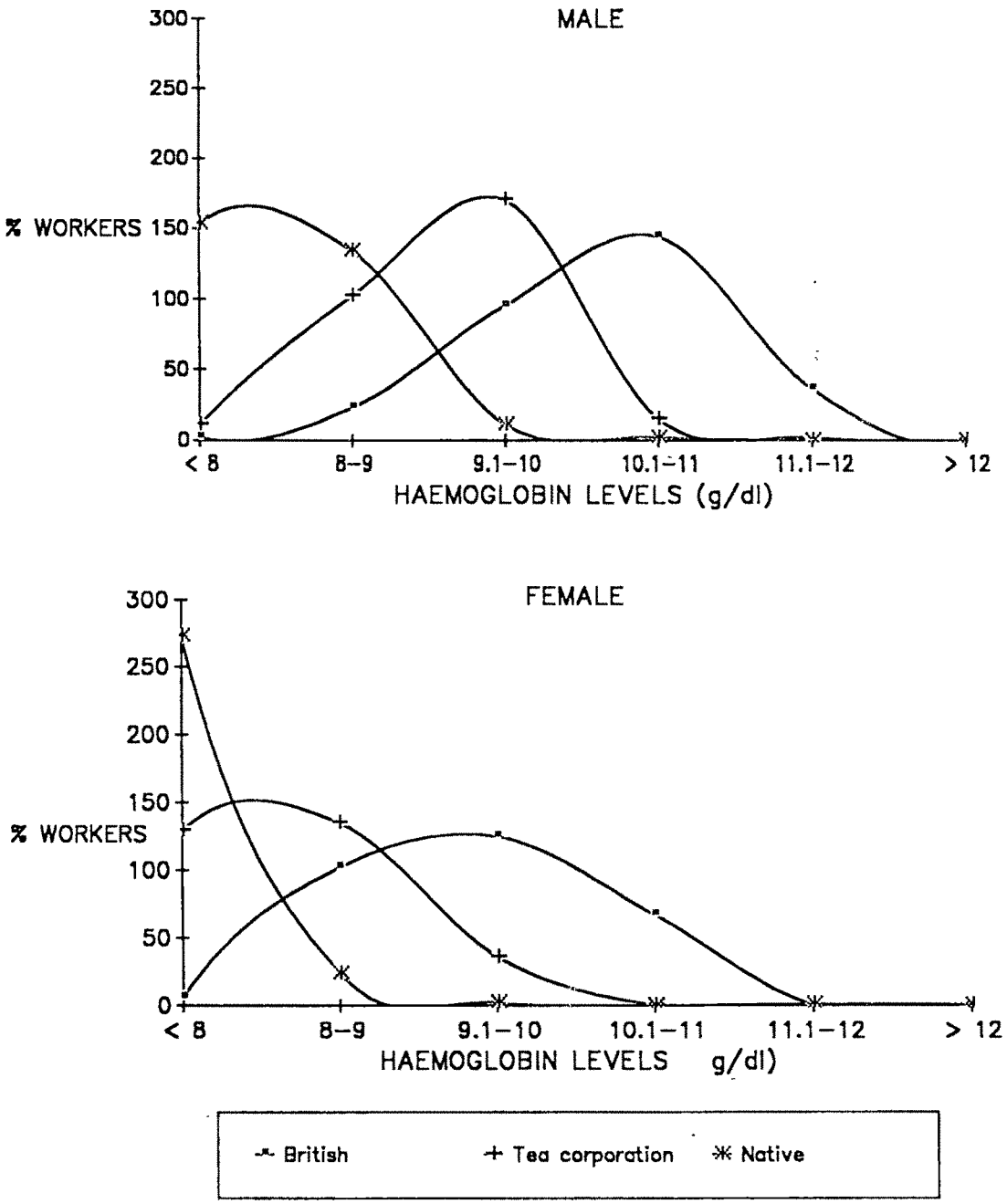


TABLE 20

Influence of type of plantation on the mean haemoglobin levels of the male plantation workers in three types of plantations

Type of plantation and season	Haemoglobin Value (g/dl) (Mean±SE) (No.)	F test	
		Values	Significance
British (B)	10.15±0.04 (300)	671	***
Tea Corporation (TC)	9.13±0.03 (300)		
Native (N)	7.9±0.04 (300)		

't' test	Values	Significance
B vs T	18.65	***
B vs N	36.68	***
TC vs N	22.66	***

*** Values significant at $p<0.001$.

(Figures in parentheses indicate number of subjects.)

TABLE 21

Influence of type of plantation on the mean haemoglobin levels of the female plantation workers in three types of plantations

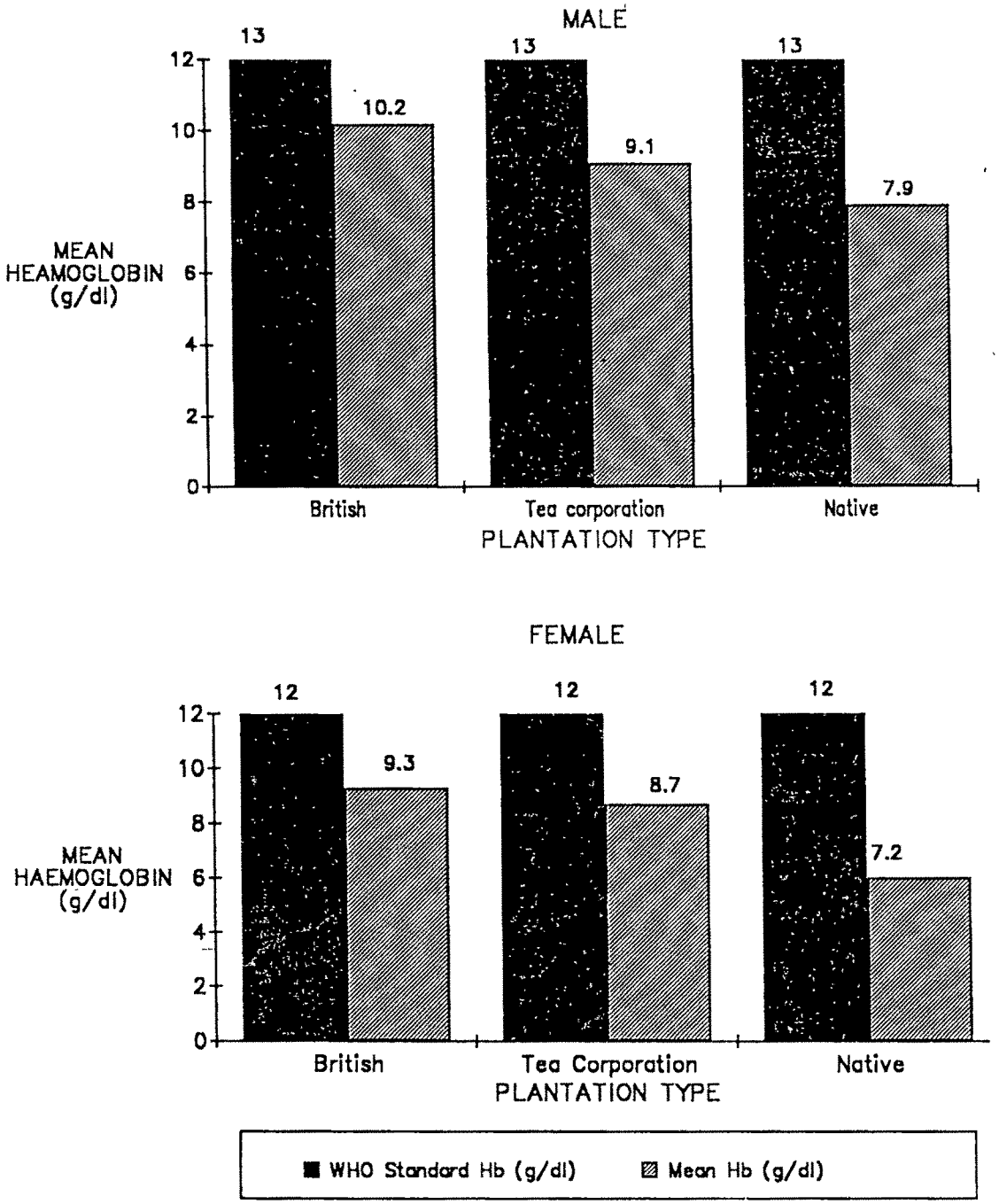
Type of plantation and season	Haemoglobin Value (g/dl) (Mean±SE) (No.)	F test Values	F test Significance
British (B)	9.31±0.04 (300)	575.3	***
Tea Corporation (TC)	8.71±0.04 (300)		
Native (N)	7.21±0.04 (300)		

't' test	Values	Significance
B vs T	21.33	***
B vs N	39.54	***
TC vs N	19.32	***

*** Values significant at $p<0.001$.

(Figures in parentheses indicate number of subjects.)

FIGURE 4
MEAN HAEMOGLOBIN (Hb) LEVELS OF WORKERS IN THE THREE TYPES OF PLANTATIONS AS COMPARED WITH WHO STANDARDS



The level of haemoglobin in blood is considered to be a reliable indicator to assess the health and nutritional status of a population. The haemoglobin levels of male and female workers of the three plantation types were determined. The frequency distribution of haemoglobin values of the workers (Figure 3) revealed that the curve was skewed to the left of the WHO cutoff point of 13 g/dl and 12 g/dl for male and female plantation workers respectively. Majority of the male workers had haemoglobin values in the range of 10.1-11 g/dl in the 'British'; 9-10 g/dl in the 'Tea Corporation'; and <8 g/dl in the 'Native'. The same are presented in Tables 20 and 21. Regardless of sex, the haemoglobin levels of the plantation workers were found to be **much below the accepted values of 13 g/dl for male and 12 g/dl for female (WHO 1968)**. Figure 4 shows the mean haemoglobin values of male and female workers of the three types of plantations as compared with WHO norms.

Similar observations on Assam tea garden labourers have been made by Foy and Kondi (1987).

Between the three plantation types, the mean haemoglobin levels of the 'British' whether male or female, were higher by 1 to 2 g/dl than the 'Tea Corporation' and the 'Native'. The 'Native' appeared severely anaemic as their mean haemoglobin values were less than 8 g/dl and were significantly ($p<0.001$) lower than that of the 'British'.

Hence, it appeared that all the plantation workers suffered from moderate to severe type of iron deficiency anaemia.

TABLE 22

Effect of parasitic infection on the mean haemoglobin levels of the male plantation workers

Types of plantation/ infection	Hb level g/dl	F values	't' values
British (B)			
		***	Parasitic infected
Either protozoa or helminths	9.97 ± 0.05 (63)	636.10	B vs TC = 16.31 ***
			B vs N = 32.89 ***
			TC vs N = 21.90
			Parasitic non-infected
Neither protozoa nor helminths	10.77 ± 0.07 (230)		B vs TC = 8.03 ***
			B vs N = 11.32 ***
			TC vs N = 4.73
Tea Corporation (TC)			Parasitic infected vs Non-infected
Either protozoa or helminths	9.05 ± 0.03 (261)		B = 4.94 ***
			TC = 9.43 ***
Neither protozoa nor helminths	9.78 ± 0.10 (32)		N = 6.77 ***
Native (N)			
Either protozoa or helminths	7.94 ± 0.04 (287)		
Neither protozoa nor helminths	8.92 ± 0.15 (9)		

*** Significant at $p<0.001$

(Figures in parentheses indicate actual number of subjects.)

TABLE 23

Effect of parasitic infection on the mean haemoglobin levels of the female plantation workers

Types of plantation/ infection	Hb level g/dl	F values	't' values
British (B)			
		***	Parasitic infected
Either protozoa or helminths	9.15 ± 0.04 (225)	642.14	B vs TC = 19.64 ***
			B vs N = 35.04 ***
			TC vs N = 18.61
			Parasitic non-infected
Neither protozoa nor helminths	9.82 ± 0.08 (65)		B vs TC = 3.76 ***
			B vs N = 2.73 NS
			TC vs N = 1.93
Tea Corporation (TC)			Parasitic infected vs Non-infected
Either protozoa or helminths	8.09 ± 0.03 (275)		B = 7.77 ***
			TC = 8.36 ***
Neither protozoa nor helminths	9.24 ± 0.13 (18)		N = 0.81 NS
Native (N)			
Either protozoa or helminths	7.20 ± 0.04 (290)		
Neither protozoa nor helminths	7.80 ± 0.73 (3)		

NS = Not Significant in relation to 'Native' as probably the number in 'neither protozoa' is too small.

(Figures in parentheses indicate actual number of subjects.)

*** Significant at $p<0.001$.

The relatively higher haemoglobin levels of workers in the 'British' might be due to regular iron supplementation followed in the 'British'during the peak tea plucking season. While it is irregular to very irregular in the 'Tea Corporation' and the 'Native' plantations. Also the daily dietary iron intake of 20 to 23 mg in the 'British' was higher as compared to 18 to 22 mg in the 'Tea Corporation' and the 'Native' in both male and female workers. However, it is well known that dietary iron is poorly available from cereal-pulse diets and this coupled with hookworm infection which leads to a poor iron status.

Other associated factors were the better per capita monthly income of workers of the 'British'; the higher number of nuclear families among them; and the small family size per nuclear family as compared to the workers from other two plantation types. These factors contributed to a better health and nutrition status of the workers in the former. Apart from the socio-economic factors, environmental factors also play a major role in the etiology of anaemia. The environmental factors like housing, toilet facilities used and source of water were relatively better in the 'British' and these perhaps contributed to a better haemoglobin status among the workers. A significant association was observed between the prevalence of parasitic infections and haemoglobin values (Table 22 and 23). The haemoglobin values were significantly higher in the non-infected workers than those infected parasitically in the three plantation types in both the sexes. Similar results have been reported by Rahamathullah (1983), Samarasinghe (1990) and Basta (1973).

The above findings on prevalence of anaemia among plantation workers endorse those of Rahamathullah (1983). In Sri Lankan plantation workers, Gardner et al (1979) and Edgerton et al (1977 and 1979) had observed a haemoglobin profile similar to that reported in the present study. Mcdonald (1939) had reported prevalence of anaemia specifically among tea garden labour class of Assam. Haemoglobin levels as low as 6.9 g/dl and 6.2 g/dl to 8.2 g/dl have been reported by Bora (1985) and Baroova (1988) respectively.

The most important constraint in meeting the iron requirements in order to maintain normal haemoglobin levels, is the limited absorption of dietary iron. Iron absorption from a cereal based diet is inhibited by phosphates and phytates in food (NNMB 1975). Consumption of tea further reduces the iron absorption due to the chelating effect of tannins on iron (Merhav et al, 1985). In the present study tea was found to be favourite beverage among the workers and was taken in large quantities. The above discussion can thus explain the prevalence of anaemia among the workers.

It is indeed discouraging to note that passage of decades and advancement of science has not influenced nor improved the socio-economic status of tea plantation workers and has resulted in no apparent change in their nutritional status especially so in relation to nutritional anaemia.

TABLE 24

Influence of type of plantation on the per cent prevalence of clinical signs of vitamin deficiencies among the male plantation workers

Clinical signs	Type of Plantation		
	British (B) (%)	Tea Corporation (TC) (%)	Native (N) (%)
Clinical signs present	65 (195)	96 (288)	100 (300)
Clinical signs absent	35 (105)	4 (12)	-
a) Vitamin A deficiency:			
Bitot's spots	10 (1)	8 (1)	22 (4)
Night-blindness	90 (9)	67 (8)	45 (8)
Conjunctival xerosis	-	25 (3)	33 (6)
Total	100 (10)	100 (12)	100 (18)
b) Vitamin B Complex deficiency			
Angular stomatitis	-	2 (1)	-
Angular scars	50 (4)	16 (18)	23 (22)
Atropic papillae	1 (12)	51 (28)	69 (67)
Magenta tongue	38 (3)	31 (17)	10 (10)
Rawness of tongue	-	-	1 (1)
Total	100 (8)	100 (55)	100 (97)

TABLE 25

Influence of type of plantation on the per cent prevalence of clinical signs of vitamin deficiencies among the female plantation workers

Clinical signs	Type of Plantation		
	British (B) (%)	Tea Corporation (TC) (%)	Native (N) (%)
Clinical signs present	66 (198)	96 (289)	100 (300)
Clinical signs absent	34 (102)	4 (11)	-
Total	100 (300)	100 (300)	100 (300)
a) Vitamin A deficiency:			
Bitot's spots	10 (1)	29 (4)	26 (6)
Night-blindness	60 (6)	64 (9)	52 (12)
Conjunctival xerosis	30 (3)	7 (1)	22 (5)
Total	100 (10)	100 (14)	100 (23)
b) Vitamin B Complex deficiency:			
Angular stomatitis	7 (2)	1 (1)	1 (1)
Angular scars	51 (14)	4 (4)	22 (36)
Atropic papillae	14 (4)	93 (99)	74 (120)
Magenta tongue	14 (4)	3 (3)	9 (14)
Rawness of tongue	14 (4)	-	4 (6)
Total	100 (28)	100 (106)	100 (161)

Clinical assessment

Clinical examination has always been and remains an important practical method for assessing nutritional status. Clinical examination for prevalence of nutritional disorders is a fairly subjective indicator even in the hands of trained investigators. The plantation workers were clinically examined for the deficiency signs of vitamin A and B-complex. The data on clinical examination of male and female workers are presented in Tables 24 and 25 respectively.

The deficiency signs of vitamin A or B or of both were present in 65 to 66% of male and female workers of the 'British' and nearly among 100% of the 'Tea Corporation' and the 'Native'.

Among the vitamin A deficient male and female workers more than half to 90% manifested the pre-clinical vitamin A deficiency signs namely night-blindness. The advanced stage of vitamin A deficiency namely, presence of Bitot's spots, was observed in 22% male and 26% female workers of the 'Native'. The inadequate intake of vitamin A or its precursors, explains to some extent the prevalence of this deficiency among these workers. Another contributory factor leading to vitamin A deficiency might be the presence of worm infection, (to be discussed later) detected among the subjects. Experimental evidences support the role of worm infection in precipitating vitamin A deficiency (Pant and

Gopaldas 1986, Layrisse et al 1976, Kanani 1984, Beaton and Bengon 1976, Beaver 1969, Greenberg and Clive 1979).

The deficiency of vitamin B-complex appeared in the form of angular stomatitis, angular scars, atropic papillae and magenta tongue. The prevalence of vitamin B deficiency was observed among 3 to 30% male and 8 to 53% female workers of the three plantations. Again the prevalence was lower in the 'British' and highest in the 'Native'. Classifying for gender, more female workers were found to suffer from vitamin B deficiency than male workers. One-half of the vitamin B deficient workers exhibited angular scars, while nearly 70% male and 90% female workers had Atropic papillae. The intake of thiamine and niacin was satisfactory among the workers. Therefore, the deficient intake of riboflavin (Table 15 and 16) might be responsible for oral lesions observed among the labourers. In sum, the workers of the 'British', the 'Tea Corporation' and the 'Native' were found to suffer from mild to severe form of vitamin A and vitamin B deficiencies.

The above findings are substantiated by those of Rahamathullah (1983), Mcdonald (1939), Foy & Kondi (1957), Bora (1985) and Baroova (1988).

TABLE 26

Influence of type of plantation on the morbidity profile of their male plantation workers

Types of morbidity	Type of Plantation		
	British (B) (%)	Tea Corporation (TC) (%)	Native (N) (%)
Total	100 (300)	100 (300)	100 (300)
Not morbid	50 (152)	38 (11)	29 (88)
Influenza	4 (12)	12 (37)	9 (27)
Commoncold & cough	25 (75)	31 (92)	26 (78)
Diarrhoea	4 (10)	1 (4)	25 (75)
Vomiting	3 (7)	1 (4)	12 (35)
Fever	23 (66)	23 (69)	14 (43)
Mean days of sickness in the preceeding two months	2.2	2.3	2.3

(Figure in parentheses indicate actual number of subjects.)

TABLE 27

Influence of type of plantation on the morbidity profile of the female plantation workers

Types of morbidity	Type of Plantation		
	British (B) (%)	Tea Corporation (TC) (%)	Native (N) (%)
Total	100 (300)	100 (300)	100 (300)
Not morbid	47 (141)	42 (125)	19 (56)
Influenza	6 (19)	7 (20)	7 (21)
Commoncold & cough	27 (80)	26 (77)	28 (85)
Diarrhoea	6 (18)	6 (18)	23 (69)
Vomiting	5 (14)	3 (9)	16 (48)
Fever	20 (59)	20 (61)	26 (77)
Mean days of sickness in the preceeding two months	2.1	2.6	3

(Figure in parentheses indicate actual number of subjects.)

Morbidity status:

Morbidity or the diseased state has a direct bearing on productivity of the workers. Records on the morbidity status of male and female workers of the three plantation types were maintained. Information on sickness during the two months preceeding the date of interview was elicited using pretested proforma and cross-checked with the hospital records. The findings are presented in the Tables 26 and 27. The mean days of sickness among the male workers of the three plantation types did not vary significantly but the female workers of the 'British' were sick for less numbers of days as compared to their counterparts in the 'Tea Corporation' and the 'Native'.

However, the percentage of male and female workers who were morbid during the experimental period was lower in the 'British' than in the 'Tea Corporation' and the 'Native'. More female than male workers remained morbid during the two months preceeding the interview.

The common morbidities among the workers of these plantations were common cold and cough, diarrhoea and fever alone or in combination. One-fourth of the male workers of the 'British' and the 'Tea Corporation' had suffered from common cold and/or fever while equal number of the male workers of the 'Native' were sick with diarrhoea.

Among female workers, no such variations were observed among the three plantation types. But the percentage of those who fell

sick with these morbidities was somewhat higher among the female than the male workers in all the three plantations. The incidence of episodes of vomitting or influenza or diarrhoea was less than 14% of all listed morbidities among the subjects in the 'British' and the 'Tea Corporation'. By way of contrast diarrhoeas and vomitting alone accounted for nearly 40% of morbid episodes in the preceeding two months in the 'Native'.

Paul (1989) has reported that the occurence of skin diseases, gastro-intestinal disorders, liver and kidney ailments and bronchitis as common among the plantation workers. Basta (1974) observed incidence of morbidities like common cold and cough among rubber plantation workers of Indonesia. Rahamathullah (1983) considers morbidity to be a major factor for absenteeism among the plantation workers in South India.

From the Table 26 it is clear that the number of male non-morbid labourers were more in the 'British' followed by the 'Tea Corporation' with the highest morbidity being recorded in the 'Native' plantation. A similar trend in morbidity was observed in the case of female labourers (Table 27).

TABLE 28

Influence of type of plantation on the per cent prevalence of intestinal infection in the male plantation workers

Parasitic infection	Type of Plantation		
	British (B) (%)	Tea Corporation (TC) (%)	Native (N) (%)
Total	100 (293)	100 (293)	100 (296)
Neither protozoa nor helminths	22 (63)	11 (32)	3 (9)
Protozoa + helminths	38 (114)	56 (165)	67 (198)
Either protozoa or helminths	40 (116)	33 (97)	30 (89)
Total protozoa	43 (129)	64 (190)	70 (207)
Entamoeba histolytica	4 (13)	10 (28)	10 (30)
Giardia lamblia	48 (111)	54 (157)	57 (167)
Trichomonas hominis	1 (3)	4 (13)	4 (13)
Total helminths	64 (184)	77 (227)	88 (261)
Ascaris lumbricoides	16 (48)	31 (92)	39 (117)
Entereitis vermularis	1 (3)	2 (6)	3 (8)
Ankylostoma duodenale	48 (141)	51 (148)	53 (157)
Trichuris trichura	3 (9)	3 (10)	6 (18)

(Figures in parentheses indicate actual number of subjects.)

Parasitic infection:

It is well documented that moderate to heavy infection with intestinal parasites impairs the nutritional status of the host by mechanisms such as causing impairment of enzymatic digestion, malabsorption of nutrients and competing for the host's nutrients causing gastro-intestinal loss of nutrients.

The stool samples of both male and female workers were examined for the presence of parasite.

Of the 293 stool samples of the male workers in the 'British' plantation examined, 40% were found positive either for protozoa or helminths infections, 38% exhibited combined infections and 22% were free from infections (Table 28). The most common protozoal infection was that of Giardia lamblia. Among the helminths largest percentage of the male workers suffered from Ankylostoma duodenale infection.

In the 'Tea Corporation' and the 'Native' plantations, 11 and 3% of the 293 and 296 stool samples examined respectively were free of infection as against 22% in the 'British' plantation. Also the combined protozoal and helminth infection in the workers of the 'Tea Corporation' (56%) and the 'Native' (67%) was higher than among the workers in the 'British'. As was observed among the 'British' plantation workers, the most common protozal infection was that of Giardia lamblia and that of helminths was that of Ankylostoma duodenale.

TABLE 29

Influence of type of plantation on the per cent prevalence of intestinal infection in the female plantation workers

Parasitic infection	Type of Plantation		
	British (B) (%)	Tea Corporation (TC) (%)	Native (N) (%)
Total	100 (290)	100 (293)	100 (293)
Neither protozoa nor helminths	22 (65)	6 (18)	1 (3)
Protozoa + helminths	36 (109)	58 (169)	69 (204)
Either protozoa or helminths	42 (116)	34 (106)	30 (90)
Total protozoa	43 (125)	70 (204)	80 (236)
Entamoeba histolytica	2 (16)	18 (54)	25 (73)
Giardia lamblia	42 (118)	51 (148)	56 (164)
Trichomonas hominis	2 (5)	5 (15)	8 (23)
Total helminths	58 (167)	79 (231)	91 (265)
Ascaris lumbricoides	10 (29)	25 (73)	25 (73)
Entereitis vermularis	2 (5)	2 (6)	5 (15)
Ankylostoma duodenale	49 (142)	57 (166)	57 (191)
Trichuris trichura	2 (5)	3 (10)	5 (13)

(Figures in parentheses indicate actual number of subjects.)

Similar magnitude of parasitic infection (Table 29) was observed in female workers of the three plantation types. However, incidence of amoebiasis was found to be higher in female than male workers particularly in the 'Tea Corporation' and the 'Native' plantations.

Thus parasitic infection appears to be one of the alarming problems among the tea plantation workers. More so when the commonest type of helminthic infection is that of hookworm. Experimental evidence is available to support the fact that hookworm harbourers suffer from anaemia. Basta et al (1974) reported that 85% of the rubber plantation workers in West Java exhibited hookworm infection which was associated with anaemia. Similarly, Latham et al (1982) working with the Kenyan road construction workers reported that 69% of the workers were affected by hookworm infection. These workers had low haemoglobin values. Rahamathullah (1983) and Unnikrishnan (1989) reported a high hookworm infection in South Indian plantation workers. More recently Samarasinghe (1990) stated that worm infections and their complications were most pronounced in the plantation areas.

The alarmingly high infection rate among the tea plantation workers of the present study might be due to poor personal hygiene, a polluted environment especially that of the soil, insanitary toilets, poor housing and the non-availability of of sufficient or safe water for washing and drinking purposes among the plantation workers.

This hypothesis gets further support by the fact that the prevalence of infections among the 'British' workers was lower where environmental sanitation and other facilities were better than in the 'Tea Corporation' and in the 'Native' plantations.

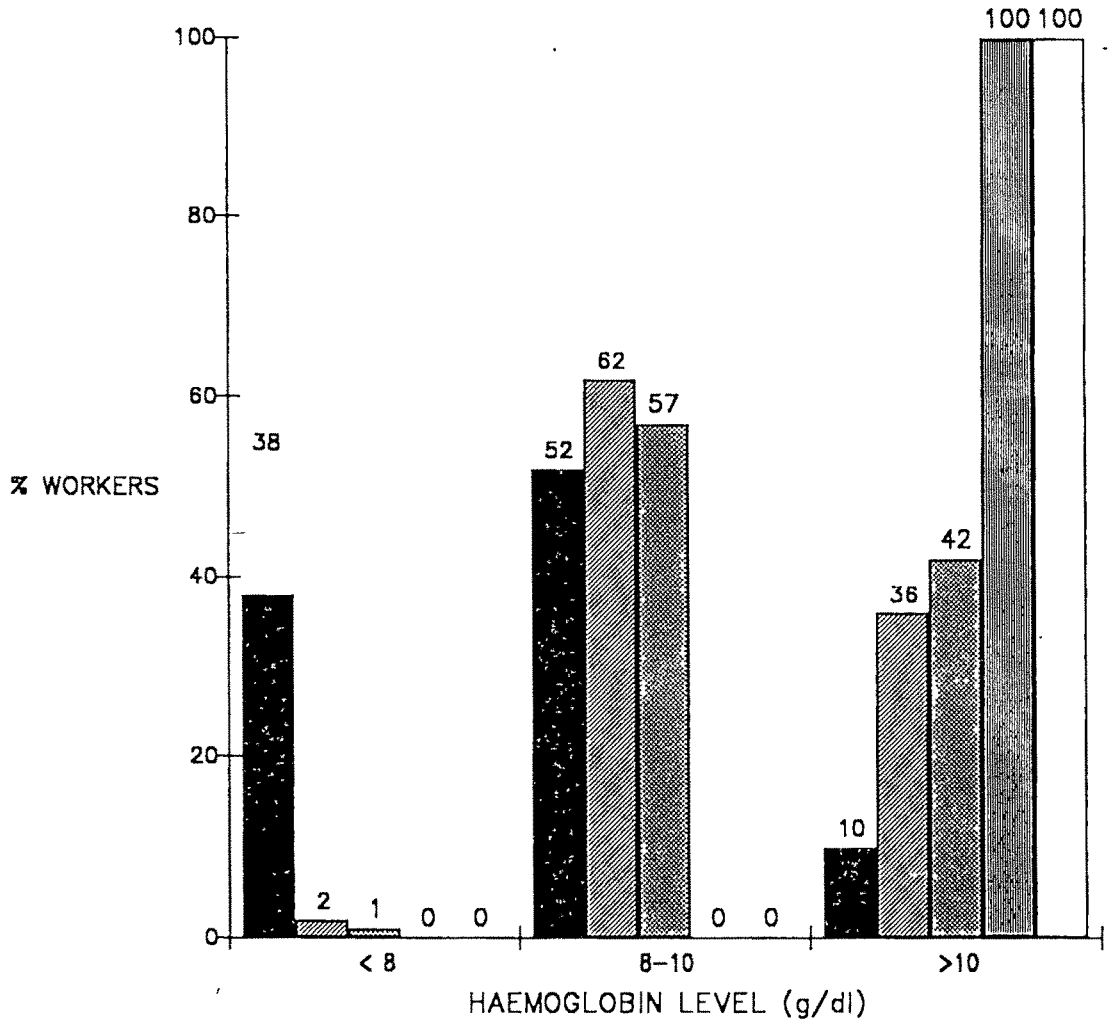
C. EFFECT OF SOCIO-ECONOMIC AND ENVIRONMENTAL FACTORS ON THE HEALTH AND NUTRITIONAL STATUS OF THE WORKERS

Socio-economic variables have been widely used as indicators of the nutritional and health status of a community. Poverty has been considered as one of the major factors responsible for undernutrition. It is also believed that socio-economic factors accompanied by environmental evaluation can predict fairly accurately the nutrition and health status of a community. Thus, in the present investigation, the association between socio-economic and environmental factors with nutritional and health status of the workers was determined.

Table 30 through 46 and Figures 5 to 14 present the association between socio-economic and /environmental factors, namely, literacy/educational status of the workers; house type; water, and toilet facilities; on the one hand and the nutrition/health status of the workers, specifically in terms of haemoglobin levels, prevalence of parasitic infections, prevalence of morbidity, prevalence of clinical signs of vitamin deficiencies and Body Mass Index (BMI) on the other.

FIGURE 5

INFLUENCE OF LITERACY/EDUCATIONAL STATUS ON THE HAEMOGLOBIN LEVEL OF THE PLANTATION WORKERS



χ^2 value = 244.63 for df 8 significant at $p < 0.001$

- Illiterate
- Can read
- Can read & Write
- Primary pass
- Upto middle school

TABLE 30

Influence of literacy/educational status on the per cent prevalence of parasitic infections among plantation workers

Educational status	Parasitic Infections (%)		
	* Present	** Absent	Total (% distribution of literacy/educational status)
Illiterate	92 (1349)	8 (122)	84 (1471)
Can read	82 (160)	18 (34)	11 (194)
Can read and write	67 (57)	33 (32)	5 (89)
Primary pass	64 (2)	36 (1)	0.2 (3)
Upto middle school	-	100 (1)	0.1 (1)
			100 (1758)

X^2 values between the educational level and parasitic infection = 86.95 for df 4 significant at $p<0.001$.

(Figures in parentheses indicate actual number of subjects.)

* Either protozoa or helminth present.
** Neither protozoa nor helminth present.

TABLE 31

Influence of type of housing on the per cent prevalence of morbidity among plantation workers

Educational status	Morbidity Status (%)		
	* Present	** Absent	Total (% distribution of literacy/educational status)
Illiterate	68 (1023)	32 (482)	83 (1505)
Can read	40 (80)	60 (120)	11 (200)
Can read and write	33 (21)	67 (70)	5 (91)
Primary pass	1 (23)	77 (2)	0.2 (3)
Upto middle school	-	100 (1)	0.1 (1)
			100 (1800)

X^2 values between the education and morbidity status = 125.53 df 4 significant at $p<0.001$.

(Figures in parentheses indicate actual number of subjects.)

* Presence of morbidity like influenza, common cold & cough, diarrhoea, vomiting and fever.

** Absence of any of the morbidities mentioned at *.

Figure 5 shows a significant association between literacy/educational status of the workers and their haemoglobin levels. Among the illiterate workers, nearly 40% were severely anaemic having haemoglobin levels of <8 g/dl as against only 3% among those who could read or read and write. The majority of these workers who could read (62%) or who could read and write (57%) had haemoglobin levels between 8-10 g/dl. The haemoglobin levels of all those who had some years of schooling were above 10 g/dl.

A significant association between literacy/educational status of the workers and the prevalence of parasitic infections was observed (Table 30). Over 90% of illiterate workers showed parasitic infection. There was a linear decline in parasitic infection among the workers with an improved literacy status. None of the workers who had schooling upto middle level harboured intestinal worms.

Similar to haemoglobin levels and the prevalence of parasitic infections, morbidity status exhibited a significant association with the literacy level of the workers (Table 31). Nearly 70% of the illiterate workers suffered from various morbidities in the preceding two months from the date of data collection, as against 40% of those who could read, 33% of those who could read and write, and 1% of those who studied upto middle school level. These data suggest that better the literacy/educational status, lower was the prevalence of morbidity.

TABLE 32

Influence of education on the per cent prevalence of clinical signs of vitamin deficiencies among male plantation workers

Educational status	Vitamin Deficiency Signs (%)		
	* Present	** Absent	Total (% distribution of literacy/educational status)
Illiterate	29 (439)	71 (1068)	84 (1505)
Can read	6 (11)	94 (189)	11 (200)
Can read and write	1 (1)	99 (90)	5 (91)
Primary pass	-	100 (3)	0.2 (3)
Upto middle school	-	100 (1)	0.1 (1)
			100 (1800)

X^2 values = 82.82 for df 3 significant at $p<0.001$.

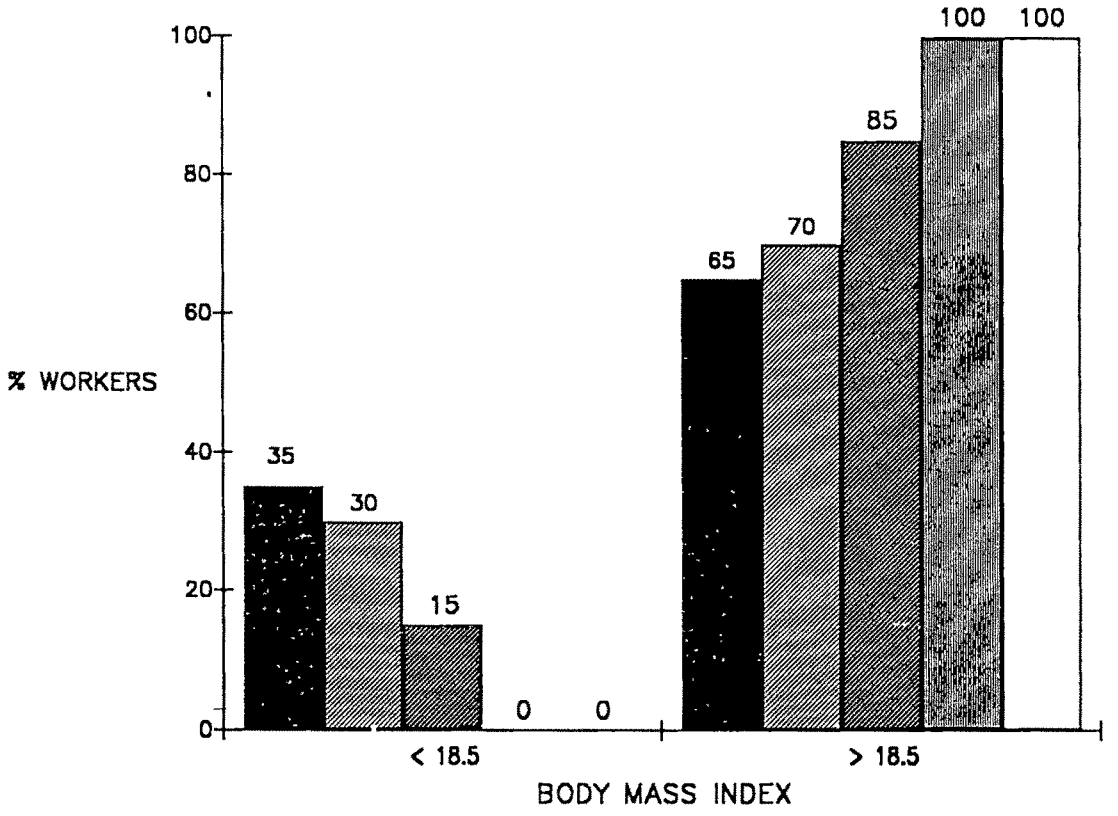
(Figures in parentheses indicate actual number of subjects.)

* Presence of Bitot's spots, Night-blindness, Conjunctival Xerosis, Angular stomatitis, Angular scar, Atrophic papillae, Magenta tongue, Rawness of tongue etc. alone or in combination.

** None of the deficiency signs mentioned above were present.

FIGURE 6

INFLUENCE OF LITERACY/EDUCATIONAL STATUS ON BODY MASS INDEX (BMI) OFTHE PLANTATION WORKERS



BMI = Weight (kg)/Height^2 (m); BMI < 18.5 is undernourished and BMI ⩾ 18.5 is normal for adults in the developing world (Waterlow 1989)

χ^2 value = 30.46 for df 3 significant at p < 0.001

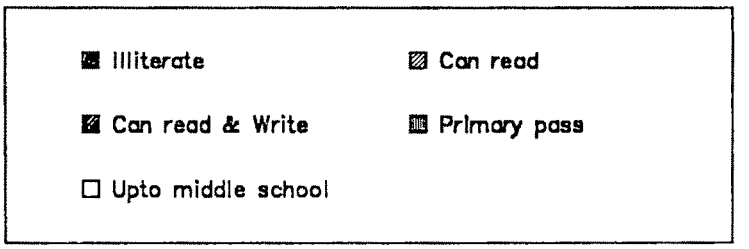


Table 32 shows a significant association between the literacy/educational status and the prevalence of vitamin deficiencies among the workers. One-third of the illiterate workers as against only 7% of those who could read, or read and write, showed vitamin deficiency signs.

Figure 6 shows a significant positive association between literacy/educational status of the workers and their Body Mass Index. As per a recent index developed by Waterlow (1989), adults in the developing world who had a BMI (weight in kg by height^{2}m) of $\geq$ 18.5 could be considered normal; whereas those with a BMI <18.5 were undernourished for the developing world. A significantly higher percentage of illiterate workers were below the cut off point of 18.5, indicating a poor nutritional status. All the workers who had studied upto the middle school level showed normal nutritional status with a BMI above the cut off point of 18.5.

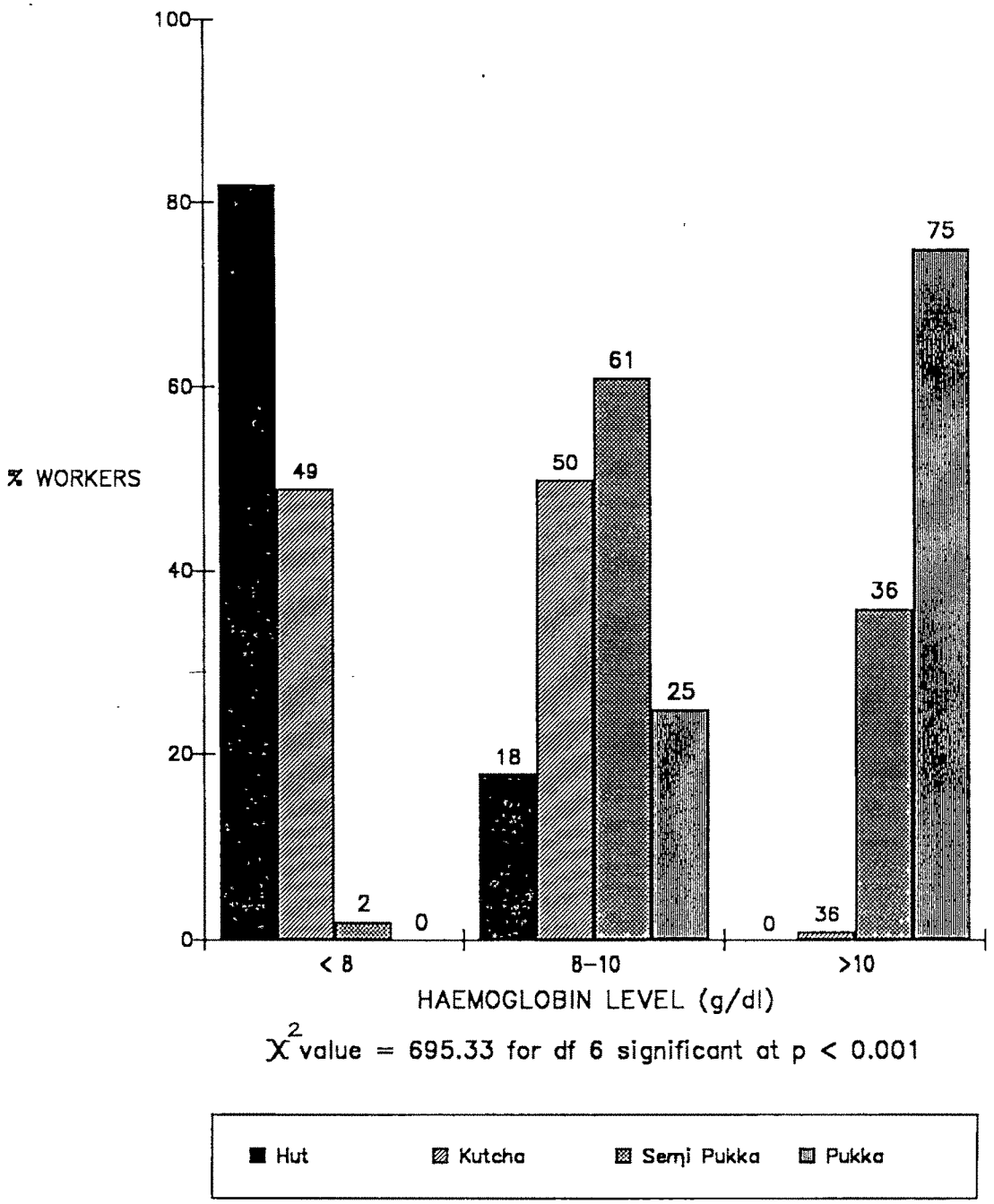
Thus literacy/educational status of the workers appears to exert significant influence on their nutritional and health status.

In the present study a hut was defined as a very small dwelling place with bamboo walls covered with mud plaster, a thatched roof and a floor of plain earth.

A 'kutcha' house is a dwelling place with thatched roof, walls made of concrete pillars and bamboos plastered with mud while the floor is of plain earth. A 'semi-pukka' house is one in

FIGURE 7

INFLUENCE OF TYPE OF HOUSING ON THE HAEMOGLOBIN LEVELS OF THE PLANTATION WORKERS



χ^2 value = 695.33 for df 6 significant at $p < 0.001$

TABLE 33

Influence of type of housing on the per cent prevalence of parasitic infections among plantation workers

Type of housing	Parasitic Infections (%)		
	Present *	Absent **	Total (% distribution of house type)
Hut	100 (22)	-	1 (22)
Kutcha	96 (1029)	4 (49)	61 (1078)
Semi Pukka	79 (513)	21 (133)	37 (646)
Pukka	34 (4)	66 (8)	1 (12)
			100 (1758)

X^2 values between the type of housing and parasitic infection = 123.81 for df 3 significant at $p<0.001$.

(Figures in parentheses indicate actual number of subjects.)

* Either protozoa or helminths present.

** Neither protozoa nor helminths present.

which both roof and walls are made of corrugated or galvanized tin sheets, concrete or cement, and floor is of plain earth. A 'pukka' house was one wherein the roof was made of corrugated or galvanized tin sheets, concrete or cement and where the walls and floor were also of concrete or cement namely a permanent construction.

A significant association between house type and iron status of the workers was observed (Figure 7). More than 80% of the workers who lived in huts and nearly 50% of the workers who lived in kutcha houses were severely anaemic with haemoglobin levels of less than 8 g/dl, while 2% of those who lived in semi pukka houses and none of those who lived in pukka houses suffered from severe anaemia. A majority of those dwelling in semi pukka house had haemoglobin levels ranging from 8 to 10 g/dl and 70% of those who lived in pukka house, had haemoglobin levels above 10 g/dl.

The type of housing (Table 33) also showed a significant association with parasitic infection. Nearly 100% of the workers who lived in either huts or kutcha houses were infected while only one-third of those who lived in pukka houses exhibited infections. Nearly 80% of the workers living in semi pukka house suffered from worm infections. The much higher levelof parasitic infections among the hut or 'kutcha' house dwellers is attributed to the plain earth floors which could be a good source of soil transmitted parasitic infections.

TABLE 34

Influence of type of housing on the per cent prevalence of morbidity among plantation workers

Type of housing	Morbidity Status (%)		
	* Present	** Absent	Total (% distribution of house type)
Hut	77 (17)	23 (5)	1 (22)
Kutcha	69 (761)	31 (341)	61 (1102)
Semi Pukka	49 (325)	51 (339)	37 (664)
Pukka	33 (4)	67 (8)	1 (12)
			100 (1800)

X^2 values between the type of housing and morbidity status = 56.46 for df 2 significant at $p<0.001$.

(Figures in parentheses indicate actual number of subjects.)

* Presence of morbidity like influenza, common cold & cough, diarrhoea, vomiting and fever.

** Absence of any morbidity mentioned above.

TABLE 35

Influence of type of housing on the per cent prevalence of clinical signs of vitamin deficiencies among plantation workers

Type of housing	Vitamin Deficiency (%)		
	* Present	** Absent	Total (% distribution of house type)
Hut	59 (13)	41 (9)	1 (22)
Kutcha	35 (385)	65 (717)	61 (1102)
Semi Pukka	8 (51)	92 (613)	37 (664)
Pukka	- (4)	100 (12)	1 (12)
			100 (1800)

X^2 values for df 3 not significant.

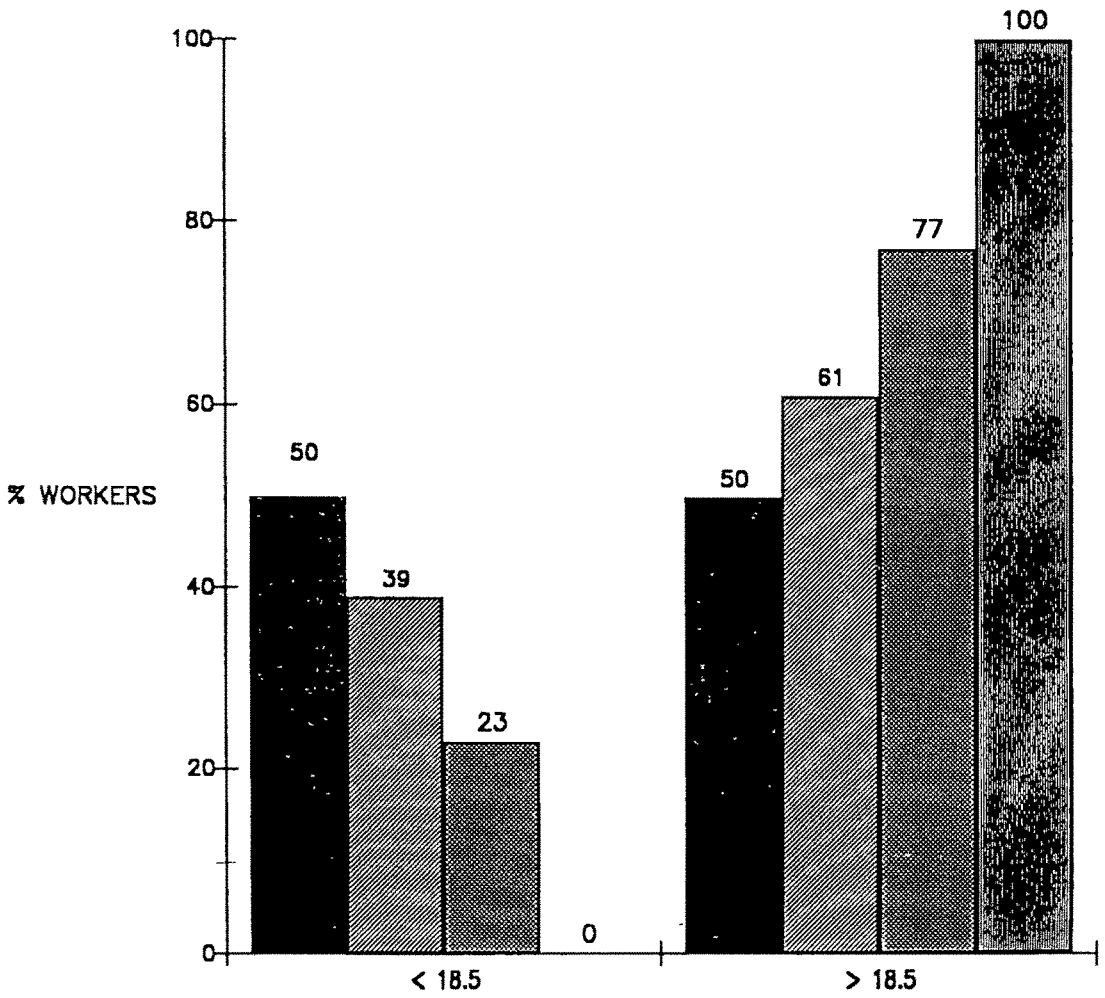
(Figures in parentheses indicate actual number of subjects.)

* Presence of Bitot's spots, Night-blindness, Conjunctival Xerosis, Angular stomatitis, Angular scar, Atrophic papillae, Magenta tongue, Rawness of tongue etc. alone or in combination.

** None of the deficiency signs mentioned above were present.

FIGURE 8

INFLUENCE OF TYPE OF HOUSING ON THE BODY MASS INDEX (BMI) OF THE PLANTATION WORKERS



BMI = Weight (kg)/Height^2 (m); BMI < 18.5 is undernourished and BMI ≥ 18.5 is normal for adults in the developing world (Waterlow 1989)

χ^2 value = 60.93 for df 3 significant at $p < 0.001$

The prevalence of morbidities among workers also showed a significant association with the type of housing (Table 34). Nearly 80% of the workers who lived in huts and 70% of those who lived in kutcha houses suffered from various morbidities during the two months preceeding the date of data collection. By way of contrast, a lower level of prevalence of nearly 50% for those who lived in semi-pukka houses and 33% for those who lived in pukka houses was observed.

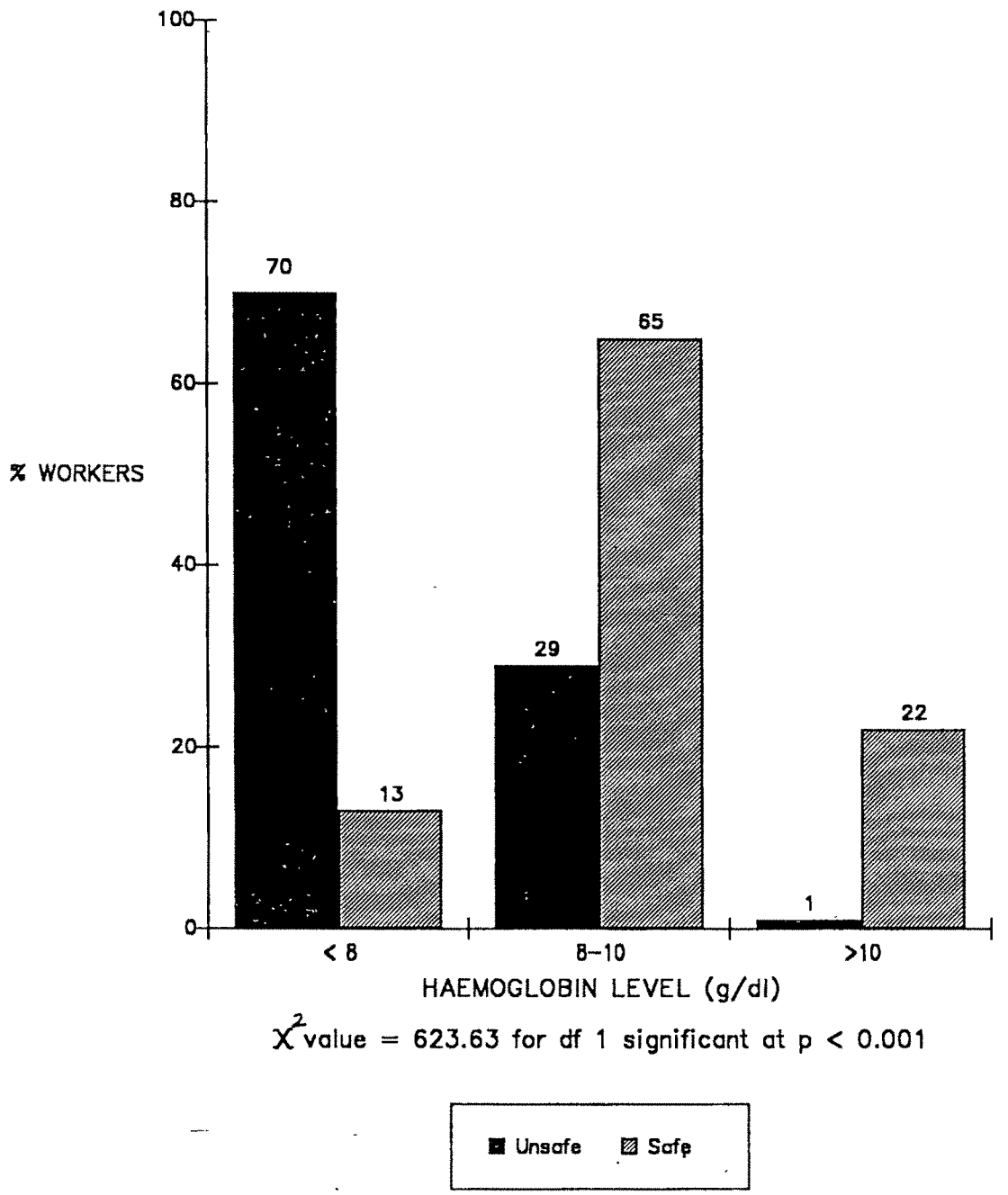
Similarly a significant association was observed between vitamin deficiencies and house type (Table 35). More than half of the workers who lived in huts showed deficiencies of vitamins. In contrast, almost all the workers who lived in semi pukka or pukka houses were free from vitamin deficiencies.

The nutritional status of the workers in terms of BMI showed significant association (Figure 8) with the type of houses they lived in. More than 70% of the workers who lived in semi pukka or pukka houses were found to be in the normal nutritional status category while 50 to 60% of those who lived in huts or kutcha houses were malnourished, with a BMI lower than the cutoff of 18.5.

In the present study water was considered safe if it came from a tubewell or a chlorinated piped water source. Water was considered unsafe if it was obtained from uncovered wells, ponds or tanks. Water that is contaminated/polluted is considered unsafe because it carries pathogenic bacteria and other infective

FIGURE 9

INFLUENCE OF SOURCE OF DRINKING WATER ON THE HAEMOGLOBIN LEVELS OF THE PLANTATION WORKERS



χ^2 value = 623.63 for df 1 significant at $p < 0.001$

TABLE 36

Influence of source of drinking water on the per cent prevalence of parasitic infections among the plantation workers

Source of water	Parasitic Infections (%)		
	* Present	** Absent	Total (% distribution of source of water)
Unsafe	98 (557)	2 (12)	33 (589)
Safe	84 (991)	16 (178)	67 (1169)
			100 (1758)

X^2 values = 69.32 df 1 Significant at $p<0.001$.

(Figures in parentheses indicate actual number of subjects.)

* Either protozoa or helminths present excluding hookworm.

** Neither protozoa nor helminths present.

TABLE 37

Influence of source of drinking water on the morbidity status of the plantation workers

Type of water	Morbidity Status (% Prevalence)		
	* Present	** Absent	Total (% distribution of source of water)
Unsafe	52 (314)	48 (286)	33 (600)
Safe	27 (328)	73 (872)	67 (1200)
			100 (1800)

X^2 values = 107.87 for df 1 Significant at $p<0.001$.

(Figures in parentheses indicate actual number of subjects.)

* Diarrhoea, vomiting and fever, were present either alone or in combination.

** Diarrhoea, vomiting and fever are all absent.

agents causing water borne diseases including parasitic infections.

In the present study a larger percentage of workers (Figure 9) who used open tanks and open wells as their water source were severely anaemic (Haemoglobin <8 g/dl) in contrast to those who had access to piped water or tube wells. On the other hand, above 80% of the workers had access to safe water source and were either mildly anaemic or non anaemic. It emerges that providing safe drinking water will be a single welfare measure that will have immeasurable positive impact on all aspects of health and nutritional status discussed upto now.

Table 36 depicts a significant association between the source of water and parasitic infections. Almost every one (98%) of those who used unsafe water showed parasitic infections. Even those who had access to safe water (piped or tube-well) showed a high prevalence of parasitic infections pointing to the possibility that either the 'safe' water source was not entirely 'safe' or that workers were using both safe and unsafe water sources, or that soil transmitted infections exerted a more powerful influence on parasitic infections than the water source.

Prevalence of morbidity was also significantly related to the type of water (Table 37). More than 50% of the workers who used unsafe water suffered from various morbidities over a two-months period preceding the date of morbidity survey. On the other hand, a significantly lower percentage (27%) of those who

TABLE 38

Influence of source of drinking water on the per cent prevalence of clinical signs of vitamin deficiencies among the plantation workers

Type of water	Vitamin Deficiency Signs — % Prevalence		
	* Present	** Absent	Total (% distribution of source of water)
Unsafe	42 (251)	58 (349)	33 (600)
Safe	16 (198)	84 (1002)	67 (1200)
			100 (1800)

X^2 values = 135.77 for df 1 Significant at $p<0.05$.

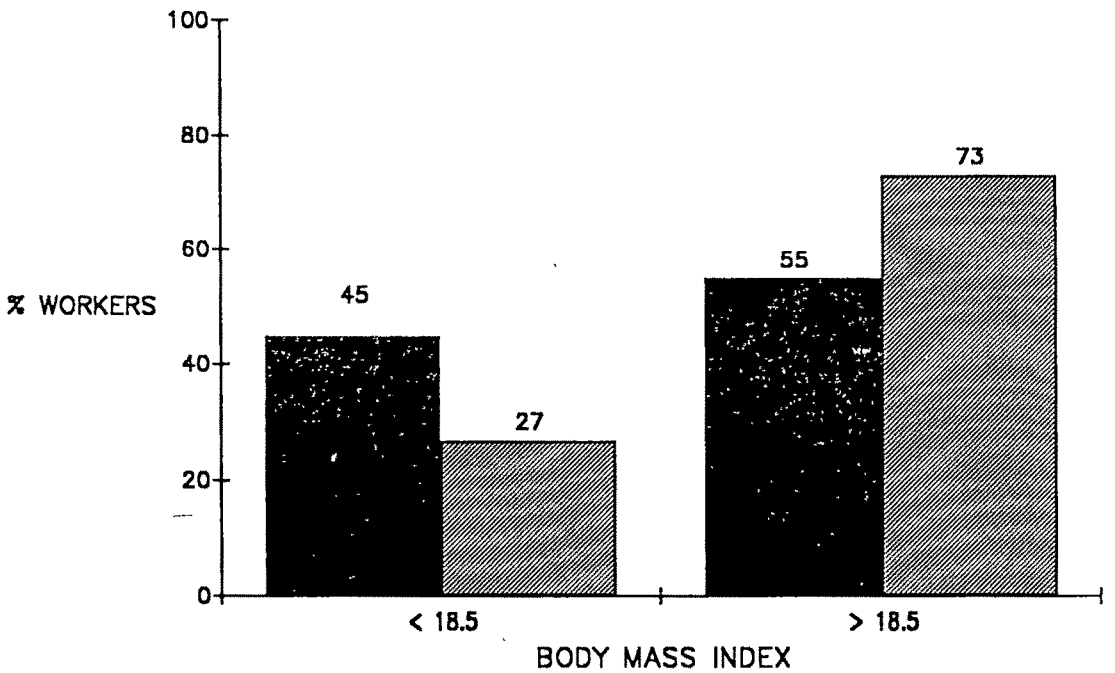
(Figures in parentheses indicate actual number of subjects.)

* Presence of Bitot's spots, Night-blindness, Conjunctival Xerosis, Angular stomatitis, Angular scar, Atrophic papillae, Magenta tongue, Rawness of tongue etc alone or in combination.

** None of the deficiency signs mentioned above were present.

FIGURE 10

INFLUENCE OF SOURCE OF DRINKING WATER ON THE BODY MASS INDEX (BMI) OF THE PLANTATION WORKERS

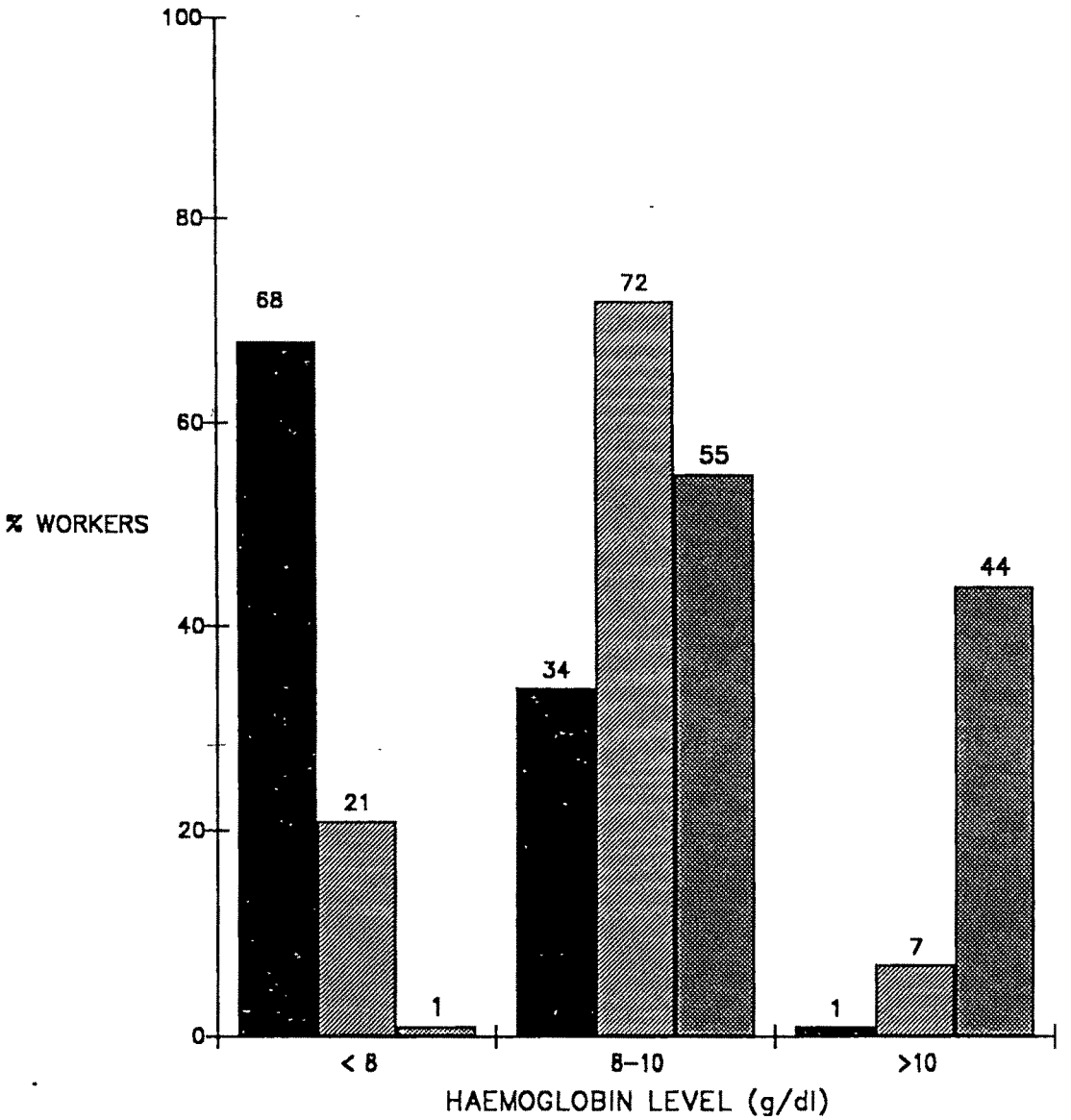


BMI=Weight (kg)/Height^2(m); BMI < 18.5 is undernourished and BMI ⩾ 18.5 is normal for adults in the developing world (Waterlow 1989)

X^2value = 26.46 for df 1 significant at p < 0.001

FIGURE 11

INFLUENCE OF TOILET USED ON THE HAEMOGLOBIN LEVELS OF THE PLANTATION WORKERS



X^2 value = 872.38 for df 4 significant at $p < 0.001$

TABLE 39

Influence of toilet used on the parasitic infections of the plantation workers

Types of toilet used	Types of Infections (%)		
	* Present	** Absent	Total (% distribution of type of toilet used)
Open air	99 (653)	2 (16)	38 (669)
Non sanitary	91 (555)	9 (54)	35 (609)
Sanitary	75 (360)	25 (120)	27 (480)
			100 (1758)

X^2 values 151.83 for df 2 significant at $p<0.001$.

(Figures in parentheses indicate actual number of subjects.)

* Either protozoa or helminths present.

** Neither protozoa nor helminths present.

used safe water were morbid during the same period. A significantly larger percentage of workers who used unsafe water showed vitamin deficiency signs than those who used safe water (Table 38).

The negative effect of the use of unsafe water was observed on the nutritional status of the workers. Nearly half of the workers who used unsafe water were malnourished as against less than one-third who used safe water (Figure 10).

Sanitation and Nutritional Status

The use of open fields/hillsides for defecation is common among the plantation workers. Figure 11 reveals that a much higher percentage of those who used 'open air' for defecation had low hemoglobin values of less than 8 g/dl. Contaminated soil is known to be the most common reason for soil-transmitted helminthic-infections. Table 39 shows that intestinal parasitic and helminthic infections were almost universal among plantation workers who used 'open air' or non-sanitary toilets; however, it was also high (75%) among those who used sanitary toilets. Hence, the powerful negative influence of soil-transmitted diseases in tea plantation workers should be recognized by the Management as a serious public health problem that needs to be addressed and eradicated.

TABLE 40

Influence of toilet used on the morbidity status of the plantation workers

Type of toilet used	Morbidity Status (% Prevalence)		
	* Present	** Absent	Total (% distribution of type of toilet used)
Open air	74 (507)	26 (176)	38 (683)
Non sanitary	63 (395)	37 (229)	35 (624)
Sanitary	45 (223)	55 (223)	27 (493)
			100 (1800)

X^2 values 102.99 for df 2 significant at $p<0.001$.

(Figures in parentheses indicate actual number of subjects.)

* Any morbidity like influenza, common cold & cough, diarrhoea, fever & vomiting present.

** No morbidity present.

TABLE 41

Influence of toilet used on the clinical signs of vitamin deficiencies among the plantation workers

Type of toilet used	Vitamin Deficiency % Prevalence		
	* Present	** Absent	Total (% distribution of type of toilet used)
Open air	37 (256)	63 (427)	38 (683)
Non sanitary	28 (117)	72 (447)	35 (624)
Sanitary	3 (16)	97 (447)	27 (493)

X^2 values 185.23 for df 2 significant at $p<0.001$.

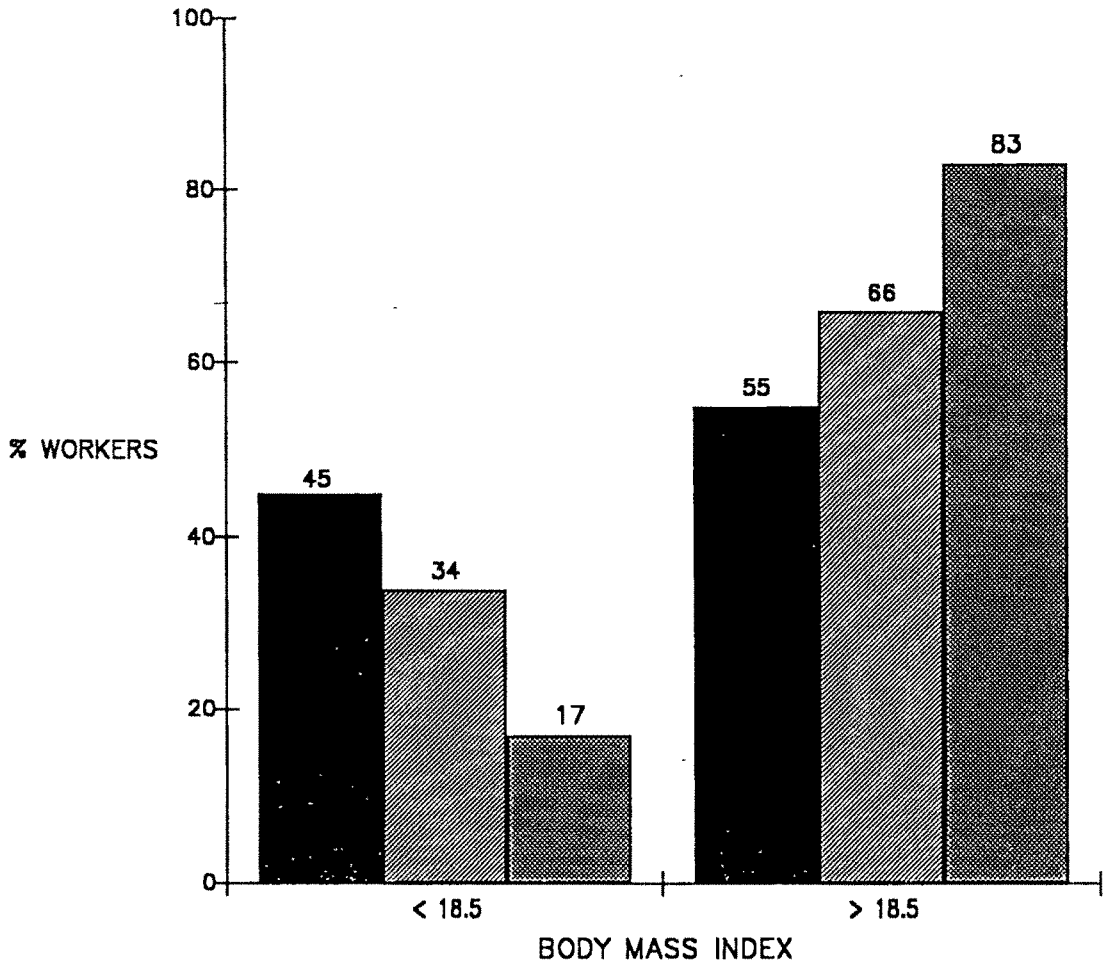
(Figures in parentheses indicate actual number of subjects.)

* Presence of Bitot's spots, Night-blindness, Conjunctival xerosis, Angular stomatitis, Angular scar, Atrophic papillae, Magenta tongue, Rawness of tongue etc. alone or in combination.

** None of the deficiency signs mentioned above were present.

FIGURE 12

INFLUENCE OF TOILET USED ON THE BODY MASS INDEX (BMI) OF THE PLANTATION WORKERS



BMI = Weight (kg)/Height^2(m); BMI < 18.5 is undernourished and BMI ⩾ 18.5 is normal for adults in the developing world (Waterlow 1989)

X^2value = 38.58 for df 2 significant at $p < 0.001$

Table 40 shows a significant association between the type of toilet used and the morbidity status of the workers. The prevalence of morbidity was nearly one and a half times among the workers who used open air as compared to those who used sanitary toilets.

Vitamin deficiencies were associated with the type of toilet used. Vitamin deficiencies were significantly higher among the workers who used open air followed by non sanitary toilets than among those using sanitary toilets (Table 41).

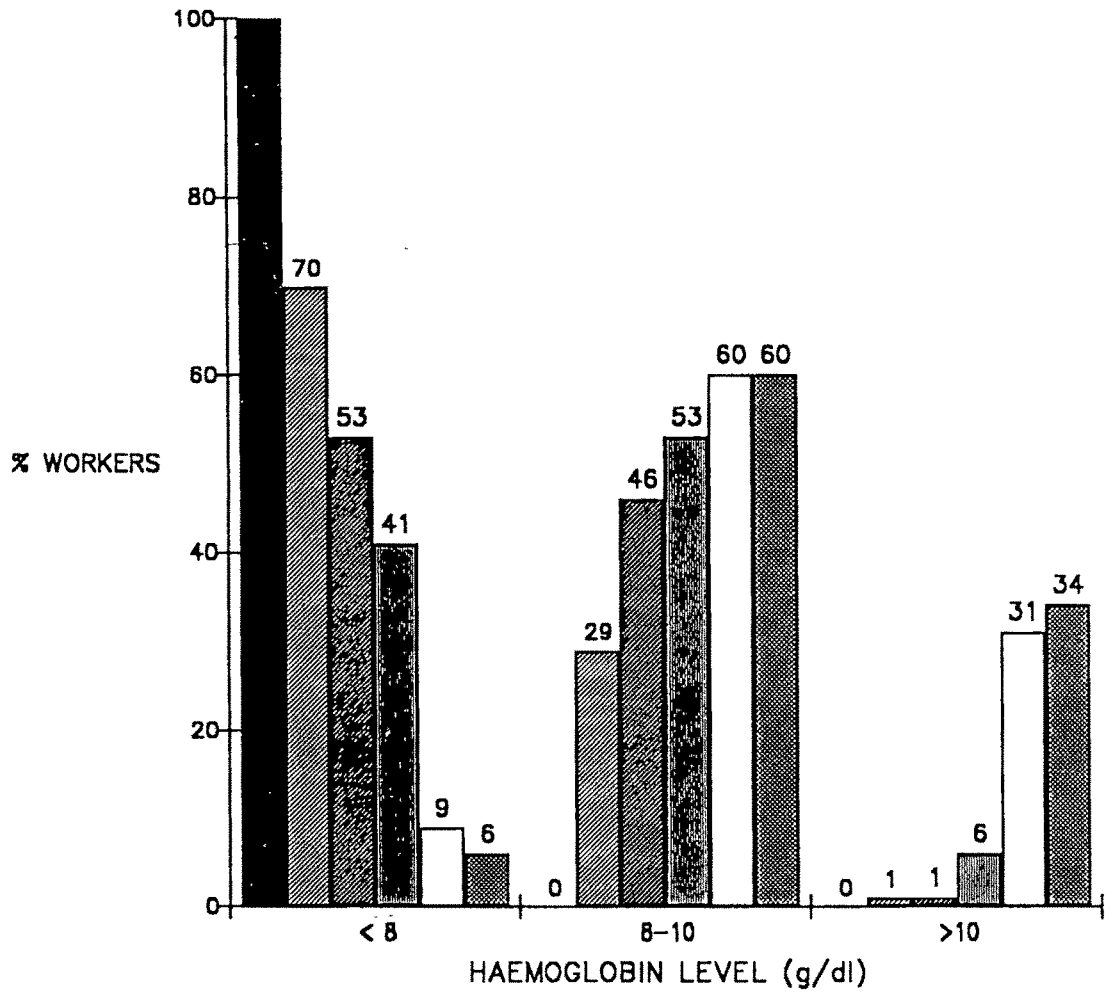
Nutritional status as assessed by Body Mass Index (BMI) was adversely affected by poor toilet facilities (Figure 12). The percentage of workers who were malnourished as per BMI, was significantly lower among those who used sanitary toilets than among those who used open air or non sanitary toilets.

Per capita Income and Nutritional Status

Poverty is considered the root cause of ill health. The prevalence of severe anaemia (Hb < 8 g/dl), worm infections, morbidities, vitamin deficiencies and poor nutritional status (namely low BMI) was universal among the workers whose monthly per capita income was less than Rs.50 (Tables 42 to 44 and Figures 13 and 14).

FIGURE 13

INFLUENCE OF MONTHLY PER CAPITA INCOME ON THE HAEMOGLOBIN LEVELS OF THE PLANTATION WORKERS



χ^2 value = 439.95 for df 10 significant at $p < 0.001$

TABLE 42

Influence of per capita income on the per cent prevalence of parasitic infections among the plantation workers

Per capita income/month in Rs.	Parasitic Infections — % Prevalence		
	* Present	** Absent	Total (% distribution of per capita income)
50	100 (1)	-	0.1 (1)
51 - 75	100 (90)	-	5 (90)
76 - 100	96 (220)	4 (10)	13 (230)
101 - 125	95 (743)	5 (40)	46 (783)
126 - 150	80 (447)	20 (110)	32 (557)
150	69 (67)	31 (30)	5 (97)
			100 (1758)

X^2 values 140.59 for df 5 significant at $p < 0.001$.

(Figures in parentheses indicate actual number of subjects.)

* Either protozoa or helminths present.

** Neither protozoa nor helminths present.

TABLE 43

Influence of per capita income on the morbidity status of the plantation workers

Per capita income/month in Rs.	Morbidity Status (% Prevalence)		
	* Present	** Absent	Total (% distribution of per capita income)
50	100 (1)	-	0.1 (1)
51 - 75	25 (23)	75 (70)	5 (93)
76 - 100	32 (74)	68 (160)	13 (234)
101 - 125	36 (267)	64 (131)	44 (798)
126 - 150	50 (286)	50 (287)	32 (573)
150	54 (54)	46 (47)	6 (101)
			100 (1800)

X^2 values 80.95 for df 5 significant at $p<0.001$.

(Figures in parentheses indicate actual number of subjects.)

* Presence of morbidity like influenza, common cold & cough, diarrhoea, vomiting and fever.

** Absence of any of the morbidities mentioned at *.

TABLE 44

Influence of per capita income on clinical signs of vitamin deficiencies of the plantation workers

Per capita income/month in Rs.	Vitamin Deficiency Signs % Prevalence		
	* Present	** Absent	Total (% distribution of per capita income)
50	100 (1)	-	0.1 (1)
51 - 75	51 (47)	49 (46)	5 (93)
76 - 100	34 (79)	66 (155)	13 (234)
101 - 125	33 (264)	67 (534)	44 (798)
126 - 150	9 (51)	91 (522)	32 (573)
150	8 (8)	92 (93)	6 (101)
			100 (1800)

X^2 values 165.23 for df 5 significant at $p<0.001$.

(Figures in parentheses indicate actual number of subjects.)

* Presence of Bitot's spots, Night-blindness, Conjunctival xerosis, Angular stomatitis, Angular scar, Atrophic papillae, Magenta tongue, Rawness of tongue etc.alone or in combination

** None of the deficiency signs mentioned above were present.

The prevalence of severe anaemia decreased as the monthly per capita income increased from Rs.50 to Rs.150 and above (Figure 13). As a matter of fact, less than 10% workers with monthly per capita income of Rs.126 and above exhibited severe anaemia. Over one-third of these workers had haemoglobin levels above 10 g/dl. These data show negative association between the prevalence of severe anaemia and income per capita.

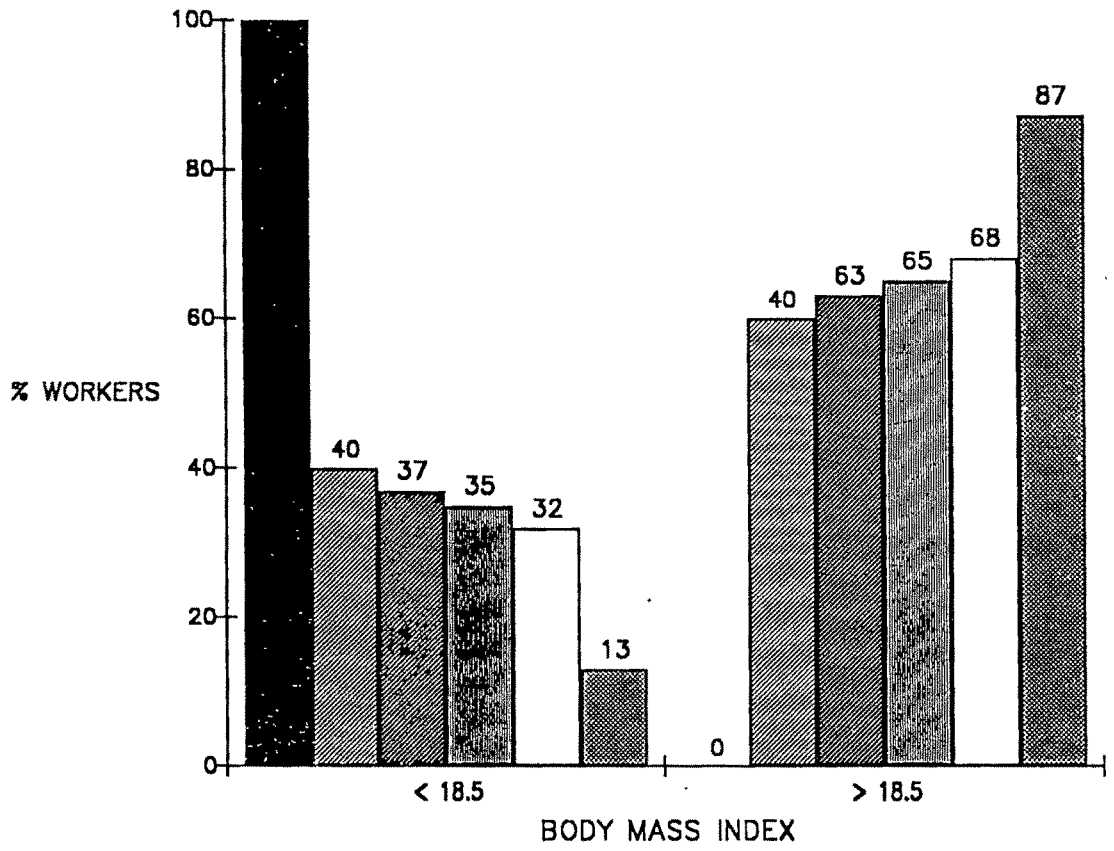
Likewise, a significant negative association was observed between income and the prevalence of parasitic infection among the workers (Table 42). About one-third of the workers whose per capita monthly income was above Rs.150 were found to be free from parasitic infections. The prevalence of parasitic infections was significantly related to the income status of the workers. The prevalence of parasitic infections decreased as the per capita monthly income increased from less than Rs.50 to Rs.150 and above.

The per capita income did not show any association with the prevalence of morbidity during the preceeding two months of the survey (Table 43).

Vitamin deficiencies were also found to be related to income (Table 44). Less than 10% of the workers whose monthly income ranged between Rs.126-150 and above exhibited vitamin A and vitamin B-complex deficiency signs. One-third to one-half of those whose income was below Rs.126 per capita suffered from vitamin deficiencies.

FIGURE 14

INFLUENCE OF MONTHLY PER CAPITA INCOME ON THE BODY MASS INDEX(BMI) OF THE PLANTATION WORKERS



BMI = Weight (kg)/Height^2(m);BMI < 18.5 is undernourished and BMI ⩾ 18.5 is normal for adults in the developing world (Waterlow 1989)

X^2 value = 51.4 for df 4 significant at p < 0.001

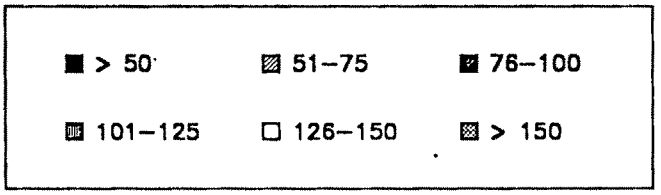


TABLE 45

Regression model of the effect of socio-economic and environmental variables on haemoglobin values

Socio-economic and environmental variables		Haemoglobin B	SEB	T	SIGT
Water source	..	0.9047	0.0469	19.292	0.001 ***
House type	..	0.6767	0.0707	9.571	0.001 ***
Education	..	0.4254	0.0551	7.717	0.001 ***
Sanitation	..	0.2860	0.0717	3.990	0.001 ***
Constant	..	8.6027	0.1864	43.241	0.001 ***
R^2	..	0.5577			

B - Regression Co-efficient

SEB - Standard Error of regression co-efficient

T - t' test

SIGT - Significance of T

Constant - Constant is used to describe the average relationship that exists between two or more variables.

*** - $p<0.001$.

A significant association was observed between income and nutritional status of the workers expressed as BMI (Figure 14). Nearly 90% of the workers whose monthly income was above Rs.150 per capita were in normal nutritional category as against 60% to 70% of those whose income was between Rs.51-150 per capita.

Regression analysis of socio-economic and environmental factors on haemoglobin level

The relationship between socio-economic and environmental variables and haemoglobin level observed in the analysis (Table 45) was found to be significantly associated to a greater extent in the multivariate context. As indicated by the regression co-efficient (B), the water source, house type, education and sanitation were, in that order, significantly related to the haemoglobin status of the workers. The model developed was significant at $p<0.001$, its predictive power (indicated by R^2) was strong, explaining 55.8% variability in haemoglobin levels by socio-economic and environmental factors of the workers.

Among the socio-economic and environmental variables, the water source exerted the maximum influence (90.47%) on the haemoglobin levels of tea plantation workers; it was followed by the house type (67.67%). On the other hand, the haemoglobin levels were affected to a lesser extent by factors like education (42.54%) and sanitation (28.60%).

TABLE 46

Analysis of Co-variance of nutritional status and dietary intake as assessed by the environmental variables (after controlling for income)

Nutritional status/ Dietary intake variables	Main effect (Environment)		Covariate (Income)	
	F values	Sig F	F values	Sig F
Height ...	22.27	0.001 ***	8.57	0.001 ***
Weight ...	60.90	0.001 ***	99.29	0.001 ***
Hb ...	11.86	0.001 ***	856.99	0.001 ***
Protein ...	11.86	0.001 ***	1.03	0.31 NS
Energy ...	26.70	0.001 ***	8.43	0.01 **

NS - Not Significant

*** - $p<0.001$

** - $p<0.01$.

Table 46 depicts the association between socio-economic and environmental factors, anthropometric measurements, haemoglobin levels and nutrient intakes of workers, adjusting the income as a co-variate. The main effect of all the environmental variables was significantly associated ($p<0.001$) with height, weight, haemoglobin, protein and energy. Conversely, per capita income also represented an intervening variable which influenced significantly ($p<0.001$) all the anthropometric variables and haemoglobin levels. On the other hand, energy intake was found to be influenced by income ($p<0.001$) alone. However, the influence of income was not seen on protein intake.

In a country like India, where economic conditions are the main constraints, the socio-economic and environmental variables may profoundly influence the food intake in turn, affecting parameters indicating nutritional status like height, weight and haemoglobin etc. In the present investigation, income was adjusted to determine the main effect of other socio-economic and environmental variables on nutritional status. An ideal housing, safe drinking water, education and sanitation will decrease the incidence of morbidity like parasitic infections and other communicable diseases (Table 22, 23, 24, 25, 26 and 27).

The data show a significant association between socio-economic and environmental factors and the nutritional and health status of the tea plantation workers. Environmental factors particularly the water source were observed to be the most dominating factors affecting the nutritional and health status of

the workers in terms of their haemoglobin levels. Haemoglobin level is one of the key variables mediating physical work capacity and productivity of the workers. Thus, provision of safe water alone will play a significant role in improving productivity. House type was identified to be the second most critical factor influencing haemoglobin levels followed by education and sanitation. Therefore, the improvement in environmental conditions alone will go a long way in increasing the productivity.

The adverse effect of socio-economic variables such as illiteracy and income on nutritional and health status has been documented by several investigators. The negative relationship between illiteracy and nutritional status has been reported by Samarasinghe (1990), Unnikrishnan (1989), Baroova (1988), Rahamathullah (1987), Bora (1985) and Paul (1984). Rahamathullah reported on the negative influence of income in 1983 and again in 1987. Hence, it can be inferred from the above discussion that the Management should take steps to improve the environment in order to improve the health status of the workers thereby increasing productivity of the plantation.

D. QUALITY OF LIFE INDEX (QLI) OF WORKERS IN THE THREE TYPES OF PLANTATIONS

As described in the Chapter on Methods, a composite QLI was evolved wherein a scoring system was applied to the

TABLE 47

Influence of type of plantation on Quality of Life Index (QLI) of the workers

Quality of Life Index	Type of Plantation		
	British (B) (%)	Tea Corporation (TC) (%)	Native (N) (%)
Very good (80%)	2 (11)	-	-
Good (79-60%)	94 (562)	13 (76)	1 (5)
Fair (59-40%)	4 (27)	87 (522)	83 (489)
Poor (40%)	-	3 (2)	16 (79)
Total ...	100 (600)	100 (600)	100 (600)

X^2 values = 1512.38 for df 6 significant at $p<0.001$.

(Figures in parentheses indicate actual number of subjects.)

TABLE 48

Mean Quality of Life Index (QLI) of the workers of British', Tea Corporation' and Native' plantations

Types of plantation	Mean QLI	F values	T values
		***	***
British'(B)	19.22 ± 0.06 (Good)	3061.61	B vs T = 40.95 B vs N = 80.46 TC vs N = 36.07
Tea Corporation' (TC)	15.50 ± 0.07 (Fair)		
Native' (N)	12.34 ± 0.06 (Fair)		

*** Significant at $p<0.001$.

TABLE 49

Influence of Quality of Life Index (QLI) on the haemoglobin levels of the plantation workers

Quality of Life	Haemoglobin Level			Total (% distribution of QLI)
	8 g/dl	8-10 g/dl	10 g/dl	
Very good	-	-	100 (11)	1 (11)
Good	3 (16)	59 (359)	38 (265)	36 (643)
Fair	46 (438)	53 (550)	1 (14)	58 (1047)
Poor	76 (75)	23 (23)	1 (1)	6 (99)
				100 (1800)

X^2 value = 719.86 for df 6 significant at p 0.001.

(Figures in parentheses indicate actual number of subjects.)

indicators/variables of education, income, housing, water source and sanitation. Table 47 reveals that the bulk of the workers in the 'British' enjoyed a score of 'Good' QLI. In contrast most of the workers in the 'Tea Corporation' and the 'Native' had QLIS in the 'Fair' category. The major determinants of the less favourable QLI scores in the 'Tea Corporation' and the 'Native' were inferior housing, unsafe water and poor sanitation existing in these plantations (Please refer Tables 9, 10, and 11).

The mean QLI score of workers in the 'British' was significantly superior to that of the 'Tea Corporation' or the 'Native' (Table 48). The mean QLI of the workers of the 'Native' plantation was significantly less than that of the other two.

The data presented in Table 49 indicate that if the QLI of a plantation is 'Good' as was the case in the 'British', then one could expect about 60% of the workers to have haemoglobin levels of 8-10 g/dl; and the remaining 40% of the workers with haemoglobin levels of 10 g/dl. In the case of QLIs of 'Fair' to 'Poor' as was the case in the 'Tea Corporation' and the 'Native', the haemoglobin levels of workers were low with approximately half of the workers with haemoglobin levels of less than 8 g/dl; and the remaining with haemoglobin levels of 8-10 g/dl. Since nutritional anaemia as reflected by low Hb levels has a direct and negative influence on tea-plucking and productivity, it is in the interest of the Management to bring up the QLI of their plantations to at least the level of 'Good'.

TABLE 50

Influence of Quality of Life Index (QLI) on the per cent prevalence of parasitic infections among plantation workers

Quality of Life	Percentage Infections		Total (% distribution of QLI)
	* Present	** Absent	
Very good	64 (7)	36 (4)	1 (11)
Good	78 (488)	22 (138)	36 (625)
Fair	95 (976)	5 (48)	58 (1024)
Poor	100 (97)	-	5 (97)
			100 (1758)

X^2 values = 141.00 for df 3 significant at $p<0.001$.

(Figures in parentheses indicate actual number of subjects.)

* Either protozoa or helminths present.

** Neither protozoa nor helminths present.

TABLE 51

Influence of Quality of Life Index (QLI) on the per cent prevalence of morbidity among plantation workers

Quality of Life	Percentage Morbidity		Total (% distribution of QLI)
	* Present	** Absent	
Very good		100 (11)	1. (11)
Good	30 (196)	70 (447)	36 (643)
Fair	47 (494)	53 (553)	58 (1047)
Poor	81 (80)	19 (19)	5 (99)
			100 (1800)

X^2 values = 157.29 for df 3 significant at $p<0.001$.

(Figures in parentheses indicate actual number of subjects.)

* Any morbidity like influenza, common cold & cough, diarrhoea, fever and vomiting present.

** No morbidity present.

TABLE 52

Influence of Quality of Life Index on the per cent prevalence of clinical signs of vitamin deficiencies among plantation workers

Quality of Life	Vitamin Deficiency Signs — Percentage prevalence		Total (% distribution of QLI)
	* Present	** Absent	
Very good		100 (11)	1 (11)
Good	8 (49)	92 (594)	36 (643)
Fair	33 (350)	67 (697)	58 (1047)
Poor	51 (50)	49 (49)	5 (99)
			100 (1800)

X^2 values = 181.533 for df 3 significant at $p<0.001$.

(Figures in parentheses indicate actual number of subjects.)

* Presence of Bitot's spots, Night-blindness, Conjunctival xerosis, Angular stomatitis, Angular scar, Atrophic papillae, Magenta tongue, Rawness of tongue etc.alone or in combination

** None of the deficiency signs mentioned above were present.

TABLE 53

Influence of Quality of Life on the Body Mass Index (BMI)[1] of the workers

Quality of Life	BMI Percentage		Total (% distribution of QLI)
	cutoff point	cutoff point	
Very Good	82 (9)	18 (2)	1 (11)
Good	76 (486)	24 (159)	36 (643)
Fair	65 (680)	35 (367)	58 (1047)
Poor	25 (25)	75 (74)	5 (99)
			100 (1800)

X^2 values = 40.44 for df 3 significant at $p<0.001$.

(Figures in parentheses indicate actual number of subjects.)

1 BMI = BMI $\geq$ 18.5 is normal and BMI $<$ 18.5 is undernourished for adults of the both sexes in the developing world (according to Waterlow's classification, 1989).

The presence of intestinal parasites was rampant in spite of the QLI of 'Very Good' (Table 50). Unfortunately, only about a third of all plantation workers surveyed had a QLI of 'Good', while the rest had a QLI of 'Fair'. Hence, the inference is that the Management would have to take steps to make the environment much more sanitary or at least institute mass periodic de-worming measures for plantation workers. Since hookworm was the most prevalent helminthic infection, the provision of appropriate footwear would also go a long way in controlling this infection.

A QLI of 'Good' indicated that the prevalence of common morbidities was be at the level of 30% while if it was 'Fair', prevalence went up to nearly 50% (Table 51). Since productivity is directly linked to regular attendance, it would be in the interest of the Management to endeavour to raise the QLI of the plantation to at least 'Good' if not 'Very Good' to keep common morbidities and resultant absentism down.

By and large, if the QLI of a plantation could be held to be 'Good', then the clinical nutritional status of the population would be acceptable (Table 52).

If the QLI of a plantation was 'Good', then over 75% of the workers would have a normal BMI (Table 53). In the case of a QLI of 'Fair', about 65% of the workers would have a normal BMI.

On summing up Tables 47 to 53 the following can be inferred with respect to QLI:

(i) The bulk of the plantation workers in the 'British' had a QLI of 'Good' whereas the bulk of the workers had a QLI of 'Fair' in the 'Tea Corporation' and the 'Native' plantations. The mean QLI score of 19.22 in the 'British' was significantly superior to that in the 'Tea Corporation' (15.50) or the 'Native' (12.34).

(ii) The QLI has emerged as a good predictor of haemoglobin levels among workers. If the QLI is 'Good', most of the workers will be moderately (59%) to mildly (38%) anaemic. If the QLI is 'Fair', most of the workers will be moderately to severely anaemic. Since productivity and nutritional anemia are intimately linked, the QLI can serve Management as a useful tool to assess the need for implementing micronutrient iron supplementation measures.

(iii) The QLI was a sensitive indicator of the prevalence of common morbidities (fever, upper respiratory infection (URI), and infections of the gastro-intestinal tract (GIT). A QLI of 'Good' indicated a 30% prevalence level of common morbidities.