

## RESULTS AND DISCUSSION

The results of the study on the **Effect of Supplementation of Health Mix and Nutrition Education on the Health and Nutritional Status of Handloom Weavers** are presented and discussed under the following major headings

### **A. Socio Economic, Dietary and other Background details of the selected Handloom Weavers**

1. Socio economic profile of the weavers
2. Dietary background of the weavers
3. Life Style pattern of the weavers
4. Work related details of the weavers
5. Health Problems among the weavers

### **B. Nutritional Status of the Handloom Weavers**

1. Anthropometric measurements of the weavers
2. Biochemical parameters of the weavers
3. Biophysical parameters of the weavers
4. Clinical examination of the weavers
5. Food and nutrient intake and energy balance of the weavers

### **C. Details regarding the Formulated Functional Food Mixes**

1. Acceptability testing of the Health mixes
2. Nutrient analysis of the Health mixes
3. Antinutritional factors in Health mixes
4. Shelf life of the Health mixes
5. Cost analysis of the Health mixes

### **D. Impact of Supplementation of the Functional Food Mixes on the Handloom Weavers**

1. Anthropometric measurements of the handloom weavers
2. Biochemical parameters of the weavers
3. Biophysical parameters of the weavers
4. Clinical Examination of the weavers
5. Work Output of the handloom weavers

### **E. Impact of Nutrition Education Program**

Knowledge, Attitude and Practice (KAP) scores of the weavers

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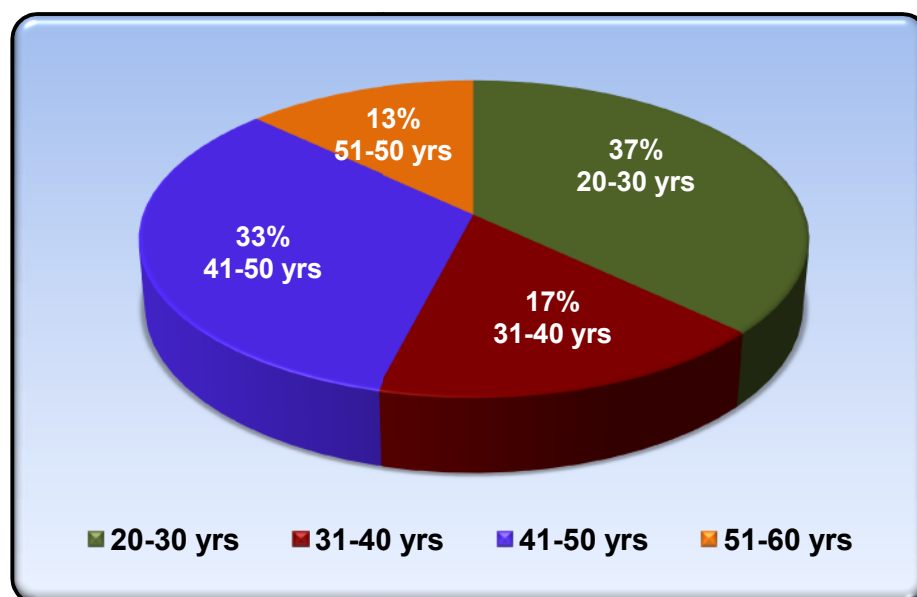
## A. Socio Economic, Dietary and other Background details of the selected Handloom Weavers

The socio economic background, dietary and other details of the 1118 adult handloom weavers comprising of 1056 men and 62 women adults are presented and discussed in the following pages.

### 1. Socio economic profile of the Weavers

#### i. Age of the selected Handloom Weavers

Age wise distribution of the selected handloom weavers in the three districts of Tamil Nadu is presented in Figure 4 and Table II



**FIGURE 4 - AGE WISE DISTRIBUTION OF THE SELECTED HANDLOOM WEAVERS**

The findings of the present study indicated that 37 per cent of the surveyed handloom weavers belonged to the age group of 20-30 years and 33 per cent belonged to the age group of 41-50 years. In Coimbatore district a majority of 55 per cent of the men belonged to 20-30 years of age. A majority of 58 and 45 per cent of men and women weavers respectively belonged to 20-30 years of age group in Vellore district. In Thiruvannamalai district 57 per cent of the men weavers, being the majority were in the age group of 41-50 years.

TABLE - II

AGE WISE DISTRIBUTION OF THE SELECTED ADULT HANDLOOM WEAVERS

Age (Yrs)	Coimbatore (501)				Vellore (104)				Thiruvannamalai (513)				Total (1118)	
	Men		Women		Men		Women		Men		Women		N	%
	N	%	N	%	N	%	N	%	N	%	N	%		
20-30	266	55	0	0	55	58	4	45	70	15	20	51	415	37
31-40	84	17	2	14	18	19	2	22	68	14	11	28	185	17
41-50	73	15	3	22	16	17	2	22	268	57	6	16	368	33
51-60	64	13	9	64	6	6	1	11	68	14	2	5	150	13
<b>Total</b>	<b>487</b>	<b>100</b>	<b>14</b>	<b>100</b>	<b>95</b>	<b>100</b>	<b>9</b>	<b>100</b>	<b>474</b>	<b>100</b>	<b>39</b>	<b>100</b>	<b>1118</b>	<b>100</b>

Welch *et al.*, (2008) found that increasing age was associated with reduced physical functioning independent of the presence of musculoskeletal conditions. Changes in physical abilities that are encountered with ageing are however, influenced by individual genetics and life style, as well as the environment in which individuals work (Buchman *et al.*, 2007).

ii. Educational status of the Handloom Weavers

Figure 5 and Table III depict the educational status of the selected handloom weavers

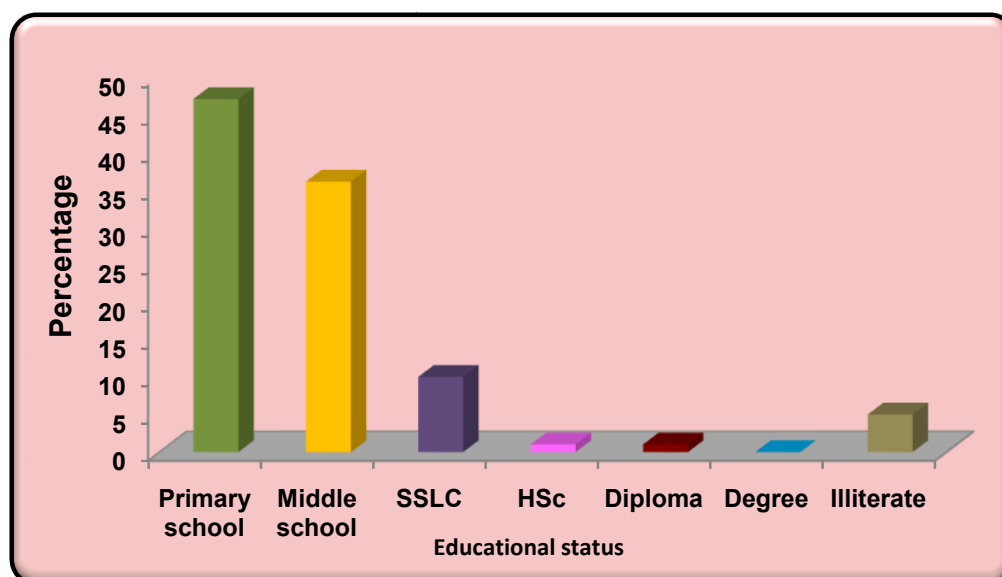


FIGURE 5 - EDUCATIONAL STATUS OF THE SELECTED HANDLOOM WEAVERS

**TABLE - III**  
**EDUCATIONAL STATUS OF THE SELECTED HANDLOOM WEAVERS**

Education	Coimbatore (501)				Vellore (104)				Thiruvannamalai (513)				Total (1118)	
	Men		Women		Men		Women		Men		Women		N	%
	N	%	N	%	N	%	N	%	N	%	N	%		
Primary school	186	38	6	43	67	71	8	89	253	53	7	18	527	47
Middle school	254	52	1	7	19	20	1	11	126	27	1	3	402	36
SSLC	24	5	1	7	2	2	0	0	77	16	4	10	108	10
HSc	2	1	0	0	0	0	0	0	9	2	2	5	13	1
Diploma	0	0	0	0	3	3	0	0	3	1	1	3	7	1
Degree	0	0	0	0	2	2	0	0	0	0	0	0	2	0
Illiterate	21	4	6	43	2	2	0	0	6	1	24	61	59	5
<b>Total</b>	<b>487</b>	<b>100</b>	<b>14</b>	<b>100</b>	<b>95</b>	<b>100</b>	<b>9</b>	<b>100</b>	<b>474</b>	<b>100</b>	<b>39</b>	<b>100</b>	<b>1118</b>	<b>100</b>

Results of the present study revealed that a majority of 47 per cent of the handloom weavers had primary school education followed by 36 per cent with middle school education. It is encouraging to find that only 5 per cent of the weavers were found to be illiterates. About 50 per cent of women weavers were found to be illiterates. In Coimbatore district, majority of (52 %) the men weavers had completed up to middle school education. In Vellore and Thiruvannamalai districts a majority of men weavers 71 and 53 per cent respectively had only primary education. Findings of the present study revealed that a higher percentage of adult weavers had only primary school education. Improved educational status will definitely enhance the socio economic conditions of handloom weavers.

### iii. Gender of the Selected Handloom Weavers

Gender wise distribution of the selected handloom weavers in the three districts is presented in Table IV.

**TABLE - IV**

#### **GENDER WISE DISTRIBUTION OF THE SELECTED HANDLOOM WEAVERS**

Sex	Coimbatore (501)		Vellore (104)		Thiruvannamalai (513)		Total (1118)	
	N	%	N	%	N	%	N	%
Men	487	97	95	91	474	92	1056	94
Women	14	3	9	9	39	8	62	6
<b>Total</b>	<b>501</b>	<b>100</b>	<b>104</b>	<b>100</b>	<b>513</b>	<b>100</b>	<b>1118</b>	<b>100</b>

From the Table it is seen that 94 per cent of the handloom weavers were men whereas only 6 per cent were women, engaged in handloom weaving. In all the homes, women were participating in weaving activity, but women engaged in actual weaving on par with men were only less in number as evidenced from the present study. About an equal number of men were available (501 and 513) in Coimbatore and Thiruvannamalai district for the study whereas only one fifth (104) were available in Vellore district for study.

#### iv. Type and size of families of the Selected Handloom Weavers

Table V shows the type and size of families of the handloom weavers

**TABLE - V**

#### **TYPE AND SIZE OF FAMILIES OF THE SELECTED HANDLOOM WEAVERS**

Details	Coimbatore (501)		Vellore (104)		Thiruvannamalai (513)		Total (1118)	
	N	%	N	%	N	%	N	%
<b>Type</b>								
Joint	33	7	2	2	31	6	66	6
Nuclear	468	93	102	98	482	94	1052	94
<b>Total</b>	<b>501</b>	<b>100</b>	<b>104</b>	<b>100</b>	<b>513</b>	<b>100</b>	<b>1118</b>	<b>100</b>
<b>Size</b>								
2-4	246	49	102	98	469	91	817	73
5-7	112	22	0	0	24	5	136	12
>7	143	29	2	2	20	4	165	15
<b>Total</b>	<b>501</b>	<b>100</b>	<b>104</b>	<b>100</b>	<b>513</b>	<b>100</b>	<b>1118</b>	<b>100</b>

It is evident from the results that among the 1118 handloom weavers surveyed only 6 per cent were from joint families whereas 94 per cent, being the majority belonged to nuclear families. The findings reveal the present day trend among people of more inclination towards nuclear families for so many reasons such as modern life styles, mobility from rural to urban areas for education or employment and cultural change.

The family size is one of the factors that affect the nutritional status of any person and the extent of help available for carrying out handloom operations. Results of the study revealed that a majority of 73 per cent of the weavers were from small families, 12 per cent of the families had 5-7 members (medium families ) and 15 per cent of the families had more than 7 members (large families). The results are in accordance with the report of the Year Book of India (2000) where 82 per cent of the families in India are reported to be of nuclear type. The present finding is in support of the view that nowadays people are becoming more attracted towards the benefits of small family norms.

**v. Monthly income of the Families of the selected Handloom weavers**

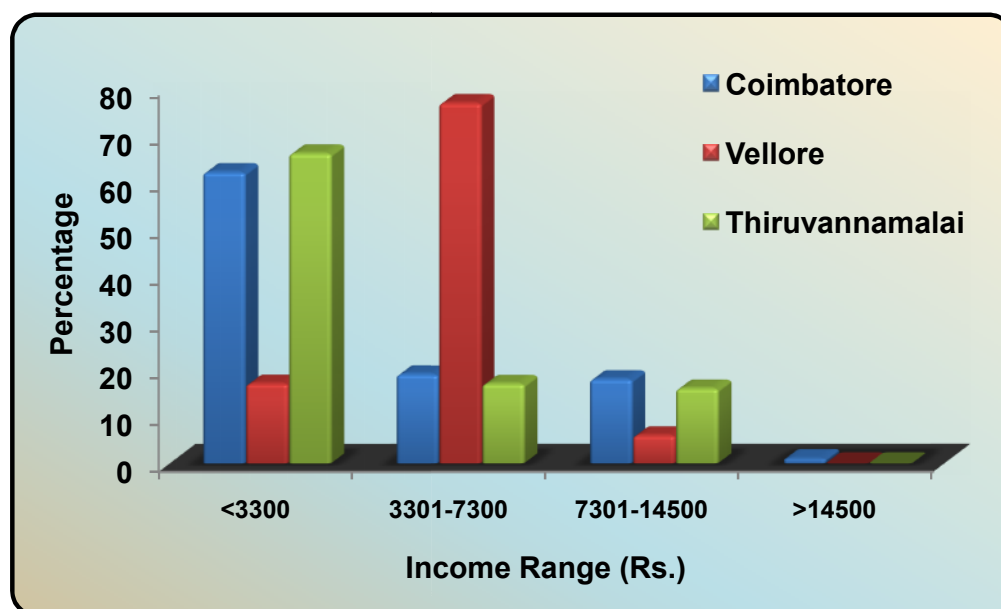
Table VI and Figure 6 present the monthly income of the selected adult Handloom weavers categorized based on 11<sup>th</sup> Five Year plan 2007-2012 norms.

**TABLE - VI**

**MONTHLY INCOME OF THE SELECTED HANDLOOM WEAVERS**

Income range (Rs.)*	Coimbatore (501)		Vellore (104)		Thiruvanna malai (513)		Total (1118)	
	N	%	N	%	N	%	N	%
<3300	313	62	18	17	141	66	472	42
3301-7300	94	19	80	77	285	17	459	41
7301-14500	89	18	6	6	87	16	182	16
>14500	5	1	0	0	0	0	5	1
<b>Total</b>	<b>501</b>	<b>100</b>	<b>104</b>	<b>100</b>	<b>513</b>	<b>100</b>	<b>1118</b>	<b>100</b>

\*11<sup>th</sup> Five year plan 2007-2012



**FIGURE 6 - MONTHLY INCOME OF THE SELECTED HANDLOOM WEAVERS**

The survey findings revealed that 42 per cent of the families of the selected handloom weavers belonged to very low income category with less than Rs. 3300 per month and 41 per cent of families belonged to low income category with Rs.3301-7300 per month based on 11<sup>th</sup> Five year plan guidelines.

In Coimbatore and Thiruvannamalai District a majority of 62 and 66 per cent of the families respectively belonged to very low income category with Rs. 3300 and below per month whereas in Vellore District 77 per cent of the families belonged to low income category with Rs.3301-7300 per month. Among all the three districts, only 16 per cent of the families of the weavers earned Rs. 7301-14500 per month categorized as middle income. The overall picture indicated the poor socio economic background of the handloom weavers which may predispose to poor nutritional status.

Studies on the social and economic determinants of health have shown that persons and groups of higher socio economic status have lower rates of obesity, type 2 diabetes and cardio vascular disease (Marmot and Wilkinson, 2000).

#### vi. Distribution of Families according to Expenditure Patterns

Table VII presents the distribution of the families according to expenditure pattern in Coimbatore district

**TABLE - VII**  
**DISTRIBUTION OF FAMILIES ACCORDING TO EXPENDITURE**  
**PATTERN IN COIMBATORE DISTRICT**

(N=501)

Items	Range in Percentage							
	0-25%		26-50%		51-75%		76-100%	
	N	%	N	%	N	%	N	%
Food	338	67	163	33	-	-	-	-
Clothing	334	67	167	33	-	-	-	-
House rent	346	69	155	31	-	-	-	-
Education	325	65	186	37	-	-	-	-
Fuel/ light	478	95	23	5	-	-	-	-
Durable goods (Furniture)	-	-	-	-	-	-	-	-
Medicine	456	91	45	9	-	-	-	-

In Coimbatore district a maximum of 67 per cent of the families spent within 0-25 per cent on food. About 67 per cent of the weavers spent upto 0-25 per cent from their total family income for clothing. Nearly 69 per cent of the weavers spent 0-25 per cent of their total income for house rent. Similarly 65 per cent of the weavers spent within 0-25 per cent on education. Almost 95 per cent of weavers spent upto 25 per cent for fuel and 91 per cent of them spent within 25 per cent for medicine.

The distribution of the families according to the expenditure pattern in Vellore district is presented in Table VIII.

**TABLE - VIII**  
**DISTRIBUTION OF FAMILIES ACCORDING TO EXPENDITURE**  
**PATTERN IN VELLORE DISTRICT**

(N=104)

Items	Range in Percentage							
	0-25%		26-50%		51-75%		76-100%	
	N	%	N	%	N	%	N	%
Food	91	88	-	-	13	12	-	-
Clothing	39	38	65	62	-	-	-	-
House rent	97	93	7	7	-	-	-	-
Education	39	38	65	62	-	-	-	-
Fuel/ light	89	86	15	14	-	-	-	-
Durable goods (Furniture)	97	93	7	7	-	-	-	-
Medicine	93	89	11	11	-	-	-	-

In Vellore district almost 88 per cent of the weavers spent 0-25 per cent of income for food. Around 62 per cent of weavers spent 26-50 per cent for clothing. A majority of 93 per cent of weavers spent 0-25 per cent for house rent. Almost 86 per cent of the weavers spent 0-25 per cent for fuel. A maximum of 93 per cent of the weavers spent 0-25 per cent for furnitures. About 89 per cent of the weavers spent 0-25 per cent for medicine.

Table IX presents the distribution of the families according to the expenditure pattern in Thiruvannamalai district

**TABLE - IX**

**DISTRIBUTION OF FAMILIES ACCORDING TO EXPENDITURE PATTERN IN THIRUVANNAMALAI DISTRICT**

**(N=513)**

Items	Range in Percentage							
	0-25%		26-50%		51-75%		76-100%	
	N	%	N	%	N	%	N	%
Food	474	92	26	5	13	3	-	-
Clothing	458	89	55	11	-	-	-	-
House rent	497	97	16	3	-	-	-	-
Education	133	26	380	74	-	-	-	-
Fuel/ light	482	94	31	6	-	-	-	-
Durable goods (Furniture)	-	-	-	-	-	-	-	-
Medicine	482	94	31	6	-	-	-	-

In Thiruvannamalai district majority of the weavers ranging from 89 to 97 per cent spent 0-25 per cent on food, clothing, house rent, fuel and medicines. A majority of 74 per cent of weavers spent 26-50 per cent on education of their children. The overall expenditure pattern revealed that majority of the weavers spent within 25 per cent of income each on food, clothing, house rent, education, fuel and medicine.

**vii. Details of loan got by the Selected Handloom Weavers**

Among the three districts, 187 families (17%) out of 1118 families surveyed were not balancing their expenditure within the income available and hence got loans from outside to meet the expenditure.

Table X presents the loan details of the selected Handloom weavers

It is evident from the table that out of the 187 handloom weavers who had got loans 40 per cent received loan to the tune of Rs.25, 000 to Rs. 50,000 and 47 per cent of adults being the maximum received Rs. 50,000 to 1,00,000. It is interesting to note that none of the women weavers got loans in Coimbatore district but a few women weavers in Vellore and Thiruvannamalai Districts got loans.

TABLE - X

DETAILS OF LOAN GOT BY THE SELECTED HANDLOOM WEAVERS

Details	Coimbatore (86)				Vellore (12)				Thiruvannamalai (89)				Total (187)	
	Men (86)		Women (0)		Male (11)		Female (1)		Male (86)		Female (3)		N	%
	N	%	N	%	N	%	N	%	N	%	N	%		
<b>Amount of Loan</b>														
Rs. 10,000- 15,000	0	0	-	-	0	-	0	0	3	3	0	0	3	2
Rs. 15,000-25,000	10	12	-	-	0	-	0	0	11	13	0	0	21	11
Rs.25,000- 50,000	36	42	-	-	5	45	1	100	29	34	3	100	74	40
Rs.50,000- 1,00,000	40	46	-	-	6	55	0	0	43	50	0	0	89	47
<b>Purpose of Loan</b>														
Business	21	25	-	-	1	9	0	0	13	15	0	0	35	19
Medical treatment	39	45	-	-	8	73	0	0	49	57	2	67	98	52
Education	26	30	-	-	2	18	1	100	24	28	1	33	54	29
<b>Source of Loan</b>														
Private Bank	14	16	-	-	0	0	0	0	9	10	0	0	23	12
Govt. Bank	0	0	-	-	1	9	0	0	6	7	0	0	7	4
Money lenders	26	30	-	-	4	36	0	0	15	18	1	33	46	25
SHG	46	54	-	-	6	55	1	100	56	65	2	67	111	59
<b>Mode of Repayment</b>														
Weekly	0	0	-	-	0	0	0	0	0	0	0	0	0	0
Monthly	86	100	-	-	11	100	1	100	86	100	3	100	187	100
Annual	0	0	-	-	0	0	0	0	0	0	0	0	0	0

A majority of 52 per cent of the weavers got the loan for the purpose of medical treatments which might be for non communicable diseases. The other purposes for getting loan included expansion of business and education of children. It is also observed that 59 per cent being the maximum got the loans from Self Help Groups whereas others received loans from private banks, government banks and money lenders. Almost majority of the weavers were repaying the loans on monthly basis.

## 2. Dietary background of the Weavers

### i. Type of diet and meal pattern

The type of diet and meal pattern followed by the selected handloom weavers are presented in Table XI

**TABLE - XI**

**TYPE OF DIET AND MEAL PATTERN AMONG THE SELECTED HANDLOOM WEAVERS**

Diet	Coimbatore (501)		Vellore (104)		Thiruvannamalai (513)		Total (1118)	
	N	%	N	%	N	%	N	%
Vegetarian	34	7	6	6	22	4	62	6
Non-vegetarian	464	92	98	94	482	94	1044	93
Ova vegetarian	3	1	0	0	9	2	12	1
<b>Total</b>	<b>501</b>	<b>100</b>	<b>104</b>	<b>100</b>	<b>513</b>	<b>100</b>	<b>1118</b>	<b>100</b>
<b>Meal Pattern</b>								
2 Meals	289	58	98	94	156	30	543	48
3 Meals	199	40	6	6	351	69	556	50
4 Meals	13	2	0	0	6	1	19	2
<b>Total</b>	<b>501</b>	<b>100</b>	<b>104</b>	<b>100</b>	<b>513</b>	<b>100</b>	<b>1118</b>	<b>100</b>

It is clear from the table that 93 per cent of the adults being the majority were non-vegetarians and only 6 per cent of the weavers were vegetarians. Ova-vegetarians constituted only one per cent of the surveyed adults. Though a majority of weavers were non-vegetarians, their intake of non-vegetarian items was very less and mostly once or twice a week.

The study revealed that a majority of 50 per cent of the weavers were taking 3 meals in a day, whereas 48 per cent of the weavers were taking only 2 meals daily. A low percentage (2%) of the weavers were taking 4 meals per day.

About 51 per cent of the adult weavers took their meals at regular timings whereas 48 per cent of the adults were irregular in their food intake due to their busy work schedule.

## ii. Type and quantity of beverages consumed by the selected Handloom weavers

The type and quantity of beverages consumed by the selected handloom weavers are presented in Table XII.

**TABLE - XII**  
**TYPE AND QUANTITY OF BEVERAGES CONSUMED BY THE**  
**SELECTED HANDLOOM WEAVERS**

Beverages	Coimbatore (501)				Vellore (104)				Thiruvannamalai (513)				Total (1118)	
	Men		Women		Men		Women		Men		Women		N	%
	N	%	N	%	N	%	N	%	N	%	N	%		
Coffee	89	18	0	0	0	0	0	0	86	18	13	33	188	17
Tea	398	82	14	100	95	100	9	100	388	82	26	67	930	83
<b>Total</b>	<b>487</b>	<b>100</b>	<b>14</b>	<b>100</b>	<b>95</b>	<b>100</b>	<b>9</b>	<b>100</b>	<b>474</b>	<b>100</b>	<b>39</b>	<b>100</b>	<b>1118</b>	<b>100</b>
Quantity	< 2 cups				2-4 cups				5-7 cups				Total	
	N		%		N		%		N		%		N	%
	N	%	N	%	N	%	N	%	N	%	N	%		
Coffee	53	28	110	13	25	35	188	17						
Tea	134	72	750	87	46	65	930	83						
<b>Total</b>	<b>187</b>	<b>100</b>	<b>860</b>	<b>100</b>	<b>71</b>	<b>100</b>	<b>1118</b>	<b>100</b>						

The results of the study indicated that 83 per cent of the weavers, being the majority were consuming tea whereas only 17 per cent of them were consuming coffee. This reveals that tea is preferred more by the handloom weavers. Majority of the handloom weavers (87 %) were consuming 2-4 cups of tea per day. Survey results revealed that 97 per cent of the weavers were not taking aerated drinks whereas only 3 per cent of the weavers were taking aerated drinks which comprised of 7up, Miranda and Maaza.

### iii. Type and quantity of oil consumed by the families of the Handloom weavers

Table XIII depicts the type and quantity of oil consumed per day by the families of the selected adult handloom weavers

**TABLE - XIII**  
**TYPE AND QUANTITY OF OIL CONSUMED BY THE FAMILIES**  
**OF THE HANDLOOM WEAVERS**

Type of oil	Coimbatore (501)		Vellore (104)		Thiruvannamalai (513)		Total (1118)	
	N	%	N	%	N	%	N	%
Palm oil	120	24	29	28	212	41	361	32
Groundnut oil	164	33	25	24	249	49	438	39
Sun flower oil	217	43	50	48	52	10	319	29
<b>Total</b>	<b>501</b>	<b>100</b>	<b>104</b>	<b>100</b>	<b>513</b>	<b>100</b>	<b>1118</b>	<b>100</b>
<b>Quantity of Oil / per day in g</b>								
10-30	226	45	86	82	211	41	523	47
31-50	155	31	8	8	90	17	253	23
51-70	21	4	6	6	96	19	123	11
71-90	99	20	4	4	116	23	219	19
<b>Total</b>	<b>501</b>	<b>100</b>	<b>104</b>	<b>100</b>	<b>513</b>	<b>100</b>	<b>1118</b>	<b>100</b>

It is seen that groundnut oil was consumed by 39 per cent of the weavers families being the majority followed by use of palm oil by 32 per cent of families. Sunflower oil was used by 29 per cent of the families. Coconut oil, gingelly oil and other commercial oils were not used by the weaver families for cooking as revealed by the survey.

From the Table it is evident that a majority of 82 and 45 per cent of the weavers families were consuming 10 to 30 g of oil per day in Coimbatore and Vellore district respectively. About 31 and 17 per cent of the families were consuming 31 to 50 g of oil per day in Coimbatore and Vellore district respectively. In Coimbatore and Thiruvannamalai district 20 and 23 per cent of the weavers respectively were consuming a higher quantity of 71to 90 g of oil per day. The quantity of oil used might depend upon the number of members in the family and the items prepared.

#### iv. Type of water used by the families of Handloom weavers

A majority of 80 per cent of the weavers were using potable water which is supplied by the municipality. On the other hand 20 per cent of the families of handloom weavers were using water filters or hot water for drinking.

#### v. Food intake pattern among the families of the handloom weavers

The frequency of food intake among the families of the selected handloom weavers is shown in Table XIV

TABLE - XIV

#### FOOD INTAKE PATTERN OF THE FAMILIES OF THE HANDLOOM WEAVERS

(In Percentage)

Food items	Daily	Weekly once	Weekly twice	Occasionally	Never
<b><u>Cereals</u></b>					
Rice	100	-	-	-	-
Ragi	-	15	10	40	35
Wheat	12	33	30	20	5
Others	37	33	10	20	-
<b><u>Pulses</u></b>					
Red gram dhal	88	-	12	-	-
Bengal gram dhal	25	5	28	42	-
Black gram dhal	-	25	45	30	-
Others	20	25	30	25	-
<b><u>Leafy vegetables</u></b>					
Amaranth	-	33	42	25	-
Drumstick	-	20	30	25	25
Mint	20	43	30	7	-
Others	43	30	20	7	-
<b><u>Roots and tubers</u></b>					
Carrot	38	7	30	25	-
Beetroot	-	28	47	20	5
Potato	-	33	30	37	-
Onion	100	-	-	-	-
Others	28	47	20	5	-

Contd...

## FOOD INTAKE PATTERN OF THE FAMILIES OF THE HANDLOOM WEAVERS

Food items	Daily	Weekly once	Weekly twice	Occasionally	Never
<b><u>Other vegetables</u></b>					
Beans	25	53	15	7	-
Cauliflower	-	33	30	37	-
Sundaikai	-	-	63	37	-
Brinjal	-	20	60	20	-
Gourd Vegetables	-	40	30	20	10
Others	20	43	30	7	-
<b><u>Fruits</u></b>					
Guava	-	-	37	63	-
Papaya	7	33	35	25	-
Banana	25	30	20	25	-
Others	12	33	30	20	5
<b><u>Milk and milk products</u></b>					
Milk	33	17	20	30	-
Curd	57	17	13	13	-
Butter milk	65	10	25	-	-
Others	33	17	20	30	-
<b><u>Nuts and oil seeds</u></b>					
Cashew nuts	-	12	15	63	10
Ground nuts	12	30	45	13	-
Coconut	53	17	5	25	-
<b><u>Meat and poultry</u></b>					
Egg	27	30	18	25	-
Mutton	-	35	40	25	-
Fish	-	30	20	50	-
Chicken	-	47	28	12	13
Others	30	33	17	20	-
<b><u>Sugar and products</u></b>					
Sugar	100	-	-	-	-
Honey	-	30	45	15	10
Jaggery	-	45	28	27	-
Others	30	45	15	10	-

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All the families of the selected handloom weavers consumed rice daily during any one or two meals. A majority of 40 per cent of weavers consumed ragi occasionally whereas wheat was consumed by 33 per cent of the weavers weekly once. Almost 88 per cent of the weavers consumed red gram dhal daily in the form of sambar. Only 5 per cent of weavers consumed Bengal gram dhal weekly once. Majority of the adults consumed weekly once or twice leafy vegetables like amaranth and drumstick leaves whereas 25 percent of them never consumed drumstick leaves.

It is encouraging to note that carrot was consumed daily by 38 per cent of weavers and others consumed either weekly once or twice. Beetroot and potato were the other roots and tubers consumed by weavers but not daily. Onion was consumed everyday by all.

Banana and papaya were consumed daily by 25 and 7 per cent of weavers respectively. Majority of the weavers (63 %) consumed guava occasionally. Most of the adults consumed buttermilk, curd and milk daily. Groundnut was consumed weekly twice and coconut was consumed daily by majority of the weavers. Majority of the adult weavers (63%) consumed cashew nuts occasionally. Chicken and mutton were consumed weekly once or twice by majority. Egg was taken daily by 27 per cent of adults. Sugar was consumed by all the adults daily whereas honey was used by 30 and 45 percent of weavers either weekly once or twice. Jaggery was also consumed by 45 and 28 per cent of weavers once or twice a week.

Except cereals, pulses, milk and milk products, oil and sugar all the other food groups like greens, vegetables and fruits were consumed once or twice a week or occasionally by the weavers. Vitamins and mineral rich foods were not consumed frequently by the weavers.

### **3. Life Style pattern of the Weavers**

#### **i. Type of house of the selected Handloom weavers**

Table XV presents the type of houses in which the selected handloom weavers are living

**TABLE - XV**

**TYPE OF HOUSES OF THE SELECTED HANDLOOM WEAVERS**

Type of House	Coimbatore		Vellore		Thiruvannamalai		Total	
	N	%	N	%	N	%	N	%
Tiled	114	23	101	97	312	61	527	65
Thatched	245	49	0	0	156	30	401	27
Concrete	142	28	3	3	45	9	190	8
<b>Total</b>	<b>501</b>	<b>100</b>	<b>104</b>	<b>100</b>	<b>513</b>	<b>100</b>	<b>1118</b>	<b>100</b>
<b>Categories</b>								
Rented	482	96	101	97	471	92	1054	94
Own house	19	4	3	3	42	8	74	6
<b>Total</b>	<b>501</b>	<b>100</b>	<b>104</b>	<b>100</b>	<b>513</b>	<b>100</b>	<b>1118</b>	<b>100</b>

From the Table it is seen that 65 per cent of the handloom weavers were living in tiled houses and only 8 per cent of the weavers were living in concrete houses. A majority of 97 and 61 per cent weavers were living in tiled houses at Vellore and Thiruvannamalai district respectively. But in Coimbatore district 49 per cent of the weavers were living in thatched houses.

It is discouraging to note that 94 per cent of the weavers being the majority were living in rented houses whereas only 6 per cent of the weavers were living in own house. This reflects strongly on their poor socio economic status.

**ii. Details of sanitary facilities available for the selected handloom weavers**

Results of the present study revealed that 49 per cent being the majority of the handloom weavers were using toilets built inside the house whereas 46 per cent of them were using community toilets. Among the three districts a majority of 60 per cent of the weavers in Thiruvannamalai district were using community toilets. Even after a lot of government efforts still 5 per cent of the weavers were using open field as toilets revealing the poor facilities available in such localities.

**iii. Details of transport facility used by the selected Handloom weavers**

Handloom weavers used to spend money for travelling mainly to reach the place of work or travelling becomes a part and parcel of their life. Table XVI depicts the details of transport facility used by the selected handloom weavers

**TABLE - XVI****DETAILS OF TRANSPORT FACILITY USED BY THE SELECTED HANDLOOM WEAVERS**

Transport Facility	Coimbatore (501)		Vellore (104)		Thiruvannamalai (513)		Total (1118)	
	N	%	N	%	N	%	N	%
Bicycle	212	42	82	79	434	85	728	65
Motorbike	203	41	5	5	38	7	246	22
Bus	86	17	17	21	41	8	144	13
<b>Total</b>	<b>501</b>	<b>100</b>	<b>104</b>	<b>100</b>	<b>513</b>	<b>100</b>	<b>1118</b>	<b>100</b>

It is seen that a maximum of 65 per cent of the weavers were having bicycle for travelling and 22 per cent of them were using motor bikes. Among the three districts, 85 per cent of weavers in Thiruvannamalai district and 79 per cent of weavers in vellore district being the majority were using only bicycle for transportation. Motorbikes were used by a majority (41 %) of weavers in Coimbatore district. Bus facility was availed by 13 per cent of weavers in all the three districts.

**iv. Location of work place of the Selected Handloom weavers**

Table XVII depicts the location of work (weaving) of the selected handloom weavers.

**TABLE - XVII****LOCATION OF WORK PLACE OF THE SELECTED HANDLOOM WEAVERS**

Location of Work	Coimbatore		Vellore		Thiruvannamalai		Total	
	N	%	N	%	N	%	N	%
In their House	290	58	52	50	280	55	622	56
In their Village	165	33	52	50	223	43	440	39
Nearby Village/town	46	9	0	0	10	2	56	5
<b>Total</b>	<b>501</b>	<b>100</b>	<b>104</b>	<b>100</b>	<b>513</b>	<b>100</b>	<b>1118</b>	<b>100</b>

A maximum of 56 per cent of the weavers were having the weaving units in their own house and an equal percentage was distributed among the three districts.

About 39 per cent of weavers had their work place in their village whereas only 5 per cent of the weavers were going for weaving job in the nearby village/ town.

#### v. Practice of exercise and yoga by the selected Handloom weavers

Details on exercise and yoga practices adopted by the handloom weavers is presented in Table XVIII.

**TABLE – XVIII**  
**PRACTICE OF EXERCISE AND YOGA BY THE SELECTED**  
**HANDLOOM WEAVERS**

Details	Coimbatore				Vellore				Thiruvannamalai				Total	
	Men		Women		Men		Women		Men		Women		N	%
	N	%	N	%	N	%	N	%	N	%	N	%		
<b>Exercise</b>														
Yes	11	2	14	100	14	15	3	33	42	9	21	54	105	9
No	476	98	0	0	81	85	6	67	432	91	18	46	1013	91
<b>Total</b>	<b>487</b>	<b>100</b>	<b>14</b>	<b>100</b>	<b>95</b>	<b>100</b>	<b>9</b>	<b>100</b>	<b>474</b>	<b>100</b>	<b>39</b>	<b>100</b>	<b>1118</b>	<b>100</b>
<b>Yoga</b>														
Yes	0	0	0	0	7	7	0	0	17	4	6	15	30	3
No	487	100	14	100	88	93	9	100	457	96	33	85	1088	97
<b>Total</b>	<b>487</b>	<b>100</b>	<b>14</b>	<b>100</b>	<b>95</b>	<b>100</b>	<b>9</b>	<b>100</b>	<b>513</b>	<b>100</b>	<b>38</b>	<b>100</b>	<b>1118</b>	<b>100</b>

A large percentage of weavers 97 and 91 in all the three districts did not do any type of exercise or yoga respectively. People with diabetes who do exercise are less likely to experience a heart attack or stroke than diabetics who do not exercise regularly. Regular exercise helps to control blood glucose levels and improve the body's ability to use insulin (Greff, 2003). Exercise also lowers total cholesterol, raises HDL cholesterol, lowers triglycerides and reduces blood pressure (Braunstein, 2003).

Meditation and yoga could help relax stress and stress has been found to be a causative factor for diabetes. Yoga effectively reduces stress, thus reducing glucagon and possibly improving insulin action (Chandratreya, 2008). In spite of knowing the benefits of exercise or yoga, the selected handloom weavers did not find time to do exercise or yoga. Among the less number of weavers (9%) who did exercise, walking was the predominant activity they practised and a few were doing simple exercises. Only 3 per cent of weavers did simple yoga exercise.

### iii. Smoking and alcoholism among men weavers

Details on Smoking and alcohol intake by the selected men handloom weavers are presented in Table XIX.

**TABLE – XIX**  
**SMOKING AND ALCOHOLISM AMONG THE SELECTED MEN**  
**HANDLOOM WEAVERS**

Habits	Coimbatore (86)		Vellore (12)		Thiruvannamalai (35)		Total (133)	
	N	%	N	%	N	%	N	%
<b>Smoking</b>								
Yes	86	18	12	13	35	7	133	13
No	401	82	83	87	439	93	923	87
<b>Total</b>	<b>486</b>	<b>100</b>	<b>95</b>	<b>100</b>	<b>474</b>	<b>100</b>	<b>1056</b>	<b>100</b>
<b>Types</b>								
Cigarette	6	7	3	25	6	17	15	11
Beedi	80	93	9	75	29	83	118	89
<b>Total</b>	<b>86</b>	<b>100</b>	<b>12</b>	<b>100</b>	<b>35</b>	<b>100</b>	<b>133</b>	<b>100</b>
<b>Alcohol consumption</b>								
Yes	248	51	7	7	24	5	279	26
No	239	49	88	93	450	95	777	74
<b>Total</b>	<b>487</b>	<b>100</b>	<b>95</b>	<b>100</b>	<b>474</b>	<b>100</b>	<b>1056</b>	<b>100</b>
<b>Duration</b>								
Daily	115	46	4	57	13	54	132	47
Weekly once	33	13	1	14	3	13	37	13
Weekly twice	62	25	2	29	6	25	70	25
Rarely	38	16	0	0	2	8	40	15
<b>Total</b>	<b>248</b>	<b>100</b>	<b>7</b>	<b>100</b>	<b>24</b>	<b>100</b>	<b>279</b>	<b>100</b>

It is encouraging to note that 87 per cent being the majority of the handloom weavers were not having the smoking habit whereas 13 per cent of the weavers had smoking habit. Among those who smoked, a maximum of 89 per cent used beedi and only 11 per cent of them used cigarettes. Smoking is the biggest risk factor for sudden deaths. The risk of heart disease is ten times greater for a smoker who is under 50 years than a non-smoker of the same age. Smoking is an important

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modifiable risk factor for diabetes, the metabolic syndrome (Oh, 2005). In the present study even the lowest percentage of smokers need to be educated about the ill effects of smoking.

It is to be appreciated that 74 per cent being the majority of the men weavers did not consume alcohol whereas the remaining 26 per cent of the men weavers were consuming alcohol. Among them a majority of the (47 %) weavers were consuming alcohol daily and 25 per cent of the weavers were consuming twice in a week. Among the three districts, in Vellore and Thiruvannamalai districts a majority of 57 and 54 per cent of the handloom weavers respectively were consuming alcohol daily. Weavers spend their income on alcohol which deprives them socially and economically. Weavers need to be educated to keep away from alcohol for their own health and for the happiness of the family.

#### **4. Work related details of the weavers**

Almost 44 per cent of the weavers were not having their own weaving unit whereas 56 per cent of the weavers were having their own weaving unit. About 19 per cent of the weavers were working under co-operative societies particularly in Coimbatore district.

Only 25 per cent of the weavers were having one or two acres of agricultural land. All the weavers were having electricity facility in their home, because government provides electricity free of cost to the weavers.

#### **Infrastructure**

The findings of the study revealed that a majority of 60 and 63 per cent of the selected handloom weavers were having inadequate infrastructure or space for weaving in Coimbatore and Thiruvannamalai district respectively. In the case of Vellore district, majority (59%) of the weavers had adequate infrastructure for weaving.

#### **Ventilation**

With regard to light and ventilation facility in the working places a maximum of 90 and 86 per cent weavers in Thiruvannamalai and Vellore districts expressed that they did not have adequate light and ventilation in the work places. This showed the

poor conditions in which the handloom weavers are working under stress. In Coimbatore district 68 per cent of the weavers were satisfied with the light and ventilation facilities available in the working areas.

### Working hours among the selected Handloom weavers

Table XX depicts the working hours among the selected handloom weavers.

**TABLE - XX**

#### WORKING HOURS AMONG THE SELECTED HANDLOOM WEAVERS

Working Hours	Coimbatore (501)				Vellore (104)				Thiruvannamalai (513)				Total (1118)	
	Men		Women		Men		Women		Men		Women		N	%
	N	%	N	%	N	%	N	%	N	%	N	%		
8 hrs	286	59	14	100	95	100	9	100	460	97	24	62	888	79
12 hrs	172	35	0	0	0	0	0	0	8	2	9	23	189	17
16 hrs	29	6	0	0	0	0	0	0	6	1	6	15	41	4
<b>Total</b>	<b>487</b>	<b>100</b>	<b>14</b>	<b>100</b>	<b>95</b>	<b>100</b>	<b>9</b>	<b>100</b>	<b>474</b>	<b>100</b>	<b>39</b>	<b>100</b>	<b>1118</b>	<b>100</b>

A majority of 79 per cent of the weavers were working for 8 hours per day distributed among all the three districts. About 35 per cent of weavers especially in Coimbatore district were working for 12 hours a day. Majority of women were working for only 8 hours a day. A very less percentage (4 %) of the weavers were working for 16 hours per day which might be due to commitment to complete certain designs.

A majority of 68 per cent of the weavers were not maintaining proper time schedule for the weaving, because they were having own weaving unit. Only 32 per cent of the weavers were maintaining proper time schedule (9am to 6pm) for the weaving because they were working under the master weavers for wages.

### Duration of Weaving of Specific designs

The details of duration of weaving sarees with specific designs among the selected handloom weavers is presented in Table XXI

**TABLE - XXI**

**DURATION OF WEAVING TIME OF SAREES WITH SPECIFIC DESIGNS BY THE  
SELECTED HANDLOOM WEAVERS**

Working Hours	Coimbatore (501)				Vellore (104)				Thiruvannamalai (513)				Total (1118)	
	Men		Women		Men		Women		Men		Women		N	%
	N	%	N	%	N	%	N	%	N	%	N	%		
1 week (VS)	173	35	0	0	5	5	1	11	47	10	7	18	232	21
10 days (S)	154	32	0	0	87	92	8	89	57	12	5	13	311	28
15 days (H)	137	28	14	100	3	3	0	0	311	66	16	41	481	43
1 month (VH)	23	5	0	0	0	0	0	0	59	12	11	28	93	8
<b>Total</b>	<b>487</b>	<b>100</b>	<b>14</b>	<b>100</b>	<b>95</b>	<b>100</b>	<b>9</b>	<b>100</b>	<b>474</b>	<b>100</b>	<b>39</b>	<b>100</b>	<b>1118</b>	<b>100</b>

**VS - Very Simple**

**S- Simple**

**H- Heavy**

**VH-Very Heavy**

Findings of the study revealed that a majority of 43 per cent of the weavers were taking 15 days to weave heavy design sarees. Simple designs were done by 28 per cent of weavers within 10 days and very simple designs were done by 21 per cent of weavers within a week duration. Only 8 per cent of the weavers were working for one month to weave very heavy design sarees. As the design in the saree becomes very heavy the duration of weaving also increased proportionately.

**5. Health Problems among the weavers**

**i. Health Problems reported by the selected handloom weavers**

Table XXII presents the health problems reported by the selected handloom weavers.

The results of the study indicated that 36 per cent of the weavers being the majority had joint pain and 24 per cent were suffering from muscle pain. The higher prevalence of muscle and joint pain experienced by majority of handloom weavers might be due to their posture at work place. Handloom weavers need to be educated on proper posture at work places and facilities need to be provided for the same. About 31 per cent of the weavers were suffering from pain in fingers because of contact with strings carrying warp yarns.

**TABLE - XXII**

**HEALTH PROBLEMS EXPRESSED BY THE SELECTED  
HANDLOOM WEAVERS**

Problems *	Coimbatore		Vellore		Thiruvannamalai		Total	
	N	%	N	%	N	%	N	%
Joint Pain	144	29	43	41	218	42	405	36
Pain in fingers	76	15	0	0	239	47	350	31
Muscle pain	136	27	39	37	88	17	263	24
Blood Pressure	97	19	3	3	116	23	216	19
Diabetes Mellitus	105	21	13	13	62	12	180	16
Persistent Cough	7	1	0	0	91	18	93	8
Breathing Difficulty	9	2	6	6	19	4	34	3
Ulcer	10	2	0	0	10	2	20	2

\*Multiple Responses

Lesser percentage of people expressed health problems like blood pressure (19%), diabetes mellitus (16%), continuous cough (8 %), breathing problems (3%) and ulcer (2%). Adulthood are critical times to optimize peak bone mass and inadequate consumption of calcium in these years increases the risk of osteoporosis and bone fractures in later life (Flynn, 2003). Health is very much essential for proper livelihood and work output.

**ii. Vision problems of the selected handloom weavers**

The vision problems found among the selected handloom weavers through clinical examination are presented in Table XXIII.

**TABLE - XXIII**

**VISION PROBLEMS AMONG THE SELECTED HANDLOOM WEAVERS**

Vision problems	Coimbatore		Vellore		Thiruvannamalai		Total	
	N	%	N	%	N	%	N	%
Short sight	103	35	19	79	186	43	308	41
Long sight	188	63	5	21	128	30	321	43
Dimness of vision	6	2	0	0	117	27	123	16
<b>Total</b>	<b>297</b>	<b>100</b>	<b>24</b>	<b>100</b>	<b>431</b>	<b>100</b>	<b>752</b>	<b>100</b>

From the table it is seen that a majority of 43 and 41 per cent of the weavers more or less equal percentage were suffering from long sight and short sight respectively. Dimness of vision was reported by 16 per cent of the handloom weavers. The findings revealed that long sight and short sight were experienced by majority of handloom weavers, which might be due to the continuous attention required for the weaving process.

## B. NUTRITIONAL STATUS OF THE HANDLOOM WEAVERS

### 1. Anthropometric measurements of the weavers

#### i. Height and weight measurements of the weavers

The mean height and weight of the selected 513 handloom weavers in comparison with ICMR (2010) reference values is presented in Table XXIV.

**TABLE - XXIV**  
**MEAN HEIGHT AND WEIGHT OF THE SELECTED HANDLOOM WEAVERS**  
**COMPARED WITH ICMR (2010) VALUES**

Parameters	Men (N=474)			Women (N=39)		
	ICMR (2010)	Mean ± SD	Deficit/ Excess (%)	ICMR (2010)	Mean ± SD	Deficit/ Excess (%)
Height (cm)	172	164.6±6.8	-4.3	161	162±5.2	+0.6
Weight (kg)	62	69.07±10.4	+11.4	56	70±8.7	+25

The mean height of the selected men weavers was recorded to be 164.6 cm which is found to be lesser than that of 172 cm suggested by ICMR (2010) for adult men. Height indicates long term nutritional status. In the present study the selected weavers were found to be slightly short statured according to ICMR reference values. A deficit of 4.3 per cent was noted in comparison with ICMR values.

The mean weight of the selected men weavers was found to be 69.07 kg which is more than that of 62 kg referred by ICMR (2010). The mean weight was found to be 11.4 per cent in excess of ICMR values. Most of the men were found to be slightly obese in the present study might be due to inadequate physical activity and being confined to the loom for long hours.

The mean height of the selected women weavers was found to be 162cm which is 1cm more than that of ICMR (2010) reference values which is a welcome observation. The values are 0.6 per cent in excess of ICMR values.

The mean weight of the selected women weavers was found to be 70 kg which is 14 kg more than that of ICMR (2010) values with a percentage excess of 25. The findings of the study indicated that most of the women were found to be obese which could be reasoned out to the sedentary life style with limited physical activity among women. The overall anthropometric measurements indicated that most of the men and women were found to be obese which might lead to health problems in the long run.

## ii. Body Mass Index (BMI)

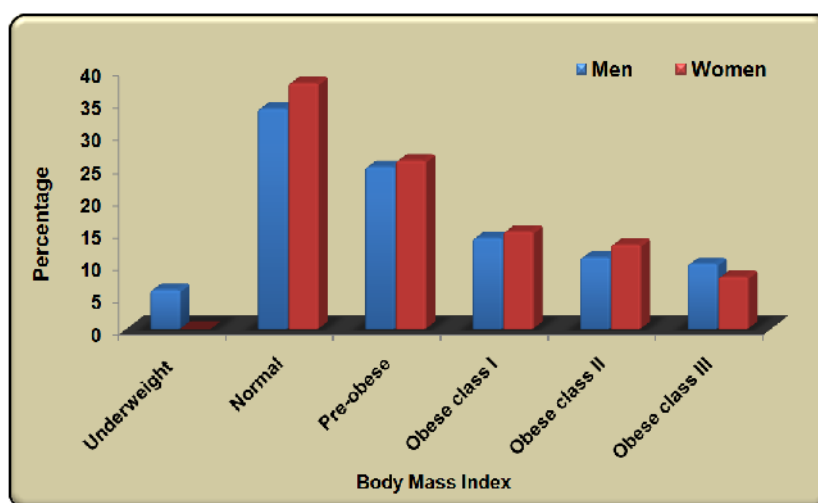
Table XXV and Figure 7 present the details regarding the Body Mass Index of the selected adult handloom weavers calculated using the height and weight data.

**TABLE - XXV**

**BODY MASS INDEX OF THE SELECTED MEN AND WOMEN WEAVERS**

Classification	BMI class*	Men (N=474)		Women (N=39)	
		No	%	No	%
Underweight	<18.5	29	6	0	0
Normal	18.5-24.9	161	34	15	38
Pre-obese	25.0-29.9	120	25	10	26
Obese class I	30.0-34.9	67	14	6	15
Obese class II	35.0-39.9	51	11	5	13
Obese class III	≥40.0	46	10	3	8
<b>Total</b>		<b>474</b>	<b>100</b>	<b>39</b>	<b>100</b>

\*WHO (2011)



**FIGURE 7 - BODY MASS INDEX OF THE SELECTED HANDLOOM WEAVERS**

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Among men weavers, 34 per cent being the majority had BMI values within normal range and only 6 per cent of men came under the category of underweight. Nearly 25 and 14 per cent of men were in the category of pre obese and obese class I respectively. There were also 11 and 10 per cent of men in obese class II and obese class III category respectively.

A majority of 38 per cent women had BMI values within normal range but none of the women came under the category of underweight. Nearly 26 and 15 per cent of women were in the category of pre obese and obese class I respectively. It is also noticed that 13 and 8 per cent of women were in obese class II and III respectively.

The overall picture of the BMI values of the handloom weavers indicated that nearly one third of men and women under study were in the normal category whereas a majority of men and women were in obese category of any one of the three types. Reduction of BMI would also reduce the risk of diabetes associated with family history (Public Health Nutrition, 2010). Risk of developing major health problems, including several chronic diseases such as heart disease and diabetes, rises progressively for BMIs above 21 (James *et al.*, 2004).

## **2. Biochemical parameters of the weavers**

Biochemical parameters related to the health problems like anaemia, diabetes mellitus, hypertension and musculoskeletal problem of weavers such as blood haemoglobin, random blood sugar and serum calcium were estimated for a sample of 403 adult men who were willing to cooperate for blood estimations.

### **i. Blood Haemoglobin levels**

The details regarding the haemoglobin levels categorized as per WHO (1992) values of the selected adult men handloom weavers are given in Table XXVI.

It is found from the Table that 70 per cent of men being the majority had haemoglobin levels ranging from 7 to 9.9g/dl suggesting the higher prevalence of moderate anaemia among handloom weavers in comparison with the normal haemoglobin level suggested by the World Health Organisation (1992) as 13 g per 100 dl for an adult man. Mild anaemia was found among 14 per cent of men and

severe anaemia was found among another 14 per cent of men. Only 2 per cent of men had normal haemoglobin levels. The overall picture revealed a higher prevalence of anaemia of different categories which may interfere with their nutritional status and work performance.

**TABLE - XXVI**  
**HAEMOGLOBIN LEVELS AND THE CATEGORY OF ANAEMIA AMONG**  
**THE SELECTED MEN WEAVERS (N=403)**

Haemoglobin Level *	Category of Anaemia	Number	Per cent
<7 g/dl	Severe	57	14
7-9.9 g/dl	Moderate	283	70
10-12.9 g/dl	Mild	56	14
>13g/dl	Normal	7	2
<b>Total</b>		<b>403</b>	<b>100</b>

\*WHO (1992) Reference values

Iron deficiency leads to a reduction in formation of red cell and haemoglobin, causing anaemia and chronic kidney disease and reduced circulating blood cells. Patients with diabetes are at a greater risk of developing anaemia earlier. People who are with type 2 diabetes are generally more anaemic (Mehdi and Toto, 2009).

#### ii. Random Blood Glucose and Serum Calcium levels

Table XXVII presents the mean values of random blood glucose and serum calcium levels of the 403 men handloom weavers in comparison with reference values.

**TABLE - XXVII**  
**MEAN BLOOD GLUCOSE AND SERUM CALCIUM LEVELS**  
**OF THE MEN WEAVERS**

(N=403)

Parameters	Desirable level (mg/dl)	Mean±SD (mg/dl)
Random blood sugar*	80–120	210±16.1
Serum Calcium#	9.0 – 10.6	7.7±0.4

\* American Diabetes Association (2013)

# Institute of Medicine, (2010)

The mean random blood glucose levels of the selected men handloom weavers was found to be 210 mg per dl which was higher than the recommended blood glucose level of 80-120mg/dl. The findings revealed a higher prevalence of diabetic tendency among men handloom weavers.

With regard to serum calcium level among the men handloom weavers, it was found to be 7.7 mg/dl which was less than the reference values of 9.0-10.6mg/dl. This highlights the higher prevalence of calcium deficiency among men handloom weavers.

### iii. Serum Phosphorus and Vitamin D levels

Table XXVIII presents the mean values of serum phosphorus (N: 90 of Musculoskeletal groups) and vitamin D (N: 15 of Musculoskeletal groups) levels of the men handloom weavers in comparison with reference values.

**TABLE - XXVIII**  
**MEAN SERUM PHOSPHORUS AND VITAMIN D LEVELS OF THE SELECTED MEN WEAVERS**

Parameters	N	Desirable level	Mean±SD (mg/dl)
Serum Phosphorus*	90	2.5–5.0 (mg/dl)	1.63±0.27
Vitamin – D*	15	21 – 100 (ng/ml)	14.18±0.39

\* Institute of Medicine, (2010)

The mean serum phosphorus levels of the selected men handloom weavers was found to be 1.63 mg per dl which was lesser than the recommended phosphorus level of 2.5-5.0mg/dl. The findings revealed a higher prevalence of phosphorus deficiency among men handloom weavers.

With regard to vitamin D levels among the men handloom weavers, it was found to be 14.18 ng/ml which was less than reference values. This highlights the higher prevalence of vitamin D deficiency among weavers. These low levels of phosphorus and vitamin D may predispose the men handloom weavers to musculoskeletal disorders.

## 1. Classification of handloom weavers according to random blood glucose and serum calcium levels

The classification of the men handloom weavers according to random blood glucose and serum calcium levels is given in Table XXIX.

**TABLE - XXIX**  
**CLASSIFICATION OF MEN WEAVERS ACCORDING TO RANDOM BLOOD GLUCOSE AND SERUM CALCIUM LEVELS**

**(N = 403)**

Category	Range	N	%
<b>Random Blood Glucose (mg/dl) *</b>			
Low	<80	18	4.4
Normal	80-140	258	64.0
Border line	140-160	17	4.2
High	160-180	1	0.2
Very High	180-200	28	7.0
Risk	200-220	81	20.0
Total		403	100
<b>Serum Calcium (mg/dl) #</b>			
Very low	7.0-8.0	76	19
Low	8.0-9.0	51	12
Normal	9.0-10.6	192	48
High	10.6-11.0	84	21
Total		403	100

\* American Diabetes Association (2013)

# Institute of Medicine, (2010)

Findings of the study revealed that 64 per cent of the men handloom weavers had desirable level of random blood glucose which is an encouraging observation. Nearly 20 and 7 per cent of male weavers were in risk and very high level of blood glucose. Only 4.4 per cent of the weavers had less than 80mg/dl blood glucose categorised as low.

With regard to serum calcium levels 48 per cent of the weavers had normal level of calcium (9-10.6mg/dl). Surprisingly 21 per cent of the weavers had high serum calcium ranging from 10.6 - 11mg/dl. About 12 per cent of the weavers had low level of serum calcium (8-9.0mg/dl) whereas 19 per cent had very low serum calcium levels (7-8mg/dl). The study revealed that nearly one third (31%) of the adult

handloom weavers had less than normal calcium levels. Inadequate intake of greens, fruits and vegetables might be the reasons for low serum calcium levels.

### 3. Biophysical Parameter among the men weavers

#### i. Blood pressure values according to systolic and diastolic values

The blood pressure values in terms of systolic and diastolic pressures in mm of Hg categorized according to JNC (2004) and shown in Table XXX.

**TABLE - XXX**  
**SYSTOLIC AND DIASTOLIC BLOOD PRESSURE VALUES OF**  
**THE HANDLOOM WEAVERS**

**(N = 403)**

Category	Range	N	%
<b>Blood Pressure - Systolic (mmHg)*</b>			
Low	<120	51	12
Normal	120	63	16
Pre Hypertension	120-140	169	42
Stage-I Hypertension	140-150	19	5
Stage-II Hypertension	>160	101	25
<b>Total</b>		<b>403</b>	<b>100</b>
<b>Blood Pressure - Diastolic (mmHg)*</b>			
Low	<80	119	29
Normal	80	67	17
Pre Hypertension	80-89	141	35
Stage-I Hypertension	90-99	60	15
Stage-II Hypertension	>100	16	4
<b>Total</b>		<b>403</b>	<b>100</b>

\*Joint National Committee (2004)

Systolic blood pressure values indicated that only 16 per cent of the men weavers had normal values whereas 12 per cent had low systolic pressure. A majority nearly 42 per cent of the weavers were in pre-hypertension category followed by 25 per cent in stage II hypertension and 5 per cent in stage I hypertension. It is alarming to note that majority of the men weavers (72 %) had high systolic pressure which might predispose to cardiovascular problems and other complications. Maintenance of blood pressure within normal range is very much essential for healthy living.

With regard to diastolic pressure only 17 per cent of the weavers had normal levels. Pre hypertension was found among 35 per cent of weavers being the majority followed by stage I hypertension among 15 per cent of weavers in terms of diastolic pressure. In tune with high systolic pressure values among men weavers diastolic pressure values were also found to be alarmingly high.

## ii. Mean Blood pressure values of the selected men weavers

The mean blood pressure values of the 403 men handloom weavers are presented in Table XXXI compared with normal values.

**TABLE - XXXI**  
**MEAN BLOOD PRESSURE VALUES OF THE WEAVERS**

Parameter	Normal	Mean±SD
Systolic BP (mmHg)	120	168±15.9
Diastolic BP (mmHg)	80	89±6.6

The mean systolic blood pressure values of the selected weavers was found to be 168 mmHg and the diastolic blood pressure was 89 mmHg. Both the systolic and diastolic blood pressure values of the adults were more than the reference values. Sedentary stressful living with slightly high intake of salt might be the reasons for the higher blood pressure values among the selected men weavers. Proper dietary modification and counseling may help them to overcome the health problem.

Treatment and control of hypertension are particularly low in most developing countries and even developed countries have far from ideal levels of control (Bakris *et al.*, 2008).

## iii. Classification of men handloom weavers according to JNC hypertension guidelines

Table XXXII presents the categorization of men handloom weavers based on the Joint National Committee (2004) hypertension guidelines.

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**TABLE - XXXII****CLASSIFICATION OF MEN HANDLOOM WEAVERS BASED ON JNC (2004)  
HYPERTENSION GUIDELINES****(N=403)**

Category	Range (mmHg)	No	%
Low Blood Pressure	*SBP <120 **DBP <80	56	14
Normal	SBP 120 DBP 80	12	3
Pre Hypertension	SBP 120-139 DBP 80-89	204	51
Stage I Hypertension	SBP 140-149 DBP 90-99	14	3
Stage II Hypertension	SBP ≥ 160 DBP ≥ 100	117	29

\*SBP – Systolic Blood pressure

\*\*DBP – Diastolic Blood pressure

In the present study 51 per cent of the weavers being the majority had pre hypertension while as many as 29 per cent of handloom weavers had stage II hypertension which is an alarming observation and needs prevention strategies. It is also noted that 14 per cent of the weavers had very low blood pressure which is also dangerous for health. Only 3 per cent of the weavers had normal blood pressure values

**4. Clinical examination of the selected handloom weavers**

The clinical signs and symptoms found among all the surveyed handloom weavers are given in Table XXXIII

**TABLE - XXXIII**  
**CLINICAL SIGNS AND SYMPTOMS AMONG WEAVERS**

(N=513)

Organs	Signs and Symptoms	Men (N=474)		Women (N=39)	
		No	%	No	%
Hair	a) Brittle	47	10	21	54
	b) Thin	85	18	18	46
Skin	a) Dryness	41	9	16	41
	b) Wrinkling	80	17	13	33
	c) Allergy	13	3	2	5
Face	a) Pale	89	19	21	54
	b) Dryness	70	15	23	59
Nails	a) Poor nail growth	92	19	14	36
	b) Brittle nails	76	16	17	44
	c) White spots on finger nails	94	20	11	28
	d) Transverse lines	33	7	13	33
Teeth & Gums	a) Bleeding gums	96	20	29	74
	b) Dental caries	212	45	23	59
	c) Decay	54	11	12	31
Eyes	a) Dimness of Vision	84	18	31	79
	b) Short sight	232	49	23	59
	c) Long sight	122	26	20	51
Nervous system	a) Behavior disturbance	92	19	23	59
	b) Sleep disturbance	212	45	16	41
	c) Mental tension	196	41	13	33
Respiratory system	a) Breathing problems	40	8	8	20
	b) Asthma	12	2	21	54
	c) Cough & cold	132	28	17	44
Digestive system	a) Ulcer	20	4	13	33
	b) Improper digestion	234	49	11	28
Extremities	a) Edema	7	1	3	8
	b) Joint pain	290	61	35	90
	c) Muscle pain	218	46	26	67
	d) General Fatigue	192	40	17	44

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Among the clinical symptoms dental caries, short sight, sleep disturbance, improper digestion, joint and muscle pain were found among a maximum of 45, 49, 45, 49, 61 and 46 per cent of men handloom weavers respectively. Mental tension and general fatigue were reported by 41 and 40 per cent of adult men respectively. Other clinical symptoms like thin hair, pale and dry face, wrinkled skin, poor and brittle nails, bleeding gums, dimness of vision, long sight and behavior disturbance were also found among 16-19 per cent of adult men weavers.

Dimness of vision, bleeding gums, joint pain and muscle pain as clinical symptoms were seen among a maximum of 79, 74, 90 and 67 per cent of women handloom weavers respectively. Other clinical symptoms like brittle hair, dryness of face, dental caries, short sight and behavior disturbance were reported by a maximum of 54 to 59 per cent of women handloom weavers respectively.

In general, clinical examination results showed a higher prevalence of dental caries, short sight, muscle pain, joint pain and general fatigue among both men and women handloom weavers.

## **5. Food and nutrient intake and energy balance among the weavers**

### **i. Mean food intake per day by the selected handloom weavers**

The mean food intake per day by the selected 60 men handloom weavers compared with ICMR (2010) Recommended Allowance is given in Table XXXIV and Figure 8. The food intake data was collected by 24 hours recall method for 3 days from men handloom weavers of Thiruvannamalai district.

In the competitive environment, textile sector has adversely affected the operation and growth of traditional handloom industry in rural areas, making many traditional weavers financially weaker, reflecting deterioration in their socio-economic and livelihood status. This change has reflected in the food choices and food intake of the handloom weavers. From the food intake data it is found that the intake of cereals was found to be deficit by 15 per cent and pulse intake was excess by 15 per cent. It is observed that the intake of green leafy vegetables and roots and tubers was found to be deficit by 36 and 39 per cent. Consumption of other vegetables and fruits was found to be highly deficit by 72 and 88 per cent respectively.

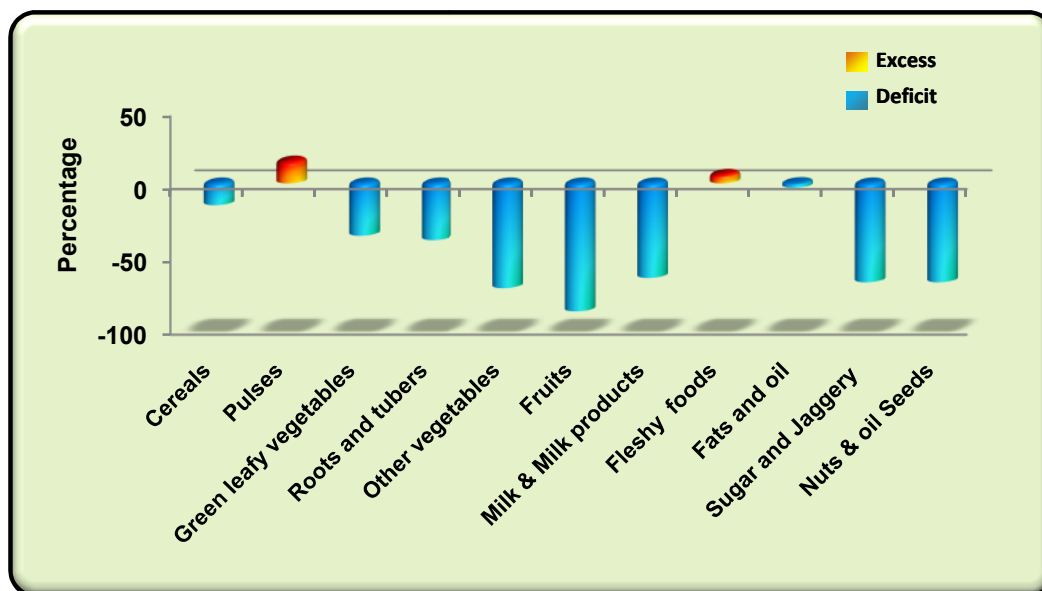
**TABLE – XXXIV**

**MEAN FOOD INTAKE PER DAY BY THE SELECTED MEN  
HANDLOOM WEAVERS**

(N = 60)

S. No	Foods	RDA (g)*	Actual intake (g)	Excess/deficit (%)
1.	Cereals	400	340	-15
2.	Pulses	40	46	15
3.	Green leafy vegetables	50	32	-36
4.	Roots and tubers	100	61	-39
5.	Other vegetables	150	41	-72
6.	Fruits	100	12	-88
7.	Milk & Milk products	300	103	-65
8.	Fleshy foods	30	32	6
9.	Fats and oil	30	29	-3
10.	Sugar and Jaggery	40	13	-68
11.	Nuts & oil Seeds	25	8	-68

\* ICMR, (2010)



**Figure 8 - MEAN FOOD INTAKE PER DAY BY THE SELECTED MEN  
HANDLOOM WEAVERS**

Milk and milk products intake was also found to be deficit by 65 per cent, whereas fleshy foods intake was found to be in excess by 6 per cent. Fats and oil intake was deficit by 3 per cent. The consumption of sugar and jaggery and nuts and oil seeds was highly deficit by 68 per cent each respectively, but it is good that intake of these foods need to be restricted. General findings indicated that consumption of health promoting foods like green leafy vegetables, fruits, milk and its products were found to be inadequate which may reflect in poor nutritional status of handloom weavers.

## ii. Mean Nutrient Intake per day by the Selected Handloom Weavers

Table XXXV and Figure 9 present the mean nutrient intake per day by the 60 selected men handloom weavers from Thiruvannamalai District in comparison with Recommended Dietary Allowance (ICMR, 2010).

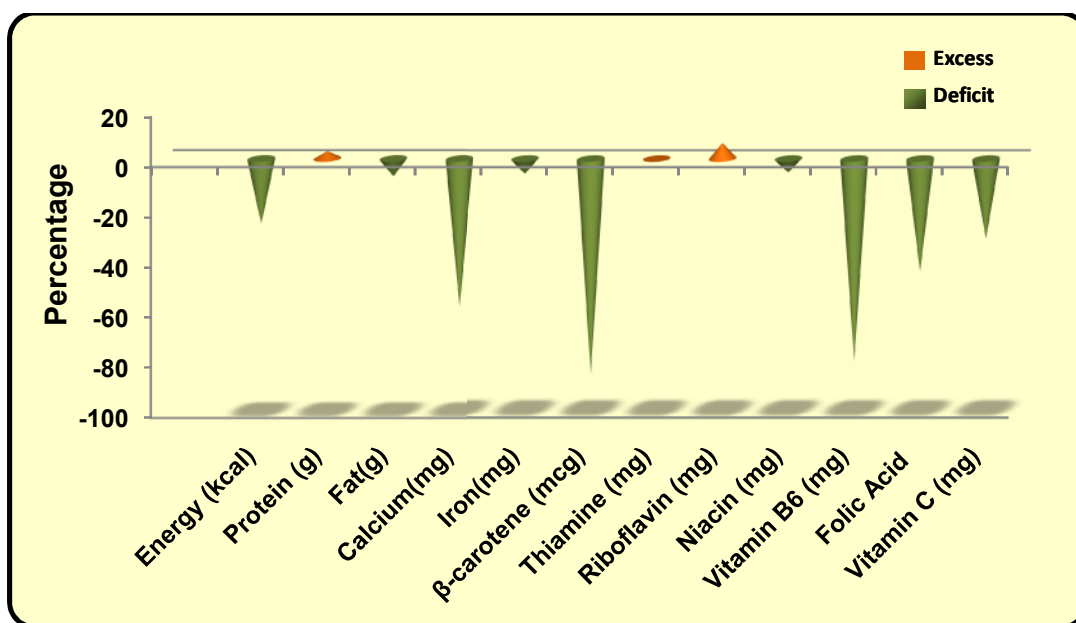
**TABLE - XXXV**  
**MEAN NUTRIENT INTAKE PER DAY BY THE SELECTED MEN**  
**HANDLOOM WEAVERS**

(N=60)

S. No	Nutrients	RDA* (2010)	Mean intake	Excess / Deficit (%)
1.	Energy (kcal)	2730	2027	-26
2.	Protein (g)	60	62	3
3.	Fat(g)	30	28	-7
4.	Calcium(mg)	600	245	-59
5.	Iron(mg)	17	16	-6
6.	β-carotene (mcg)	4800	649	-86
7.	Thiamine (mg)	1.4	1.4	0
8.	Riboflavin (mg)	1.6	1.7	6.3
9.	Niacin (mg)	18	17	-5.5
10.	Vitamin B <sub>6</sub> (mg)	2.0	0.39	-81
11.	Folic Acid	200	110	-45
12.	Vitamin C (mg)	40	27	-32

\*ICMR (2010)

From the Table it is observed that energy intake was found to be inadequate by 26 per cent and protein intake was slightly excess by 3 per cent. Fat intake was inadequate by 7 per cent. Very low consumption of green leafy vegetables and fruits has reflected in an inadequate intake of calcium by 59 per cent, iron by 6 per cent and  $\beta$  carotene by 86 per cent respectively. There was a deficit intake of vitamin B6 (81 %) folic acid (45 %) vitamin C (32 %) and niacin (5.5 %).



**FIGURE 9 - MEAN NUTRIENT INTAKE PER DAY BY THE SELECTED MEN HANDLOOM WEAVERS**

The general observation from the nutrient intake data revealed that there was an excess intake of protein and riboflavin than the recommended dietary allowance (RDA) whereas there was a deficit of energy, fat, calcium, iron,  $\beta$ -carotene, niacin, vitamin B6, folic acid and Vitamin-C. The main reasons for deficit included low food intake, poor food choice, work stress and poor socio economic status. This requires proper nutrition education among the handloom weavers to practice proper food selection based on availability and proper methods of cooking to avoid nutrient losses.

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### iii. Energy intake and energy expenditure among the handloom weavers

Details on the energy intake, energy expenditure and energy balance among the selected 27 men handloom weavers, 9 from each group are presented in Table XXXVI and Figure 10.

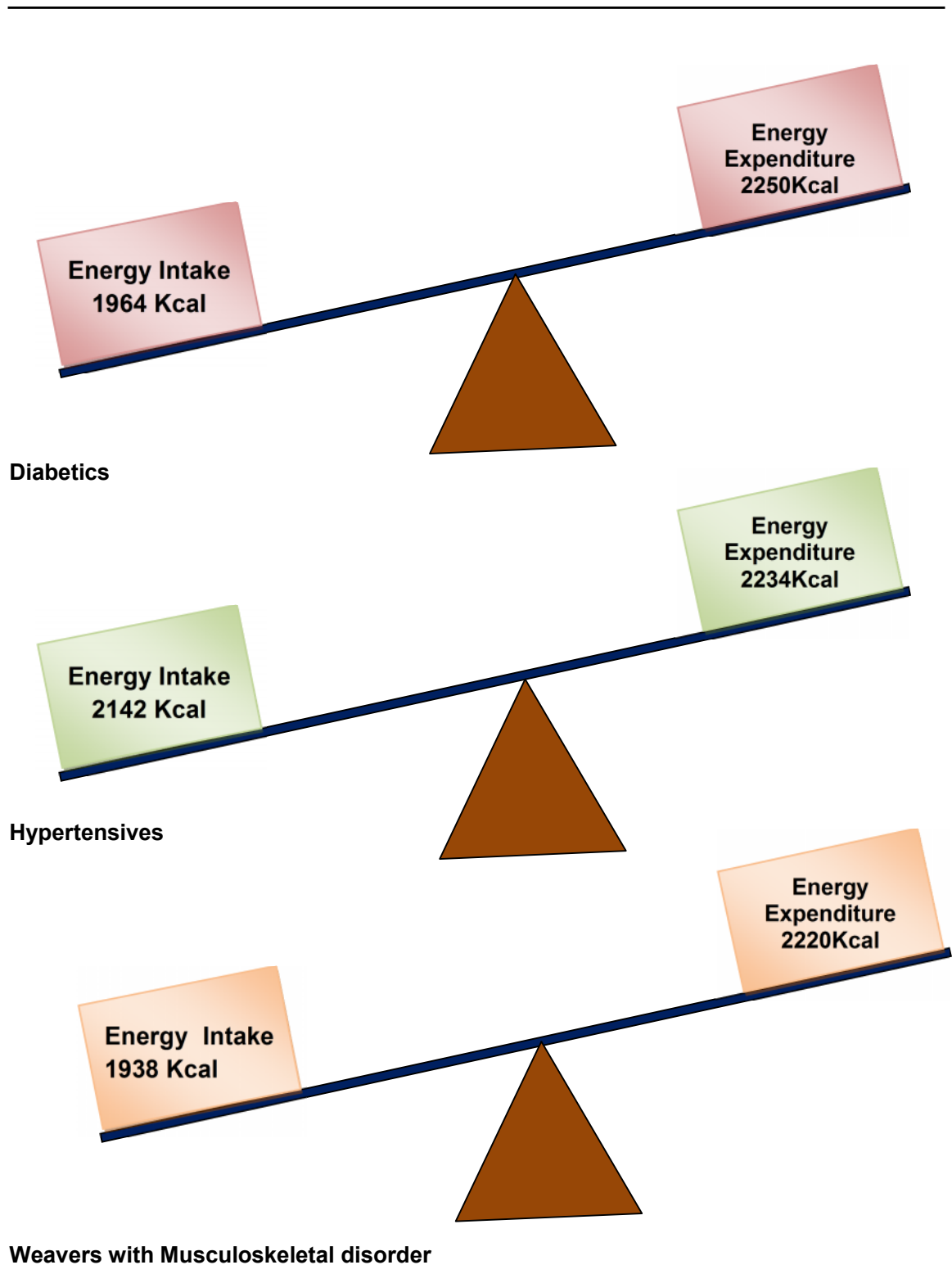
**TABLE – XXXVI**  
**MEAN ENERGY INTAKE, ENERGY EXPENDITURE AND ENERGY BALANCE**  
**OF THE SELECTED HANDLOOM WEAVERS (PER DAY)**  
**(N=27)**

Category	No	Energy Intake (Kcal)	Energy Expenditure (TDEE)* (Kcal)	Difference	Energy Balance
<u>Weavers with</u> Diabetes Mellitus	9	1964	2250	-286	Negative
Hypertension	9	2142	2234	-92	Negative
Musculoskeletal disorder	9	1938	2220	-282	Negative

**\*TDEE – Total Daily Energy Expenditure**

Energy balance among the selected 27 handloom weavers was determined based on the methods explained in the methodology.

From the Table it is clear that the energy intake of weavers with diabetes mellitus was 1964 Kcal which was lesser than the energy expenditure of 2250 Kcal indicating a negative energy balance. The energy intake of weavers with hypertension was 2142 kcal which was also slightly less than the energy expenditure of 2234 Kcal revealing a negative energy balance. Among the weavers with musculoskeletal disorders energy expenditure was 2220 kcal being higher than the energy intake of 1938 Kcal leading to negative energy balance. Almost among all the groups negative energy balance was found which may predispose them to complications of their disease condition.



**FIGURE 10 - ENERGY BALANCE OF HANDLOOM WEAVERS WITH DIABETES MELLITUS, HYPERTENSION AND MUSCULOSKELETAL DISORDER**

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## C. Details Regarding the Formulated Functional Food mixes

### 1. Acceptability testing of the Health mixes

Table XXXVII presents the mean scores given by the taste panel members to the various functional food mixes formulated for study.

**TABLE - XXXVII**  
**MEAN ACCEPTABILITY SCORES OBTAINED BY THE DEVELOPED**  
**FUNCTIONAL FOOD MIXES**  
**(Max Score=25)**

Quality	Maximum Score	Basic Health mix	Variation 1 (Amla)	Variation 2 (Flax seed)	Variation 3 (Soya)
Colour	5	4.0	3.5	4.5	4.7
Appearance	5	4.0	4.1	4.2	4.3
Flavour	5	3.8	4.1	4.3	4.8
Texture	5	3.9	3.9	4.2	4.0
Taste	5	4.2	4.2	4.1	4.3
<b>Total Score</b>	<b>25</b>	<b>19.9</b>	<b>19.8</b>	<b>21.3</b>	<b>22.1</b>

Functional food based Basic health mix and variations were subjected to organoleptic evaluation by a group of semi trained panel members using the five point scale score card.

For color, Variation 3 obtained the maximum score of 4.7 followed by variation 2, with 4.5 score. Basic health mix got a score of 4 whereas amla powder incorporated mix got only 3.5 scores for color since it was slightly brownish in colour.

With regard to appearance variation 3 and 2 got a maximum score of 4.3 and 4.2 respectively. Basic health mix obtained a score of 4 for appearance followed by 4.1 for variation 1.

For flavor, variation 3, containing soya obtained a highest score of 4.8 followed by 4.3 for variation 2. Amla incorporated variation 1 and Basic health mix got somewhat a lower score of 4.1 and 3.8 respectively for flavour. All the mixes scored nearly similar scores for texture ranging from 3.9 to 4.2 since all the powders were ground uniformly.

For taste, variation 3 with soya got a slightly highest score of 4.3 whereas Basic health mix and variation 1 got 4.2 and variation 2 got 4.1. Taste was appreciated by the panel members similarly for all.

The overall scores revealed that soya incorporated variation 3 got the maximum score of 22.1 followed by variation 2 with flax seed with a score of 21.3. Both Basic health mix and variation 1 got 19.9 and 19.8 respectively. None of the mixes were found to be bad organoleptically.

## 2. Nutrient analysis of the Health mixes

Table XXXVIII depicts the analysed values of proximate principles present in the formulated functional food mixes.

**TABLE - XXXVIII**

**PROXIMATE PRINCIPLES OF THE DEVELOPED FUNCTIONAL FOOD MIXES**

(In 100g)

Proximate Principles	Basic Health Mix	Variation – 1 (Amla)	Variation - 2 (Flax seed)	Variation- 3 (Soya)
Energy (Kcal)	384	333	368	384
Carbohydrate (g)	69.10	59.81	47.42	52.06
Protein (g)	12.80	15.75	18.60	18.37
Fat (g)	3.00	3.41	11.52	8.05
Moisture (g)	3.07	3.43	1.63	4.32
Ash (g)	8.00	9.44	12.20	10.40
Dietary fibre (g)	8.00	8.30	8.40	8.80
Crude fibre (g)	6.00	8.16	8.60	6.80

Among the food mixes developed, basic health mix and variation 3 provided 384 Kcal of energy per 100g followed by variation 1 and variation 2 which provided 333 and 368 Kcal of energy respectively. The total carbohydrate content of basic health mix and variation 1 was 69.10 and 59.81g per 100g respectively, while variation 3 and variation 2 contained 52.06 and 47.42g of carbohydrate per 100g respectively.

Protein content of mixes ranged from 12.8 to 18.6g per 100g with a maximum content in variation 2 and 3 with 18.6 and 18.37g per 100g might be due to the incorporation of flax seed and soya in these mixes. With regard to total fat content, variation 2 possessed the maximum of 11.52g per 100g due to the incorporation of flax seed in this mix followed by variation 3 with soya which had 8.05g of fat per 100g. Basic health mix and variation 1 contained 3.0 and 3.41g of fat per 100g respectively.

Among the food mixes variation 3 had maximum moisture of 4.32g per 100g followed by variation 1 and basic health mix which had 3.43 and 3.07g whereas variation 2 had a minimum moisture content of 1.63g per 100g respectively. Variation 2 had a high ash content of 12.2g per 100g due to flax seed whereas variation 3 and 2 had a slightly less amount of moisture 10.4 and 9.44g per cent respectively. Basic health mix had only 8g per cent of ash being the minimum content.

Dietary fibre content of variation 3 was the maximum with 8.80g per 100g followed by variation 2, variation 1 and basic health mix which had 8.4, 8.30 and 8g per 100g respectively. All the mixes had a similar range of dietary fibre 8 to 8.8g per 100g whereas crude fibre was found to be 6 and 6.8g per cent in basic health mix and variation 3. In the case of variation 1 and 2 the crude fibre content was high with 8.16 and 8.4g per cent respectively.

The mineral content of the developed functional food mixes is given in Table XXXIX

**TABLE - XXXIX**  
**MINERAL CONTENT OF THE DEVELOPED FUNCTIONAL FOOD MIXES**  
(In 100g)

Minerals	Basic Health Mix	Variation – 1 (Amla)	Variation- 2 (Flax seed)	Variation- 3 (Soya)
Calcium (mg)	180	419	527	472
Potassium (mg)	12.1	13.0	13.2	12.0
Sodium (mg)	6.0	7.2	5.3	5.6
Iron (mg)	2.0	3.9	4.4	4.4
Magnesium (mg)	110	163	206	135
Phosphorus (mg)	68.0	72.0	80.0	88.1

Among the minerals, variation 2 contained a higher amount of calcium 527mg per 100g respectively followed by variation 3 and variation 1 with 472 and 419mg in 100g Basic health mix had only 180mg per 100g respectively. With regard to potassium content, variation 2 had 13.2mg per 100g slightly higher than other mixes which had 12 to 13 mg per 100g.

Sodium content of variation 1 was found to be the maximum with 7.2mg per 100g. Other variations and basic health mix had 5.3 to 6.0mg per 100g of sodium. Variation 2 and 3 had a higher amount of 4.4mg per 100g of iron whereas basic health mix had only 2.0 mg followed by variation 1 which had 3.9mg per 100g.

Magnesium content was found to be more in variation 2 with 206mg followed by variation 1 and 2 which had 163 and 135mg per cent respectively. Basic health mix had less magnesium of 110mg per cent only. With regard to phosphorus, the content was more in variation 3 with 88.1mg per cent followed by variation 1 and 2 with 72 and 80mg. Basic health mix had only 68mg per cent of phosphorus. In general, all the functional food variations had more mineral content than the Basic health mix which might be due to the incorporation of specific functional foods in variations.

Table XL presents the vitamin content of the developed functional food mixes

**TABLE XL**

**VITAMIN CONTENT OF THE DEVELOPED FUNCTIONAL FOOD MIXES**

**(In 100g)**

<b>Vitamins</b>	<b>Basic Health Mix</b>	<b>Variation – 1 (Amla)</b>	<b>Variation- 2 (Flax seed)</b>	<b>Variation- 3 (Soya)</b>
Total carotenoids (µg)	1020	1420	1280	1320
β- carotene (µg)	420	460	368	360
Vitamin – C (mg)	17.28	23.85	8.78	10.94
Vitamin – E (µg)	0.20	0.28	0.44	0.30

Total carotenoids content of functional food mixes ranged from 1020 to 1420µg per 100g with a maximum content in variation 1 with amla based mix. Beta

carotene content also ranged from 360 to 460 µg per 100g with a maximum in variation 1 with 460 µg whereas variation 2 and 3 had 368 and 360 µg per cent respectively. Vitamin C content in health mixes ranged from 8.78 to 23.85 mg per 100g with a maximum content in variation 1 with 23.85mg per cent since it was an amla based mix. Vitamin E content was found to be maximum in variation 2 (0.44µg per cent) which had flax seed as a component. Other mixes like basic health mix and variations 1 and 3 had vitamin E ranging from 0.2 to 0.3 µg per cent.

### 3. Antinutritional factors in food mixes

The antinutritional factors of the developed functional food mixes is given in Table XLI

**TABLE - XLI**  
**ANTINUTRITIONAL FACTORS OF THE DEVELOPED**  
**FUNCTIONAL HEALTHMIXES**

(In 100g)

Anti Nutritional Factors	Basic Health Mix	Variation - 1	Variation-2	Variation - 3
Oxalate (mg)	146.08	407.02	122.68	82.41
Phytate (g)	0.51	0.53	0.51	0.46
Tannin (µg)	53	256	72	51
Alkaloids (g)	73.90	85.01	71.15	79.74

Among the four samples, variation-1 had the highest oxalate content of 407.02mg per 100g followed by Basic health mix which had 146.08mg per100g. Variation 3 and variation 2 had very low amounts of oxalate in them ranging from 82.41mg to 146.08mg in 100g respectively. Reports have shown that the lethal dose of oxalate is between 200 and 500mg/100g (Pearson, 1976). Noonan and Savage (1999) noted that the intake of 4 to 5 g of oxalate is the minimum dose that can result in death in an adult human. The amounts of oxalate reported in the present study are safe and within permissible levels.

With regard to phytate content except variation 3 with 0.46mg per cent all other mixes had a range of 0.51 to 0.53mg per cent. Large amounts of phytic acids have been reported to be present in fiber-rich foods. Such foods, however, are

pharmacologically recommended because they protect human from cardiovascular diseases and some forms of cancer (Norhaizan and Nor-Faizadatul, 2009). In spite of this advantage, phytic acid reduce bioavailability of minerals because it has strong binding affinity to them. This chelation process increases the incidence of mineral deficiency diseases because the minerals are made unavailable for absorption by the intestine (Ekholm *et al.*, 2003).

In the case of tannins, variation 1 contained a maximum of 256µg and variation 3 had a minimum of 51µg per 100g. The tannin content of all the other mixes ranged between 53 to 72 µg per 100g. Aletor and Adeogun (1995) reported that high level of tannins (76 to 90g per kg in Diabetes Mellitus) could be lethal if consumed. Sheep that consumed 0.9g hydrolysable tannins per kg of body weight showed signs of toxicity in 15 days (Kumar, 1991). In the case of alkaloids, variation 1 had 85.01 per cent being the highest whereas other variations had 71.15 to 79.74mg per 100g. In general, the anti nutritional factors in Health mixes were found to be within safe levels.

#### 4. Shelf life of the Health mixes

The results of the microbiological testing of the health mixes after storage for 3 months is presented in Table XLII.

**TABLE - XLII**  
**MICROBIOLOGICAL TESTING OF THE SELECTED HEALTH MIXES**

Criteria	Basic Health mix		Variation -1 (Amla)		Variation - 2 (Flax seed)		Variation -3 (Soya)	
	Initial	After 3 months	Initial	After 3 months	Initial	After 3 months	Initial	After 3 months
Total Bacterial count (cfu/g)	Abs	3×10 <sup>3</sup>	Abs	4×10 <sup>3</sup>	Abs	4×10 <sup>3</sup>	Abs	4×10 <sup>3</sup>
Yeast count	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Mould count	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL

**BDL – Below Detectable Limits      Abs-Absent**

The Prevention of Food Adulteration Act (PFA, 1954) recommends a total bacterial count not more than 40,000 per g and absence of yeast and mould count in

0.1g of the sample in cereal based food products. The total bacterial count of the health mixes was nil initially and ranged between  $3 \times 10^3$  and  $5 \times 10^3$  per g at the end of three months storage period which was within safe limits. The yeast and mould counts were found to be below detectable limits in all the four food mixes both initially and after a three months storage period. This indicates that the health mixes were free from spoilage and safe for consumption upto three months, after preparation. Though, shelf life of mixes was good upto three months, they were prepared once in a fortnight and supplied to the selected handloom weavers immediately. The storage period was a maximum of 15 days only.

### 5. Cost analysis of the Health mixes

Cost is an important criteria to be considered for any supplementation. The cost incurred in the preparation of health mixes (30 and 100g) is given in Table XLIII.

**TABLE - XLIII**  
**COST ANALYSIS OF THE HEALTH MIXES**

Category	Basic Health mix	Variation-1 (Amla)	Variation-2 (Flax seed)	Variation-3 (Soya)
Raw materials (Rs)	14.70	20.50	16.42	15.97
Processing charges (Rs)	0.50	0.50	0.50	0.50
Packaging charges (Rs)	0.30	0.30	0.30	0.30
Cost per 100g	15.50	21.30	17.22	16.77
Cost per 30g	4.65	6.39	5.17	5.03

The total cost in the preparation of the health mixes was Rs.15.50 per 100g for Basic health mix, being the minimum followed by Rs.21.30 per 100g for variation 1, Rs.17.22 per 100g for variation 2 and Rs.16.77 per 100g for variation 3. The cost of 100g of health mixes ranged from Rs.15.50 to Rs. 21.30. The total cost of basic health mix was Rs. 4.65 per 30g, Rs. 6.39 for variation 1, followed by Rs. 5.17 for variation 2 and Rs. 5.03 for variation 3. The cost of 30g of health mixes ranged from Rs. 4.65 to 6.39. It is evident that the health mixes are far more economical, affordable and can be easily prepared at home compared to commercial health mixes.

## D. Impact of Supplementation of the Functional Food Mixes on the Handloom Weavers

### 1. Anthropometric measurements of the weavers

Table XLIV depicts the details on the body weight of the selected handloom weavers before and after supplementation.

**TABLE - XLIV**  
**MEAN WEIGHT OF THE SELECTED HANDLOOM WEAVERS BEFORE AND AFTER SUPPLEMENTATION**

Groups	Weight (Kg)		Mean Difference (Kg)	't' Value
	Before (n=30)	After (n=30)		
1 ED	68.63 ± 10.63	67.80 ± 9.69	-0.83	0.312 <sup>NS</sup>
2 EDA	67.93 ± 11.32	66.90 ± 11.46	-1.03	0.346 <sup>NS</sup>
3 CD	68.40 ± 10.54	68.63 ± 10.39	0.23	0.084 <sup>NS</sup>
4 EH	68.07 ± 10.56	64.27 ± 8.34	-3.80	1.521 <sup>NS</sup>
5 EHF	67.93 ± 11.32	65.37 ± 8.88	-2.57	0.961 <sup>NS</sup>
6 CH	68.40 ± 10.54	69.33 ± 10.34	0.93	0.34 <sup>NS</sup>
7 EM	70.93 ± 10.34	69.47 ± 7.16	-1.47	0.628 <sup>NS</sup>
8 EMS	69.23 ± 8.93	66.57 ± 8.64	-2.67	1.156 <sup>NS</sup>
9 CM	71.90 ± 11.25	73.50 ± 10.03	1.60	0.571 <sup>NS</sup>

Groups 1,2,3 Handloom weavers with Diabetes mellitus

Groups 4,5,6 Handloom weavers with Hypertension

Groups 7,8,9 Handloom weavers with Musculoskeletal disorder

NS Not significant

The mean body weight of the adults belonging to all the 9 groups ranged from 67.93 to 71.90 kg and were seen to be more than the ideal body weight of 60 kg suggested by ICMR (2010) for reference man.

Adults with diabetes mellitus belonging to all the experimental groups ED and EDA showed a reduction in their body weight by 0.83 and 1.03 kg with slight increase in control group. More weight loss of 1.03kg was found among amla based functional food supplemented group (EDA).

Among experimental groups with hypertension EH and EHF, a weight loss of 3.8 and 2.57 kg was observed with a greater loss in Basic health mix group (EH). Control group (CH) showed slight increase in weight by 0.93kg. Weight reduction was also observed among adults with musculoskeletal disorder who were supplemented with Basic health mix (1.47kg) (EM) and those supplemented with soya based health mix (2.67kg) (EMS) being the maximum. An increase in weight (1.6kg) was observed among control group (CM) adults with musculoskeletal problem.

The reduction in weight among all the experimental groups was found to be statistically not significant, similarly the increase in weight among control groups was also found to be not significant.

The details on the BMI found among the selected handloom weavers before and after supplementation are presented in Table XLV.

**TABLE - XLV**

**MEAN BODY MASS INDEX OF THE SELECTED HANDLOOM WEAVERS BEFORE AND AFTER SUPPLEMENTATION**

Groups	BMI		Mean Difference	't' Value
	Before (n=30)	After (n=30)		
1 ED	25.44 ± 4.63	25.15 ± 4.42	-0.29	0.243 <sup>NS</sup>
2 EDA	25.38 ± 4.89	25.02 ± 5.06	-0.36	0.275 <sup>NS</sup>
3 CD	25.67 ± 4.37	25.76 ± 4.26	0.08	0.074 <sup>NS</sup>
4 EH	25.36 ± 4.63	23.62 ± 4.40	-1.74	1.467 <sup>NS</sup>
5 EHF	25.38 ± 4.89	24.43 ± 4.05	-0.96	0.812 <sup>NS</sup>
6 CH	25.67 ± 4.37	26.02 ± 4.28	0.35	0.303 <sup>NS</sup>
7 EM	25.63 ± 3.42	25.12 ± 2.38	-0.51	0.655 <sup>NS</sup>
8 EMS	25.33 ± 3.13	24.33 ± 3.13	-0.97	1.185 <sup>NS</sup>
9 CM	26.26 ± 3.71	26.66 ± 3.31	0.60	0.645 <sup>NS</sup>

Groups 1,2,3 Handloom weavers with Diabetes mellitus

Groups 4,5,6 Handloom weavers with Hypertension

Groups 7,8,9 Handloom weavers with Musculoskeletal disorder

NS Not significant

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At the beginning of the study, the BMI of the adults belonging to all the six experimental groups and three control groups were almost similar, ranging between 25.33 and 26.26. After supplementation, the adults belonging to ED and EDA group fed with basic health mix (ED) and amla based health mix (EDA) recorded slight reduction in BMI by 0.29 and 0.36 respectively. In the case of control group (CD) slightly increased BMI by 0.08 was observed.

Other experimental groups EH, EHF, supplemented with basic health mix and flax seed based health mix showed a reduction in their BMI by 1.74 and 0.96, respectively. Control group (CH) showed a slight increase in BMI by 0.35.

With regard to groups with adults having musculoskeletal disorders fed with basic health mix (EM) and soya based health mix (EMS) showed a reduction in BMI by 0.51 and 0.97, latter being the maximum. Control group (CM) showed a slight increase in BMI corresponding to the increase in their body weights. All the groups including experimental and control showed either an increase or decrease in BMI which were found to be statistically not significant.

## **2. Biochemical parameters of the weavers**

Table XLVI and Figures 11,12 and 13 show the changes in the blood Haemoglobin content among the selected handloom weavers before and after supplementation with formulated health mixes.

Haemoglobin levels of group EDA supplemented with amla based mix showed an increase by 4.25g per dl closely followed by ED group fed with basic health mix by 3.61g/dl and reduction in the control group by 0.25g/dl. It is evident that supplementation of basic health mix and variation 1 over a period of 4 months was effective in substantially increasing the haemoglobin level among the adults suffering from Diabetes Mellitus and statistically significant at one per cent level. Not much difference was found between ED and EDA groups. Control group showed a statistically significant reduction in Haemoglobin levels.

TABLE - XLVI

MEAN HAEMOGLOBIN CONTENT OF THE SELECTED HANDLOOM WEAVERS BEFORE AND AFTER SUPPLEMENTATION

Groups	Hemoglobin (g/dl)		Mean Difference (g/dl)	't' Value	Group compared	't' value
	Before (n=30)	After (n=30)				
1 ED	9.20 ± 1.62	12.81 ± 2.03	3.61	7.697**	ED Vs EDA	1.399 <sup>NS</sup>
2 EDA	9.22 ± 1.74	13.47 ± 1.53	4.25	9.906**	ED Vs CD	9.75**
3 CD	8.98 ± 0.56	8.73 ± 0.97	-0.25	1.095NS	EDAVs CD	14.10**
4 EH	8.99 ± 0.86	13.20 ± 1.52	4.21	12.986**	EH Vs EHF	13.65**
5 EHF	9.88 ± 1.69	13.47 ± 1.59	3.58	8.300**	EH Vs CH	2.19*
6 CH	9.26 ± 1.41	8.70 ± 1.00	-0.57	1.76*	EHF Vs CH	8.749**
7 EM	8.67 ± 1.44	12.41 ± 2.05	3.74	8.028**	EM Vs EMS	3.179*
8 EMS	9.16 ± 1.50	13.87 ± 1.38	4.71	12.45**	EM Vs CM	9.564**
9 CM	9.16 ± 1.50	8.44 ± 0.88	-0.72	2.239*	EMS Vs CM	17.860**

\* - Significant at 5% level (p<0.05)

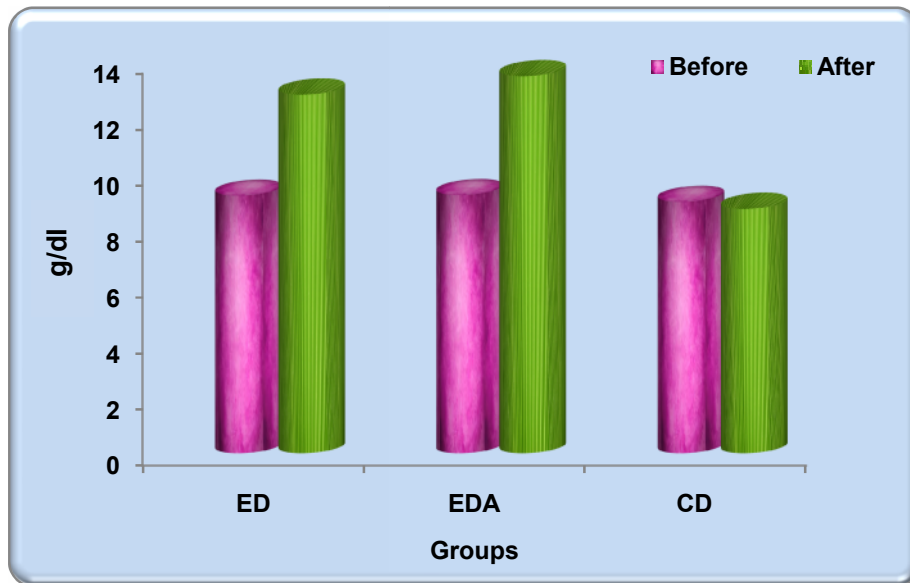
NS – Not Significant

\*\* - Significant at 1% level (p<0.01)

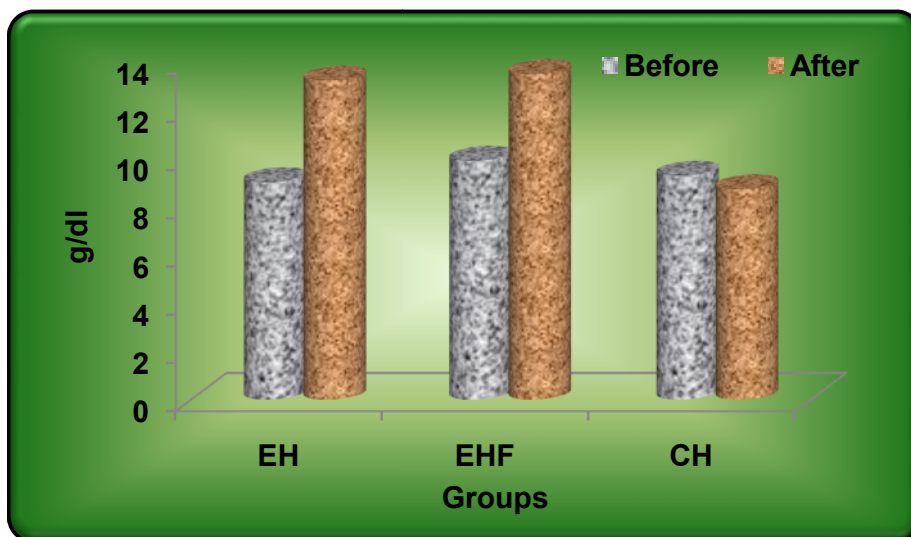
Groups 1,2,3 Handloom weavers with Diabetes mellitus

Groups 4,5,6 Handloom weavers with Hypertension

Groups 7,8,9 Handloom weavers with Musculoskeletal disorder



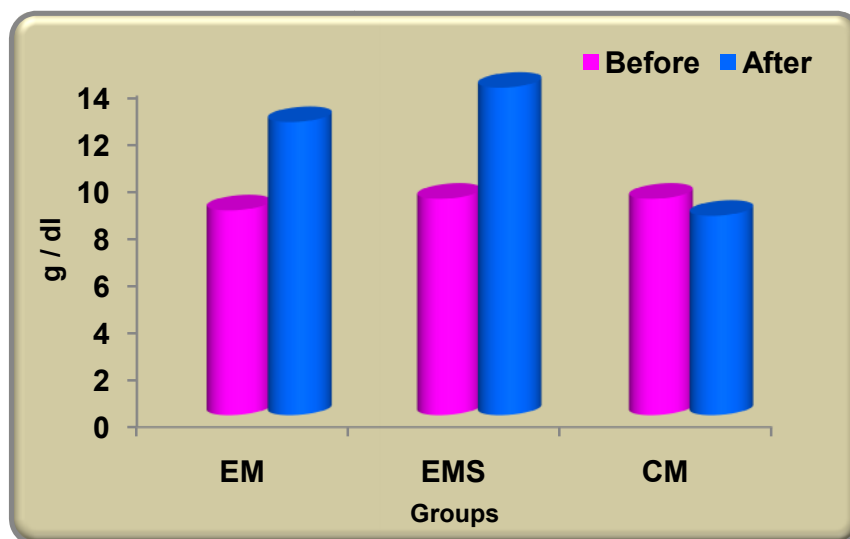
**FIGURE 11 - CHANGES IN HAEMOGLOBIN LEVELS OF THE HANDLOOM WEAVERS WITH DIABETES MELLITUS**



**FIGURE 12 - CHANGES IN HAEMOGLOBIN LEVELS OF THE HANDLOOM WEAVERS WITH HYPERTENSION**

The mean haemoglobin level of experimental group EH fed with basic health mix before supplementation was 8.99g/dl and it had increased to 13.20g/dl after supplementation and statistically highly significant at one per cent level. Experimental group EHF which was fed with flax seed mix which had initial haemoglobin values of 9.88g/dl and increased after supplementation to 13.47g/dl

which was found to be highly significant at one per cent level. The mean value of control group CH was 9.26g/dl initially and it decreased to 8.70g/dl after the study period which was statistically significant at five per cent level.



**FIGURE 13 - CHANGES IN HAEMOGLOBIN LEVELS OF THE HANDLOOM WEAVERS WITH MUSCULOSKELETAL DISORDER**

The mean haemoglobin levels of the adults with musculoskeletal disorder of all the groups were found to be less than the levels suggested by WHO (1992). Supplementation of the functional food health mixes increased the haemoglobin level among the two experimental groups with 4.71 g/dl among soya based health mix group (EMS) followed by 3.74g/dl among basic health mix (EM) group. The differences were found to be significant at one per cent level. Control group showed a significant reduction in the haemoglobin level by 0.72g per dl which was significant at 5 per cent level.

The findings revealed that supplementation of health mixes have increased the haemoglobin levels ranging from 3.61g to 4.71g per dl among all the experimental groups highlighting the nutritional importance of health mixes.

## **ii. Fasting and Post Prandial Blood glucose levels**

Table XLVII and Figures 14 and 15 present the details of the Fasting and Post prandial Blood glucose levels among the selected diabetic handloom weavers before and after supplementation.

TABLE - XLVII

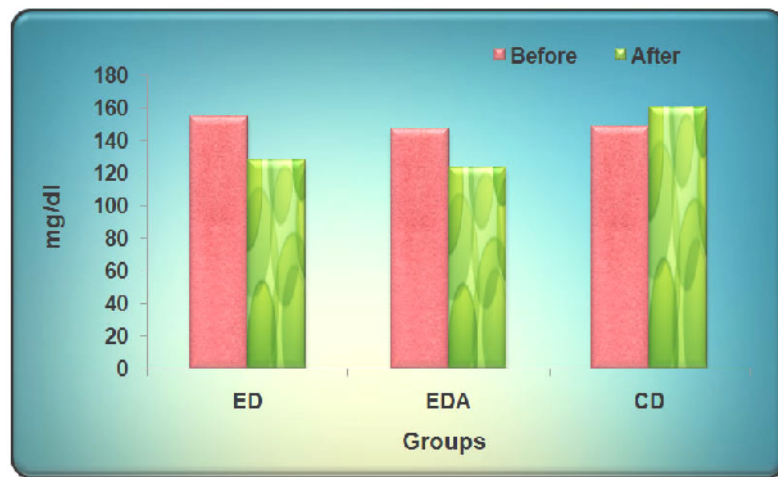
MEAN FASTING AND POST PRANDIAL BLOOD GLUCOSE LEVELS OF THE SELECTED DIABETIC HANDLOOM WEAVERS BEFORE AND AFTER SUPPLEMENTATION

Details	Groups	Before (n=30)	After (n=30)	Mean Difference	't' Value	Groups compared	't' value
Fasting Blood Glucose (mg/dl)	ED	154.43 ± 8.50	127.80 ± 12.56	-26.63	9.457**	ED Vs EDA	1.455 <sup>NS</sup>
	EDA	147.10 ± 4.64	123.50 ± 9.77	-23.60	11.750**	ED Vs CD	11.190**
	CD	148.33 ± 6.28	160.13 ± 9.21	11.80	5.700**	EDA Vs CD	14.694**
Post Prandial Blood Glucose (mg/dl)	ED	219.57 ± 11.73	184.70 ± 6.31	-34.87	14.09**	ED Vs EDA	3.169*
	EDA	214.23 ± 8.65	189.33 ± 4.71	-24.90	13.92**	ED Vs CD	18.835**
	CD	217.10 ± 9.19	220.73 ± 8.14	3.63	1.593NS	EDA Vs CD	17.974**

\* - Significant at 5% level (p<0.05)

NS – Not Significant

\*\* - Significant at 1% level (p<0.01)

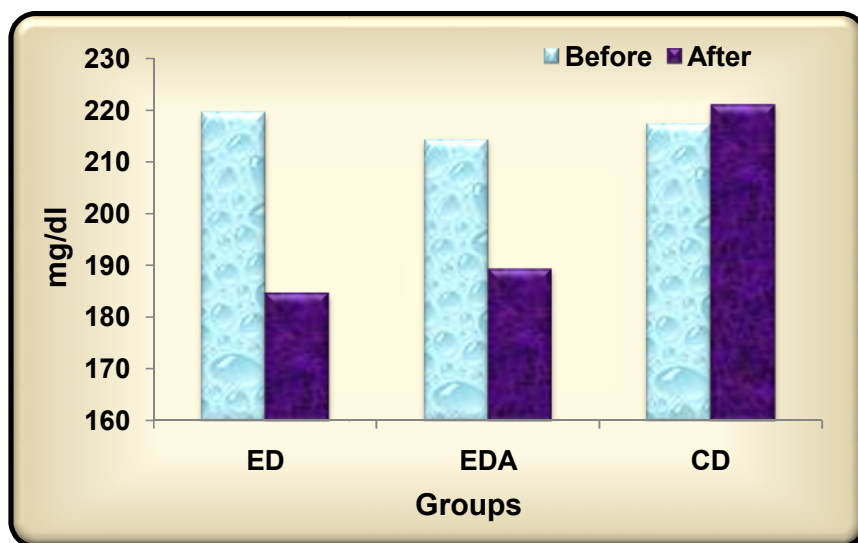


**FIGURE 14 - CHANGES IN THE FASTING BLOOD GLUCOSE LEVELS OF THE DIABETIC HANDLOOM WEAVERS**

The fasting blood glucose levels among groups ranged from 147.10 to 154.43 mg per dl before supplementation. Supplementation of basic health mix (ED) and variation 1 amla based mix (EDA) among the diabetic handloom weavers resulted in a reduction in fasting blood glucose levels by 26.63 and 23.60 mg per dl respectively. A more beneficial outcome was observed among the adults supplemented with basic health mix with a maximum reduction of fasting blood glucose by 26.63mg per dl.

Statistical analysis revealed that the reduction in the fasting blood glucose levels of experimental groups were significant at one per cent level highlighting the hypoglycemic potentials of the functional food mixes. Control group showed an increase in fasting blood glucose level by 11.8mg per dl which was statistically significant. A comparison of fasting blood glucose levels among experimental groups revealed statistically no significant difference but comparison of experimental and control groups showed a statistically significant change at one per cent level.

In a study by Chen *et al.*, (2011) the uremic diabetic patients received a daily supplement of 3 tablets each containing 100 mg emblica officinalis extract, 100 mg green tea extract and 50 mg experiment starch for 3 months. The healthy subjects did not receive any supplement serving as controls for normal ranges. Supplementation with a combination of emblica officinalis and green tea extract resulted in a significant reduction in FBS levels compared with the baseline levels prior to treatment.



**FIGURE 15 - CHANGES IN THE POST PRANDIAL BLOOD GLUCOSE LEVELS OF THE DIABETIC HANDLOOM WEAVERS**

The mean post prandial blood glucose levels of experimental group ED supplemented with basic health mix before supplementation was 219.57mg/dl and it had decreased to 184.70mg/dl after supplementation and it was statistically significant at  $p < 0.01$  level. The mean post prandial blood glucose level of experimental group EDA before supplementation was 214.23mg/dl and it had decreased to 189.33mg/dl which was statistically significant at  $p < 0.01$  level. Control group CD showed an increase by 3.63mg/dl which was statistically not significant.

It is evident that both experimental groups showed an equally effective reduction in the post prandial blood glucose levels among the weavers. It is an interesting observation that there was a remarkable reduction in post prandial blood glucose levels of the weavers in the group ED fed with Basic health mix which was significant at one per cent level. Emblica Officinalis (EO) enjoys a hallowed position in Ayurveda - an Indian indigenous system of medicine (Khan, 2009). EO primarily contain tannins, alkaloids, phenolic compounds, amino acids and carbohydrates. It is rich in chromium, which makes it very much beneficial for diabetes (Sampath *et al.*, 2012).

### iii. Serum Calcium and Phosphorus levels

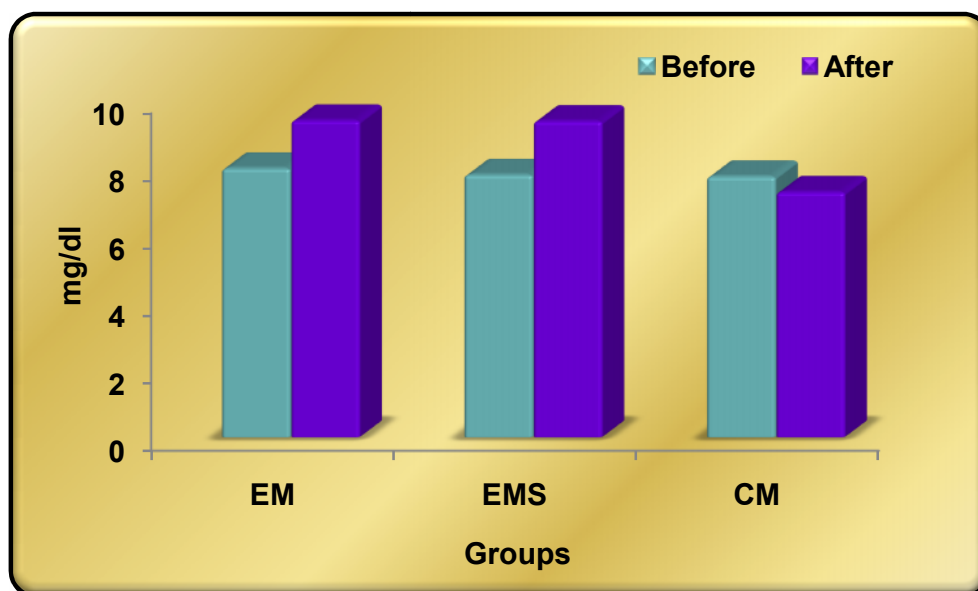
The details on the Serum calcium and serum phosphorus levels among the selected handloom weavers with musculoskeletal disorder before and after supplementation are presented in Table XLVIII and Figures 16 and 17.

TABLE - XLVIII

MEAN SERUM CALCIUM AND PHOSPHORUS LEVELS OF THE SELECTED HANDLOOM WEAVERS WITH MUSCULOSKELETAL DISORDER BEFORE AND AFTER SUPPLEMENTATION

Details	Groups	Before (n=30)	After (n=30)	Mean Difference	't' Value	Groups compared	't' value
Serum Calcium (mg/dl)	EM	7.97 ± 0.46	9.39 ± 0.42	1.42	12.472**	EM Vs EMS	0.148 <sup>NS</sup>
	EMS	7.78 ± 0.43	9.37 ± 0.26	1.60	17.1**	EM Vs CM	21.49**
	CM	7.73 ± 0.38	7.27 ± 0.34	-0.47	4.931**	EMS Vs CM	26.68**
Serum Phosphorus (mg/dl)	EM	1.82 ± 0.52	3.67 ± 0.9	1.85	17.13**	EM Vs EMS	1.563 <sup>NS</sup>
	EMS	1.54 ± 0.23	3.49 ± 0.38	1.95	23.65**	EM Vs CM	24.04**
	CM	1.56 ± 0.19	1.32 ± 0.19	-0.23	4.618**	EMS Vs CM	27.34**

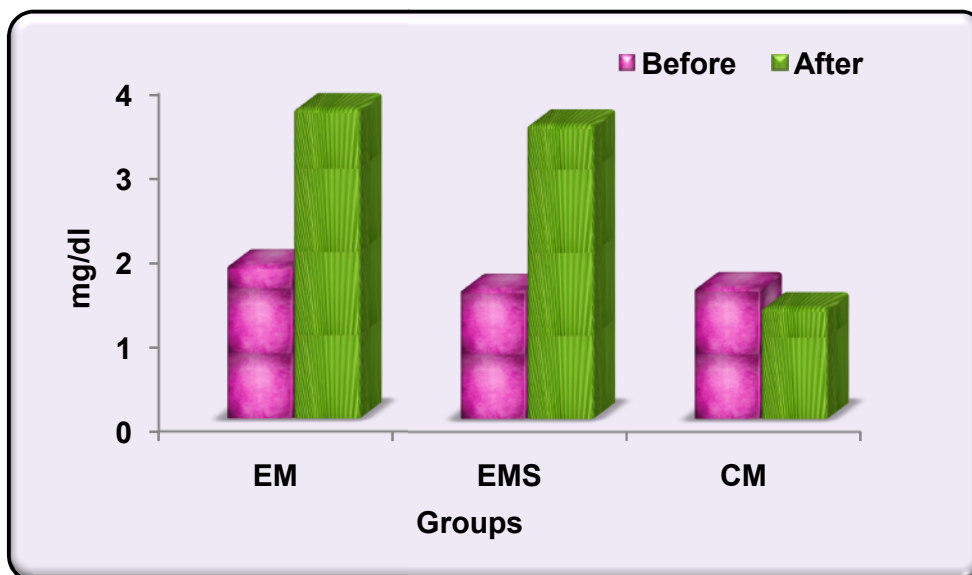
\*\* - Significant at 1% level (p<0.01)      NS – Not Significant



**FIGURE 16 - CHANGES IN THE SERUM CALCIUM LEVELS OF THE HANDLOOM WEAVERS WITH MUSCULOSKELETAL DISORDER**

At the end of four months supplementation, the group supplemented with the basic health mix (EM) evidenced a maximum increase in the serum calcium levels by 1.42mg per dl. This could be due to the high amount of calcium present in the basic health mix because of cauliflower leaves and carrots. This was followed by the soya incorporated food mix supplemented groups (EMS) with an increase of serum calcium by 1.60mg per dl. There was a slight reduction in serum calcium among the control group (CM) adult weavers.

Comparison between experimental groups showed no statistically significant difference in the serum calcium levels. A comparison of experimental groups with control group revealed a statistically significant difference at one per cent level. Several animal studies have provided convincing data on the significant improvement of bone mass or other end points after soy protein or isolated isoflavone-enriched soy extract supplementation (Picherit *et al.*, 2001).



**FIGURE 17 CHANGES IN THE SERUM PHOSPHORUS LEVELS OF THE HANDLOOM WEAVERS WITH MUSCULOSKELETAL DISORDER**

The mean initial serum phosphorus levels among the adults in the present study ranged from 1.54 to 1.82mg per dl. After supplementation there was an increase in serum phosphorus levels among the experimental groups by 1.85 and 1.95 mg per dl among EM group fed with basic mix and EMS group fed with soya based health mix respectively. All the differences were found to be statistically significant at one per cent level. However, control group (CM) showed a reduction of serum phosphorus by 0.23mg per dl. This revealed the effectiveness of functional food mix supplementation in increasing serum phosphorus levels.

It is further seen that experimental group EMS supplemented with soya incorporated health mix evidenced a greater increment in serum phosphorus levels than the other experimental group EM which was given basic mix and this was statistically not significant.

Comparison between experimental groups and control group showed a statistically significant increase in serum phosphorus levels at one per cent level.

Soy isoflavones appear to have beneficial effects on bone density. The effects of soy isoflavones, genistein and daidzein are unique to soy beans and

have numerous biologic functions, which is important in reducing the risks of osteoporosis (Dawson *et al.*, 1990).

#### iv. Serum Vitamin D levels

Table XLIX and Figure 18 present the changes in the serum vitamin D levels among the selected handloom weavers with musculoskeletal disorder before and after supplementation.

**TABLE – XLIX**

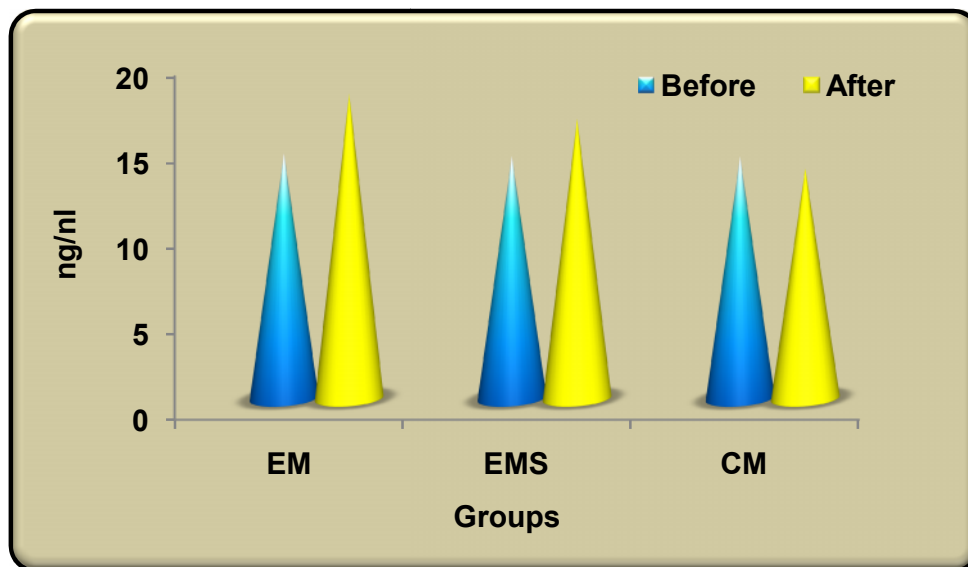
**MEAN SERUM VITAMIN D LEVELS OF THE SELECTED HANDLOOM WEAVERS WITH MUSCULOSKELETAL DISORDER BEFORE AND AFTER SUPPLEMENTATION**

Groups	Before ( $\mu\text{g}$ ) (n=30)	After ( $\mu\text{g}$ ) (n=30)	Mean ( $\mu\text{g}$ ) Difference	't' Value	Groups compared	't' value
EM	14.30 $\pm$ 0.30	17.76 $\pm$ 0.60	3.46	10.328**	EM Vs EMS	2.208*
EMS	14.13 $\pm$ 0.51	16.29 $\pm$ 1.18	2.17	3.369**	EM Vs CM	12.29**
CM	14.12 $\pm$ 0.41	13.40 $\pm$ 0.38	-0.72	2.604*	EMS Vs CM	4.66**

\* - Significant at 5% level ( $p < 0.05$ )

NS – Not Significant

\*\* - Significant at 1% level ( $p < 0.01$ )



**FIGURE 18 CHANGES IN THE VITAMIN D LEVELS OF THE HANDLOOM WEAVERS WITH MUSCULOSKELETAL DISORDER**

The initial vitamin D levels of the adults belonging to various groups ranged between 14.12 and 14.30ng per nl. Four months functional food mix supplementation resulted in a maximum increase in vitamin D levels by 3.46ng per nl in EM group supplemented with basic mix compared to EMS group fed with soya based health mix with an increase of 2.17ng per nl.

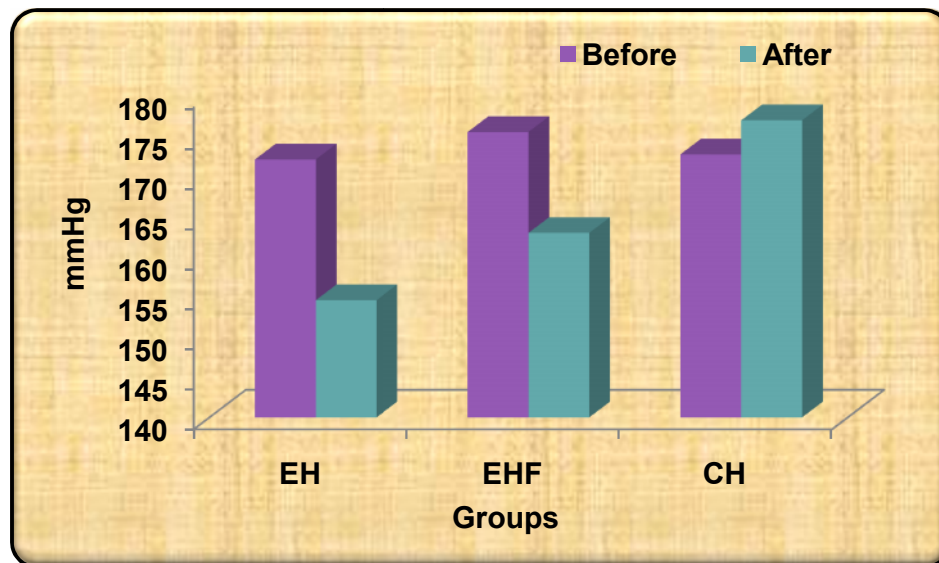
Comparison between experimental groups revealed a statistically significant difference at five per cent level. Control group showed a reduction in vitamin D levels after four months which was statistically significant at 5 per cent level.

In general, soya based health mix revealed a good increase in serum calcium and phosphorus levels, whereas with regard to serum vitamin D levels only Basic Health mix showed good improvement.

### 3. Biophysical parameters among the men weavers

#### i. Blood pressure levels of the weavers

The details on the Systolic and Diastolic blood pressure values among the selected handloom weavers with hypertension before and after supplementation are presented in Table L and Figure 19 and 20.



**FIGURE 19 - CHANGES IN THE SYSTOLIC BLOOD PRESSURE VALUES OF THE HANDLOOM WEAVERS WITH HYPERTENSION**

**TABLE – L**

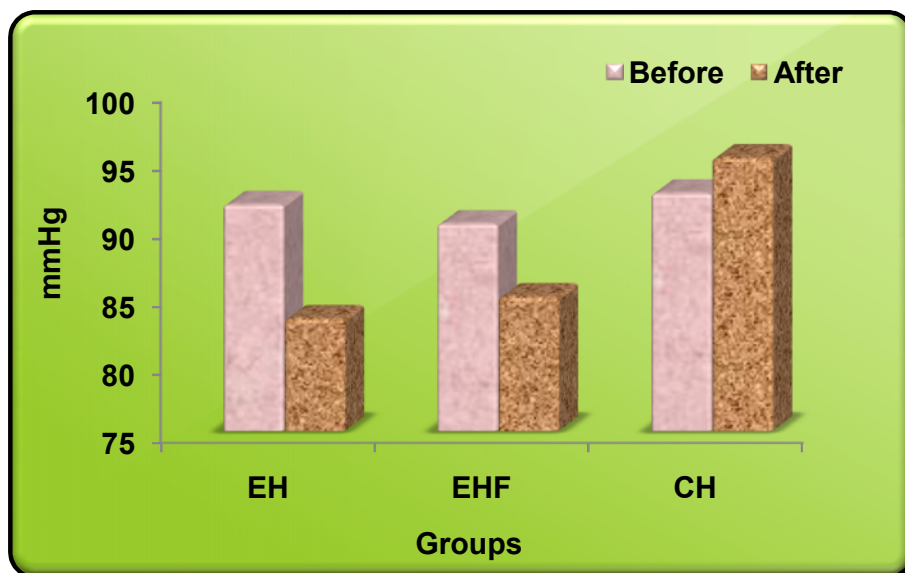
**MEAN SYSTOLIC AND DIASTOLIC BLOOD PRESSURE VALUES OF THE SELECTED HANDLOOM WEAVERS WITH HYPERTENSION BEFORE AND AFTER SUPPLEMENTATION**

Biophysical parameters	Groups	Before (n=30)	After (n=30)	Mean Difference	't' Value	Groups compared	't' value
<b>Systolic Blood Pressure (mmHg)</b>	EH	172.07 ± 12.21	154.57 ± 10.72	-17.50	5.801**	EH Vs EHF	2.841*
	EHF	175.47 ± 8.95	162.93 ± 11.69	-12.53	4.585**	EH Vs CH	9.394**
	CH	172.70 ± 14.20	176.93 ± 7.04	4.23	1.438NS	EHF Vs CH	5.526**
<b>Diastolic Blood Pressure (mmHg)</b>	EH	91.60 ± 4.91	83.23 ± 5.35	-8.37	6.206**	EH Vs EHF	1.161 <sup>NS</sup>
	EHF	90.20 ± 5.47	84.83 ± 5.14	-5.37	3.851**	EH Vs CH	7.780**
	CH	92.43 ± 5.81	95.03 ± 6.17	2.60	1.652NS	EHF Vs CH	6.838**

\* - Significant at 5% level (p<0.05)

NS – Not Significant

\*\* - Significant at 1% level (p<0.01)



**FIGURE 20 - CHANGES IN THE DIASTOLIC BLOOD PRESSURE VALUES OF THE HANDLOOM WEAVERS WITH HYPERTENSION**

All the adults participating in the present study were already diagnosed for hypertension and systolic blood pressure ranged between 172.07 and 175.47 mm Hg, coming under stage I hypertension according to the JNC (2004) criteria.

The experimental group EH fed with basic health mix and EHF fed with flax seed based mix showed a significant reduction in systolic blood pressure by 17.50 and 12.53 mm Hg respectively. Experimental group adults fed with Basic Health mix showed greater reduction in systolic pressure by 17.5mmHg compared to the one fed with flax seed based health mix with reduction in systolic pressure by 12.53 mmHg.

Comparison between experimental groups showed a statistically significant difference at 5 per cent level whereas comparison with control group showed a highly significant difference at one per cent level. The adults belonging to control group CH showed a slight increase in the systolic pressure by 4.23mmHg which was statistically not significant.

Dietary interventions have been suggested as a preferential complimentary strategy to current pharmacological strategies to control blood pressure (Bazzano *et al.*, 2013). In humans, patients with peripheral arterial disease

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(75 % hypertensive) were administered 30g of milled flaxseed per day for six months. Flax seed consumption resulted in a great reduction in systolic (-10 mmHg) and diastolic blood pressure (-7mmHg) that was statistically different from the control group. Blood pressure was inversely associated with plasma concentrations of two flax seed bio actives, alpha linolenic acid (ALA), and enterolignans (Rodriguez *et al.*, 2013).

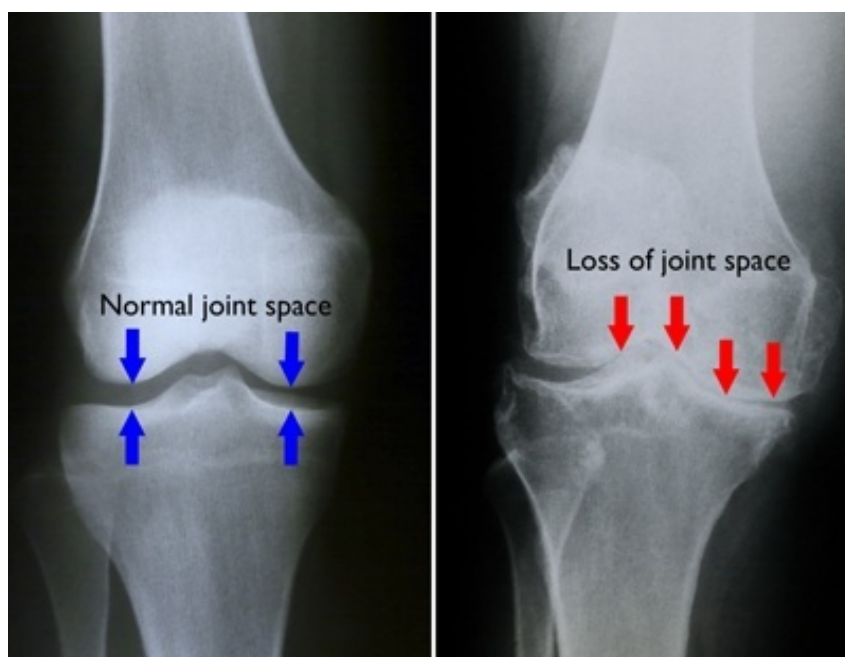
The mean diastolic blood pressure of the adults were 90.20, 91.60 and 92.43 mm Hg among the three groups namely EH, EHF and CH respectively. It is evident that the mean diastolic blood pressure of all the groups were more than normal values of 80 mm Hg as suggested by JNC (2004).

Four months supplementation had brought about a marginal reduction in the diastolic blood pressure among the two experimental groups. The reduction in the diastolic blood pressure among EH group fed with basic mix was 8.37 mm Hg which was statistically significant at one per cent level and EHF group supplemented with flax seed mix was 5.37 mm Hg which was statistically significant at one per cent level. Basic health mix fed group showed more reduction in diastolic pressure than flax seed mix fed group.

A comparison between the experimental groups revealed no statistically significant difference. On the other hand a comparison between experimental groups and control group revealed a statistically significant difference at one per cent level.

## **ii. X-ray**

Among the 90 members of the musculoskeletal group 20 adults were selected based on low serum calcium levels for the assessment of X-ray of knee joint. Among the 20 adults 18 weavers had decreased joint space. Two adults were found to be in normal condition. Over a period of four months supplementation 11 adults had no change in X-ray but expressed reduced pain in the knee joints. Figure 19 indicate the X-ray of normal knee joint and the X ray of an arthritic joint.



**Figure 21 (Left) X-ray of a normal knee, the space between the bones indicates healthy cartilage (arrows). (Right) X-ray of an arthritic knee showing severe loss of joint space**

#### **4. Clinical Examination of the weavers**

Table LI depicts the changes in the Clinical examination among the selected handloom weavers before and after supplementation.

Among the handloom weavers the prevalence of clinical symptoms such as joint pain, muscle pain, general fatigue and improper digestion showed a reduction by 10, 4, 4 and 4 per cent respectively due to supplementation of functional food mixes.

Other clinical symptoms like bleeding gums, sleep disturbance, mental tension, cough and cold showed a reduction by 3 per cent among handloom weavers. Many of the clinical symptoms showed a negligible reduction by 1-3 per cent. In general not much improvement was seen among the handloom weavers with regard to clinical symptoms even after supplementation of health mixes for four months. There was no change in clinical symptoms like allergy, dental caries, decay, dimness of vision, short sight, long sight, breathing problems and asthma after the four months period.

**TABLE – LI**

**CHANGES IN THE CLINICAL EXAMINATION AMONG THE SELECTED  
WEAVERS BEFORE AND AFTER SUPPLEMENTATION**

**(N=270)**

Organs	Signs and Symptoms	Before		After		Difference	
		(N=270)		(N=270)			
		No	%	No	%	No	%
Hair	Brittle	27	10	25	9	2	1
	Thin	75	28	73	27	2	1
Skin	Dryness	33	12	29	11	4	2
	Wrinkling	73	27	71	26	2	1
	Allergy	8	3	8	3	0	0
Face	Pale	65	24	60	22	5	2
	Dryness	43	16	41	15	2	1
Nails	Poor nail growth	75	28	69	25	6	2
	Brittle nails	56	21	55	20	1	0.3
	White spots on finger nails	53	20	52	19	1	0.3
	Transverse lines	31	12	28	10	3	1
Teeth & Gums	Bleeding gums	79	29	71	26	8	3
	Dental caries	192	71	192	71	0	0
	Decay	44	16	44	16	0	0
Eyes	Dimness of Vision	73	27	73	27	0	0
	Short sight	174	64	174	64	0	0
	Long sight	98	36	98	36	0	0
Nervous system	Behavior disturbance	81	30	78	29	3	1
	Sleep disturbance	184	68	176	65	8	3
	Mental tension	154	57	145	54	9	3
Respiratory system	Breathing problems	2	1	2	1	0	0
	Asthma	5	2	5	2	0	0
	Cough & cold	93	34	84	31	9	3
Digestive system	Ulcer	13	5	8	3	5	2
	Improper digestion	176	65	164	61	12	4
Extremities	Edema	6	2	5	2	1	0.3
	Joint pain	95	35	67	25	28	10
	Muscle pain	109	40	98	36	11	4
	General Fatigue	143	53	132	49	11	4

## 5. Work output of the weavers

The changes in the work output in terms of cloth woven among the selected handloom weavers with diabetes mellitus before and after supplementation are presented in Table LII and Figure 22.

**TABLE – LII**

**MEAN LENGTH OF CLOTH WOVEN BY THE HANDLOOM WEAVERS  
WITH DIABETES MELLITUS BEFORE AND AFTER  
SUPPLEMENTATION**

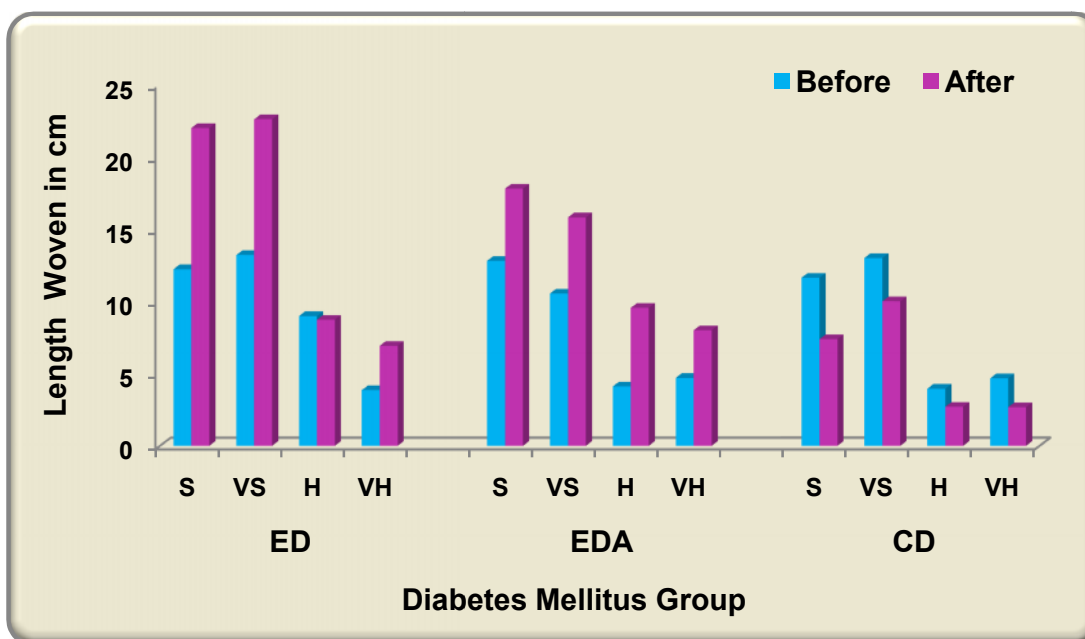
(In cms)

Groups / Designs	Before (n=30)	After (n=30)	Mean Difference	't' Value
<b>ED</b>				
Simple	12.22± 2.91	22.00± 1.58	9.78	8.360**
Very Simple	13.20± 2.95	22.60± 2.30	4.25	5.025**
Heavy	8.98 ± 0.56	8.73 ± 0.97	-0.25	8.741**
Very Heavy	3.85 ± 1.46	6.92 ± 1.69	3.07	3.36**
<b>EDA</b>				
Simple	12.8±3.83	17.8±2.68	5.00	2.136*
Very Simple	10.54±2.01	15.81±1.94	5.27	5.956*
Heavy	4.11±1.05	9.55±2.05	5.44	6.633*
Very Heavy	4.7±1.09	8±1.22	3.3	4.016**
<b>CD</b>				
Simple	11.63 ± 4.31	7.38± 2.72	-4.25	2.207*
Very Simple	13.00 ± 2.53	10.00 ± 1.55	-3.00	2.260*
Heavy	3.95 ± 1.17	2.70 ± 0.67	-1.25	2.784*
Very Heavy	4.67 ± 1.03	2.67 ± 0.52	-2.00	3.873**

\* - Significant at 5% level (p<0.05)

NS – Not Significant

\*\* - Significant at 1% level (p<0.01)



S – Simple VS – Very simple H – Heavy VH – Very Heavy

**FIGURE 22 - CHANGES IN THE LENGTH OF CLOTH WOVEN BY THE HANDLOOM WEAVERS WITH DIABETES MELLITUS**

After a period of four months supplementation of basic mix the increase in length of cloth woven by the experimental group ED was 9.78, 4.25 and 3.07cm among simple, very simple and very heavy designs respectively. The differences were found to be statistically significant at one per cent level revealing the effectiveness of functional food mix in increasing the physical activity among weavers. In the case of heavy design the length woven decreased and the difference was statistically significant at one per cent level.

The group supplemented with Amla based health mix showed an increase in the length of cloth woven by 5.00, 5.27, 5.44 and 3.3 cm based on the designs as simple, very simple, heavy and very heavy respectively. The differences were found to be statistically significant at five per cent level except for very heavy design which was statistically significant at one per cent level.

In the case of control group a slight reduction in the length of cloth woven by 4.25, 3.00, 1.25 and 2.00cm based on simple, very simple, heavy and very heavy designs respectively was observed. The differences were found to be statistically

significant at five per cent level except for very heavy design which showed the difference to be statistically significant at one per cent level.

Table LIII and Figure 23 depict the changes in the length of cloth woven by the selected handloom weavers with Hypertension before and after supplementation.

**TABLE – LIII**  
**MEAN LENGTH OF CLOTH WOVEN BY THE HANDLOOM WEAVERS**  
**WITH HYPERTENSION BEFORE AND AFTER**  
**SUPPLEMENTATION**

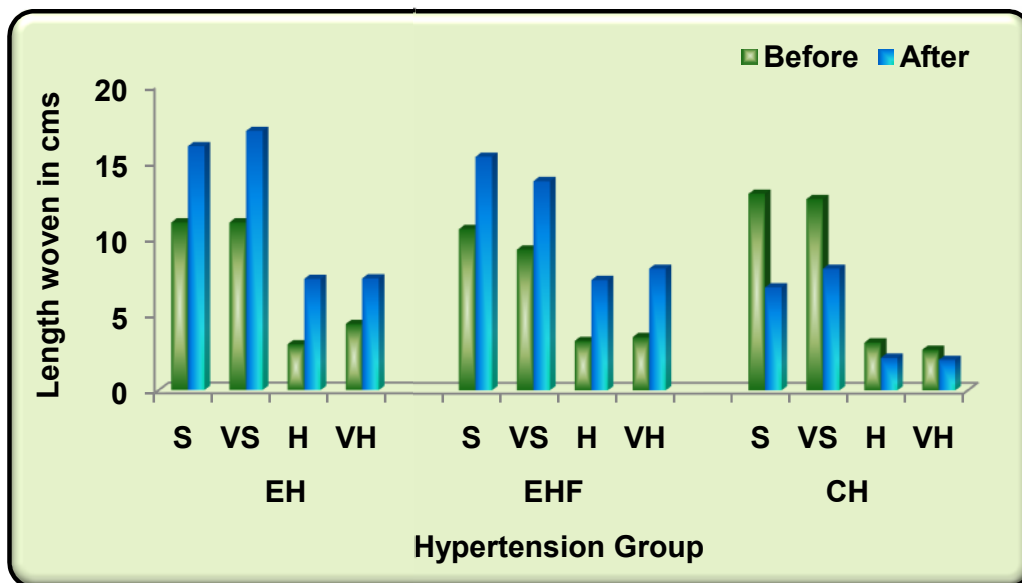
(In cms)

Groups / Designs	Before (n=30)	After (n=30)	Mean Difference	't' Value
<b>EH</b>				
Simple	11.00 ± 2.24	16.06± 1.89	5.06	6.916**
Very Simple	11.00 ± 1.00	17.00 ± 1.73	6.0	4.243*
Heavy	3.0 ± 0.58	7.29 ± 0.95	4.29	9.434**
Very Heavy	4.33 ± 0.57	7.33 ± 1.52	3.0	2.598*
<b>EHF</b>				
Simple	10.60 ± 15.35	15.35± 1.60	4.75	8.630**
Very Simple	9.25 ± 1.50	13.75 ± 1.71	4.5	3.429*
Heavy	3.25 ± 0.96	7.25 ± 1.50	4.0	3.893*
Very Heavy	3.50 ± 0.71	8.00 ± 1.41	4.5	2.846*
<b>CH</b>				
Simple	12.92 ± 1.61	6.77± 2.28	-6.15	7.648**
Very Simple	12.57 ± 1.81	8.00 ± 2.58	-4.57	3.549*
Heavy	3.14 ± 0.69	2.14 ± 0.38	-1.00	3.113*
Very Heavy	2.67 ± 0.58	2.00 ± 0.00	-0.67	1.633 <sup>NS</sup>

\* - Significant at 5% level (p<0.05)

NS – Not Significant

\*\* - Significant at 1% level (p<0.01)



S – Simple VS – Very simple H – Heavy VH – Very Heavy

**FIGURE 23 - CHANGES IN THE LENGTH OF CLOTH WOVEN BY THE HANDLOOM WEAVERS WITH HYPERTENSION**

At the end of four months supplementation, the group supplemented with the basic health mix (EH) evidenced increased length of cloth woven by 5.06, 6.0, 4.29 and 3.0cm among the simple, very simple, heavy and very heavy designs respectively, which were found to be statistically significant at one per cent level for simple and heavy designs and at five per cent level for very simple and very heavy designs. This was followed by the flax seed incorporated food mix supplemented group (EHF) with an increase in the length of cloth woven by 4.75, 4.5, 4.0 and 4.5cm respectively, which was found to be statistically significant at five per cent level except for simple design which was significant at one per cent level.

In the case of control group a reduction in length of cloth woven by 6.15, 4.57, 1.00 and 0.67 cm was observed among simple, very simple, heavy and very heavy designs respectively which were statistically significant except for very heavy design.

The changes in the work output in terms of length of cloth woven by the selected handloom weavers with musculoskeletal disorder before and after supplementation are presented in Table LIV and Figure 24.

**TABLE – LIV**

**MEAN LENGTH OF CLOTH WOVEN BY THE HANDLOOM WEAVERS WITH MUSCULOSKELETAL DISORDER BEFORE AND AFTER SUPPLEMENTATION**

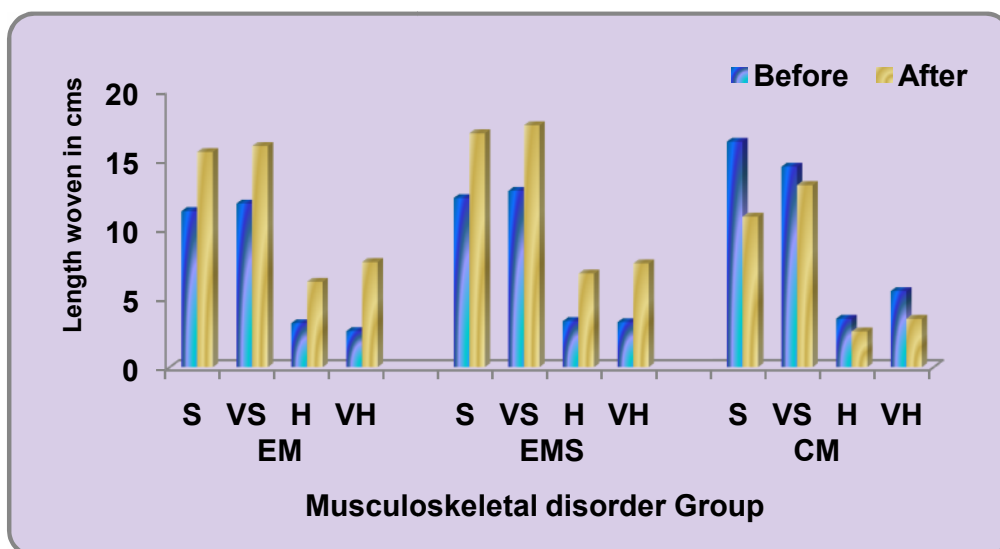
(In cms)

Groups/ Designs	Before (n=30)	After (n=30)	Mean Difference	't' Value
<b>EM</b>				
Simple	11.29 ± 2.81	15.57± 2.99	4.29	2.556*
Very Simple	11.83 ± 1.72	16.00 ± 1.90	4.17	3.635**
Heavy	3.18 ± 0.60	6.18 ± 1.19	3.00	7.116**
Very Heavy	2.60 ± 0.55	7.60 ± 1.14	5.00	7.905**
<b>EMS</b>				
Simple	12.23 ± 2.01	16.92± 1.55	4.69	6.407**
Very Simple	12.75 ± 1.71	17.50 ± 1.29	4.17	3.842*
Heavy	3.33 ± 0.70	6.77 ± 0.66	3.44	10.025**
Very Heavy	3.25 ± 1.5	7.50 ± 1.29	4.25	3.719*
<b>CM</b>				
Simple	16.31 ± 3.96	10.88± 2.75	-5.44	4.365**
Very Simple	14.50 ± 4.64	13.17 ± 5.23	-1.33	0.426 <sup>NS</sup>
Heavy	3.50 ± 0.55	2.58 ± 0.49	-0.92	2.785*
Very Heavy	5.50 ± 0.70	3.50 ± 0.71	-2.0	2.0 <sup>NS</sup>

\* - Significant at 5% level (p<0.05)

NS – Not Significant

\*\* - Significant at 1% level (p<0.01)



S – Simple VS – Very simple H – Heavy VH – Very Heavy

**FIGURE 24 - CHANGES IN THE LENGTH OF CLOTH WOVEN BY THE HANDLOOM WEAVERS WITH MUSCULOSKELTAL DISORER**

The length of cloth woven by experimental group EM after Basic health mix supplementation increased by 4.29, 4.17, 3.0 and 5.0 cm based on the designs as simple, very simple, heavy and very heavy respectively, The differences were found to be statistically significant at one per cent level for all the groups except for simple design which showed a five per cent level of significance.

With regard to experimental group (EMS) fed with soya based health mix the difference in the length of cloth woven was found to be 4.69, 4.17, 3.44 and 4.25cm. The differences were statistically significant at one per cent level for simple and heavy designs and at five per cent level for very simple and very heavy designs.

Control group (CM) showed a reduction in the length of cloth woven ranging from 0.92 to 5.44cm after a period of 4 months. Significant difference was noted in simple and heavy designs whereas very simple and very heavy designs showed no statistically significant differences.

The overall findings revealed that supplementation of functional food based health mixes improved the work output of handloom weavers assessed in terms of length of cloth woven.

## E. Impact of Nutrition Education Program

### Knowledge, Attitude and Practice scores of the weavers

The changes in the KAP scores among the selected handloom weavers before and after nutrition education are shown in Table LV and Figures 25, 26 and 27.

**TABLE – LV**

**MEAN KAP SCORES OF THE SELECTED HANDLOOM WEAVERS  
BEFORE AND AFTER EDUCATION**

**(Max Scores 25)**

Groups	Scores		Mean Difference	't' Value
	Before (n=30)	After (n=30)		
1 ED	9.30 ± 3.03	23.36 ± 1.71	14.07	21.76**
2 EDA	10.26 ± 3.12	21.63 ± 4.62	11.37	10.95**
3 CD	9.53 ± 3.71	4.76 ± 3.31	-4.77	7.04**
4 EH	9.266±3.061	22.86±1.19	13.60	22.60**
5 EHF	11.56±3.64	23.06±1.96	11.50	14.95**
6 CH	8.8±4.43	4.8±1.60	-4.0	4.56**
7 EM	9.37±3.60	23±2.01	13.63	17.771**
8 EMS	10.3±2.92	23.1±1.95	12.80	19.591**
9 CM	7.87±2.09	4.33±2.07	-3.53	6.453**

\* - Significant at 5% level (p<0.05)

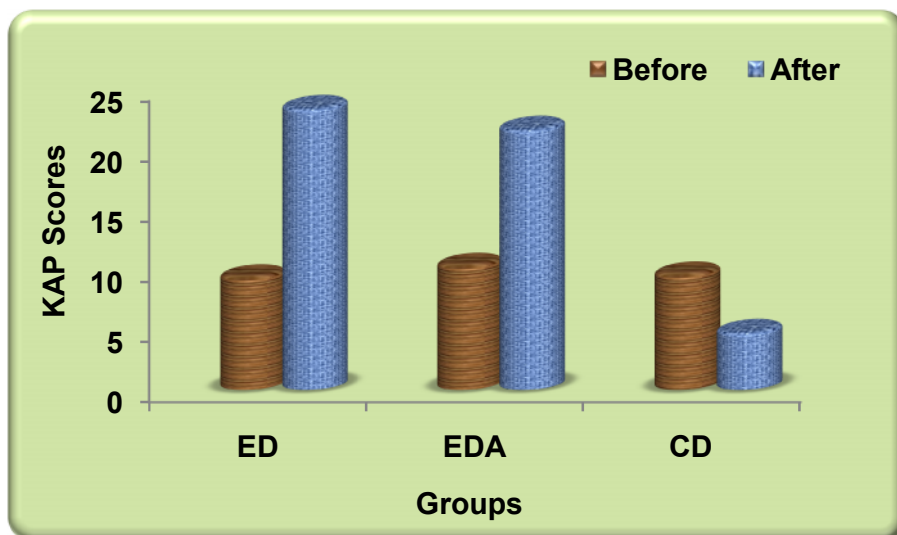
NS – Not Significant

\*\* - Significant at 1% level (p<0.01)

Groups 1,2,3 Handloom weavers with Diabetes Mellitus

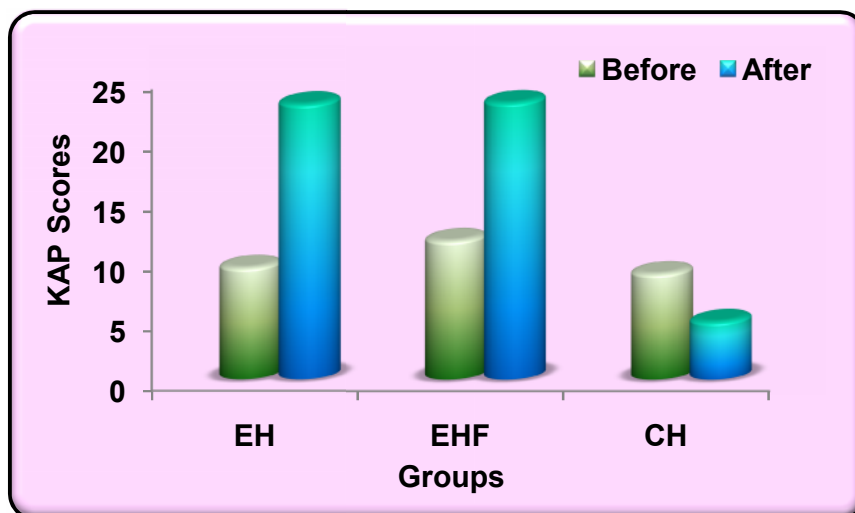
Groups 4,5,6 Handloom weavers with Hypertension

Groups 7,8,9 Handloom weavers with Musculoskeletal disorder



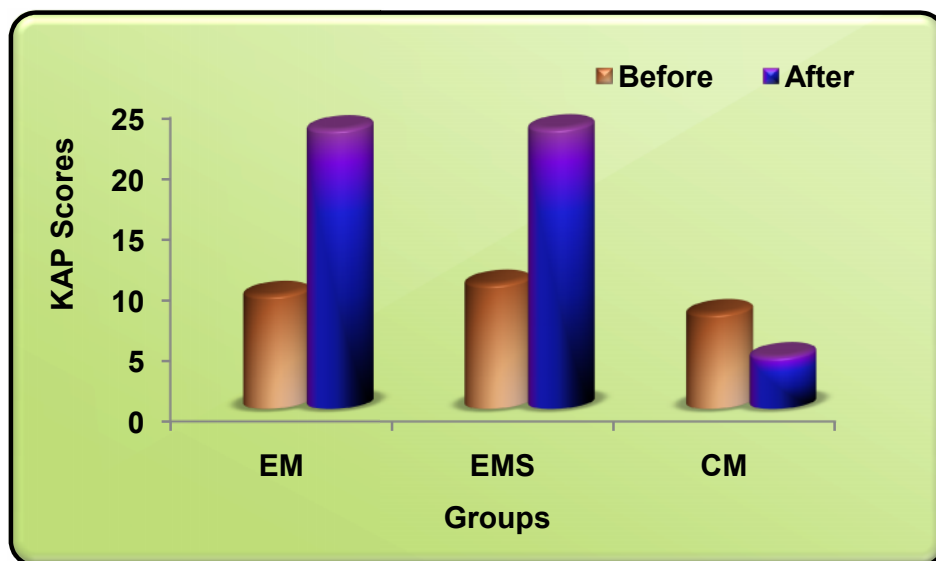
**FIGURE 25 - CHANGES IN THE KAP SCORES OF THE HANDLOOM WEAVERS WITH DIABETES MELLITUS**

Nutrition education given to handloom weavers with diabetes mellitus showed an increase in KAP scores by 14.07 and 11.37 among both the experimental groups ED and EDA and the increase was found to be statistically significant at one per cent level. Basic Health mix (ED) fed group showed higher increase in KAP scores. In the case of control group since there was no education given the mean KAP scores reduced from initial by 4.77 which was statistically significant at one per cent level.



**FIGURE 26 - CHANGES IN THE KAP SCORES OF THE HANDLOOM WEAVERS WITH HYPERTENSION**

Positive feedback was obtained in terms of KAP scores after nutrition education among both the experimental groups. The KAP scores increased by 13.60 in EH group given basic health mix and by 11.50 scores in EHF group supplemented with flax seed mix. The increase was statistically significant at one per cent level. Among the experimental groups basic health mix fed group got maximum KAP scores. Control group CH showed reduction in KAP scores by 4.00 which was statistically significant at one per cent level.



**FIGURE 27 - CHANGES IN THE KAP SCORES OF THE HANDLOOM WEAVERS WITH MUSCULOSKELETAL DISORDER**

It is encouraging to note that nutrition education had brought about an improvement in the KAP scores of the weavers in the experimental groups EM and EMS by 13.63 and 12.80 respectively, both being statistically significant at one per cent level. Among the experimental groups basic health mix (EM) fed group showed a higher KAP scores. In the case of control group (CM) a reduction in the KAP scores by 3.53 was noted which was statistically significant at one per cent level.

Overall findings indicated that nutrition education increased the KAP scores among experimental groups with a higher increase among basic health mix supplemented groups. This observation may be very promising to combine functional food mix supplementation with nutrition education to have a wholesome impact on health and nutritional status of handloom weavers.