



SUMMARY AND CONCLUSION

Human resources are perhaps the most strategic and critical determinant of growth of a nation and yet its development has not received the required attention. India has abundant human resources and it occupies the second populous country next to china. Human resources development lies at the heart of economic, social and ecological growth. With regard to economic development agriculture is the main occupation among Indians. Handloom industries occupy the second important provider of employment and economic returns to the country next to Agriculture.

Handloom Sector is an important cottage industry in India and is a very old profession. Handloom weavers are known for their knowledge, innovation and brilliance in designs. Weaving is now considered almost an art from considering deployment of skills and knowledge. Handloom industry in India is an ancient cottage industry with a decentralized setup. Handloom industry provides employment to nearly 65 lakh people with 35 lakh looms. Handloom industry is highly concentrated on Man Made Art and Tradition. Handloom sector plays a very important role in the country's economy (Srinivasa Rao, 2012).

Presently, handloom weavers are facing severe livelihood crisis because of adverse government policies, globalization and changing socio-economic conditions. However, in the present situation, there are too many issues, which are impinging on the development of the sector. Handloom weavers are facing severe health problems as well as chronic and acute diseases.

Weavers are the main population in India who suffer from major health problems such as respiratory problems, musculoskeletal disorders and chronic diseases like hypertension as well as disabilities such as permanent hearing loss due to exposure to noise (Kale, 2008).

Most of the handloom weavers also suffer from either asthma or allergy or Tuberculosis or frequent attacks of cold. Malnutrition deprives most of the human

resources in our country. There are not much studies available on the nutritional status of handloom weavers. If information on the background details are available about handloom weavers, different strategies can be adopted to improve the health and nutritional status of handloom weavers.

Dietary intervention and nutrition awareness creation may be two important approaches for improving the status of handloom weavers. Dietary intervention can make use of functional foods which aid in specific bodily functions in addition to being nutritious. Functional foods also play an important role in disease prevention and health promotion thereby reduce health care costs.

With this background the present study on **Effect of Supplementation of Health Mix and Nutrition Education on the Health and Nutritional Status of Handloom Weavers** was undertaken with the following specific objectives

To

- Study the socio economic back ground, dietary pattern, occupational health problems, life style and work pattern of handloom weavers
- Assess their nutritional status, work output and energy balance
- Formulate health mixes using locally available functional foods and evaluate the nutritive value, anti nutritional factors, shelf life and cost of the health mixes
- Supplement the health mixes to weavers based on their health problems for a period of four months
- Assess the impact of supplementation of health mixes and
- Implement nutrition education programme and evaluate the impact on handloom weavers

In Tamil Nadu, three districts comprising of Coimbatore, Vellore and Thiruvannamalai were selected for the general survey, since adult handloom weavers are adequately available in these districts for the study. In Coimbatore district 2 urban and 4 rural areas, in Vellore district 1 urban and 2 rural areas and in Thiruvannamalai district 2 urban and 2 rural areas were selected for the study

making a total of 6 urban areas and 7 rural areas. Both men and women weavers available during the study period numbering 1118 (1056 men and 62 women) aged 20-60 years were selected for the general study. Among the three districts Thiruvannamalai district was selected for supplementation study.

An interview schedule was administered among the 1118 adult handloom weavers to collect socio economic, dietary and other background details. Anthropometric measurements namely height and weight were taken and BMI was calculated for all the adults. Biochemical tests like blood haemoglobin, random blood sugar and serum calcium, which are related to the health problems like anaemia, diabetes mellitus, hypertension and musculoskeletal problems of weavers were done for a sample of 403 men weavers based on age, gender, clinical examination and health conditions. In addition, for a subsample of 90 weavers fasting and postprandial blood glucose, serum phosphorus for 90 and vitamin D for 15 were done based on the findings for the prevalence of diseased conditions by using standardized procedures. Systolic and diastolic pressures were measured for all the selected 403 adult men weavers. X-ray of knee joint was taken for a subsample of 20 handloom weavers selected with musculoskeletal disorder for the supplementation study.

Clinical signs and symptoms were examined among all the handloom weavers with the help of a physician. Food and nutrient intake of the 60 men weavers was assessed by using a 24 hour recall method followed for three consecutive days. Total energy expenditure of a subsample of 27 was assessed following the procedure recommended by ICMR (2002). From the energy intake, and energy expenditure data energy balance was computed.

For the dietary intervention functional foods like bengal gram dhal, black gram, carrot, tomato, cauliflower leaves, amla, flax seeds and soya were selected for the formulation of health mixes for supplementation. Pepper, cumin seeds, red chillies and salt were added to improve the taste and acceptability of food mixes.

For the Basic Health mix 30g bengal gram dhal flour, 15g black gram dhal flour and 5g each of all the spices and 5g each of all the vegetable powders were blended homogenously to obtain 80g of mix which had a good acceptability.

Based on the health problems of the handloom weavers, functional foods like amla powder for diabetes mellitus, flax seeds powder for hypertension and soya flour for musculoskeletal disorders respectively were added to basic health mix. Fifteen g each of amla powder or flax seeds powder or soya flour were added to 80g of basic health mix to get variation 1 with amla, variation 2 with flax seeds and variation 3 with soya flour. The health mixes were analysed for their nutrient content, antinutritional factors and microbial count. Cost of health mixes was also calculated.

Among the 1118 weavers enrolled initially for the survey, 403 weavers were selected based on their co operation for blood analysis and depending upon their age, gender and clinical examination and not taking alcohol or cigarettes. The selected 403 adult handloom weavers were screened biochemically for haemoglobin, blood sugar, and serum calcium. Blood pressure was also measured. Among them a total of 270 individuals with any one of the conditions like diabetes mellitus, hypertension, and musculoskeletal disorders were selected for supplementation study. The weavers (270) were divided into 3 groups based on their problems. Group 1 adults with diabetes mellitus (90) namely ED, EDA and CD, Group 2 adults with hypertension (90) namely EH, EHF and CH and Group 3 adults with musculoskeletal disorder (90) namely EM, EMS and CM. Experimental groups like ED, EH and EM were supplemented by basic health mix, EDA, EHF and EMS respectively were supplemented with variation 1, variation 2 and variation 3 and the control groups CD, CH and CM were not given any supplementation.

Health mixes weighing 30 g each were filled into small packets and 20 such small packets were put into a larger zip lock cover. Salt was not included for adults in group II with hypertension. The investigator distributed one such large packet once in 20 days for a period of four months to the selected adults residing in selected four villages. The subjects were asked to consume one small packet (30g) everyday along with their food such as idli, dosa, rice or sambar. The supplementation was regularly followed up. After four months, the impact was evaluated on the basis of anthropometry (height, weight and BMI), biochemical parameters (Haemoglobin, fasting and postprandial blood glucose, serum calcium, serum phosphorus and vitamin D), and biophysical parameters (blood pressure and X-ray).

In order to improve the nutrition awareness and about diseases among the weavers a nutrition education programme was organised. A total of 180 adult handloom weavers who were involved in the supplementation study were selected for nutrition education program from the four villages. Charts, posters and booklets were developed and displays were made to educate the handloom weavers on various aspects of healthy living. The effectiveness of the nutrition education imparted was evaluated through the KAP scores obtained before and after nutrition education.

Salient Findings of the study

Phase I Socio Economic, dietary and other Background information

- Among 1118 handloom weavers a maximum of 37 per cent belonged to the age group of 20-30 years and 33 per cent belonged to the age group of 41-50 years
- With regard to educational status 47 per cent being the majority 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.
- Among the total sample 94 per cent of the weavers were men whereas only 6 per cent of women were engaged in actual weaving though other women would help in other related activities
- 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.
- A majority of 73 per cent of the weavers had small families, 12 per cent had 5-7 members (medium families) and 15 per cent had more than 7 members (large families).
- 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.

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- In all the three districts expenditure pattern revealed that a maximum percentage of families spent within 0-25 per cent on food, clothing, house rent, education, fuel and medicine. Minimum percentage of families spent 25-50 per cent on food, clothing and medicine.
 - Only 187 handloom weavers got loans, among them 47 per cent of adults being the maximum received Rs. 50,000 to 1,00,000 as loan mainly for medical treatments.
 - About 93 per cent of the weavers being the majority were non-vegetarians and only 6 per cent of the weavers were vegetarians.
 - Nearly 51 per cent of the weavers took their meals at regular timings.
 - A majority of 50 per cent of the weavers were taking 3 meals a day, whereas 48 per cent were taking only 2 meals a day.
 - Majority of the weavers (83 %) were consuming tea whereas only 17 per cent were consuming coffee. Majority of the weavers (87 %) were consuming 2-4 cups of tea per day. About 97 per cent were not taking aerated drinks
 - Groundnut oil was consumed by 39 per cent of 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 families.
 - 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. In Coimbatore and Thiruvannamalai district 20 and 23 per cent of the families of weavers respectively were consuming a higher quantity of 71 to 90 g of oil per day.
 - A majority of 80 per cent of the weavers were using potable water supplied by the municipality whereas others were using water filters or hot water for drinking.
 - Rice was consumed daily for one or two meals by all the families. A majority of 40 per cent of families 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. Majority of the adults consumed weekly once or twice leafy vegetables like amaranth and

drumstick leaves whereas 25 per cent of them never consumed drumstick leaves.

- Banana and papaya were consumed daily by 25 and 7 per cent of weavers respectively. Chicken and mutton were consumed weekly once or twice by a 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.
- A majority of (65 %) 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 houses.
- A majority of (49 %) the handloom weavers were using toilets built inside the house whereas 46 per cent of them were using community toilets.
- A maximum of 65 per cent of the weavers were having bicycle for travelling and 22 per cent of them were using motor bikes. In Thiruvannamalai district, majority of the weavers were using only bicycle for transportation whereas in Coimbatore district a majority used motorbikes.
- A maximum of 56 per cent of the weavers were having the weaving units in their own house 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.
- A large group of weavers (97 and 91 %) in all the three districts did not do any type of exercise or yoga respectively. Among the less number of weavers (9%) who did exercise, walking was the predominant activity and a few were doing simple exercises. Only 3 per cent of weavers did simple yoga exercise.
- Majority (87 %) of the handloom weavers were not having the smoking habit. Among those who smoked, a maximum of 89 per cent used beedi and only 11 per cent used cigarettes.

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- A majority of 74 per cent of the men weavers did not consume alcohol whereas the remaining 26 per cent were consuming alcohol. Among them a majority (47%) were consuming alcohol daily. Among the three districts, a majority of 57 and 54 per cent of the weavers in Vellore and Thiruvannamalai respectively were consuming alcohol daily.
 - Almost 68 per cent of the weavers were not having their own weaving unit but 32 per cent had 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.
 - Results revealed that 60 and 63 per cent of weavers were having inadequate infrastructure or space for weaving in Coimbatore and Thiruvannamalai district respectively whereas in the case of Vellore district, a majority (59%) of the weavers had adequate infrastructure for weaving.
 - 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. In Coimbatore district 68 per cent of the weavers were satisfied with the light and ventilation facilities available in the working area.
 - A majority of (79 %) 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 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 are working under master weavers for wages.
 - 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.

- Nearly 36 per cent of the weavers being the majority had joint pain and 24 per cent were suffering from muscle pain. About 31 per cent of the weavers were suffering from pain in fingers because of contact with strings carrying warp yarns. Lesser percentage of people expressed health problems like blood pressure (19%), diabetes mellitus (16%), continuous cough (8 %), breathing problems (3%) and ulcer (2%).
- 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.

Phase II Nutritional Status of handloom weavers

- The mean height of the selected men and women weavers was recorded to be 164.6 cm and 162 cm, which is found to be lesser than that of 172 cm and 161cm suggested by ICMR (2010) for adult men and women respectively. A deficit of 4.3 per cent was noted for men and 0.6 per cent excess for women in comparison with ICMR values.
- The mean weight of the selected men and women weavers was found to be 69.07 kg and 70 kg which is more than that of 62 kg for men and 56 kg for women referred by ICMR (2010). The mean weight was found to be 11.4 and 14 kg more than that of ICMR values.
- A majority of 34 per cent (men) and 38 per cent (women) 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. 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.

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- A majority of 70 per cent of men 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 WHO (1992) as 13 g per 100 ml 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 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.
 - Serum calcium level among the men weavers was found to be 7.7 mg/dl which was less than the reference values of 9.0-10.6mg/dl.
 - The mean serum phosphorus levels of the selected men weavers was found to be 1.63 mg per dl which was lesser than the recommended phosphorus level of 2.5-5.0mg/dl.
 - Vitamin D level among the men handloom weavers was found to be 14.18ng/ml which was less than the reference values highlighting the higher prevalence of vitamin D deficiency among weavers
 - A majority of 64 per cent of the men weavers had desirable random blood glucose level which is an encouraging observation. Nearly 20 and 7 per cent of men 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 categorized as low.
 - Forty eight per cent of the weavers had normal calcium (9-10.6mg/dl) levels. Surprisingly 21 per cent had high serum calcium ranging from 10.6-11mg/dl and 12 per cent of the weavers had low 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 weavers had less than normal calcium levels.
 - Regarding blood pressure values only 16 per cent of the weavers had normal values whereas 12 per cent had low systolic pressure. A majority (42 %) 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 for cardiovascular problems and complications. Around 17 per cent of the weavers had normal diastolic pressure 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.

- A majority of 51 per cent of weavers had pre hypertension according to JNC (2004) criteria 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.
- 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 found among 41 and 40 per cent of adult men respectively. 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.
- From the food intake data it is found that the intake of cereals was deficit by 15 per cent and pulse intake was excess by 15 per cent. The intake of green leafy vegetables and roots and tubers was found to be deficit by 36 and 39 per cent respectively. Consumption of other vegetables and fruits was found to be highly deficit by 72 and 88 per cent respectively. 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.
- Regarding nutrient intake, energy intake was found to be slightly inadequate by 26 per cent and protein intake was excess by 3 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 β 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 %).

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- Energy intake of weavers with diabetic 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 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 a negative energy balance.

Phase III Details on Functional Food Mixes

- The overall acceptability scores out of 25 revealed that soya incorporated variation 3 got a maximum score of 22.1 followed by variation 2 with flax seed with a score of 21.2. Both Basic Health mix and variation 1 got a score of 19.9 and 19.8 respectively.
- Regarding nutritive value of health mixes the energy content ranged from 333 to 384 kcal per 100g with a maximum in basic health mix and variation 3. Total carbohydrate content ranged from 47.42g to 69.10g per cent with a maximum in Basic Health mix (69.1g %). Protein content of mixes ranged from 12.8 to 18.6g per 100g with a maximum in variation 2 and 3 with 18.6 and 18.37g per 100g respectively, might be due to flax seed and soya. Regarding fat content, variation 2 had a maximum of 11.52g per 100g might be due to flax seed incorporation.
- Moisture content of mixes ranged from 1.63g to 4.32g in 100g with a maximum in variation 3. In the case of ash content variation 2 had a high amount of 12.2g per cent might be due to flax seed. Dietary fibre content of variation 3 was the maximum with 8.8g per 100g and a range of 8 to 8.8g in all the mixes. Variation 1 and 2 had a crude fibre content of 8.16 and 8.4g per cent respectively being the highest.
- Among minerals, variation 2 had a high calcium of 527 mg per 100g whereas Basic health mix had only 180mg per 100g. Potassium content ranged from 12 to 13.2 mg among all the mixes. Sodium content of variation 1 was found to be maximum with 7.2mg per 100g. Iron content was 4.4mg per 100g each in variation 2 and 3 whereas basic mix had only 2mg per 100g. Magnesium

content was maximum in variation 2 with 206mg per 100g. Phosphorus content was more in variation 3 with 88.1mg per 100g.

- Total carotenoids content ranged from 1020 to 1420µg per 100g with a maximum in variation 1 with amla based mix. Beta carotene content also ranged from 360 to 460µg per 100g with a maximum in variation 1. Vitamin C content of health mixes ranged from 8.78 to 23.85mg per 100g with a maximum content in variation 1 with amla based mix. Vitamin E content was maximum in variation 2 (0.44 µg per cent) which had flax seed.
- Regarding antinutritional factors 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 per 100g. With regard to phytate content except variation 3 with 0.45mg per cent all other mixes had a range of 0.51 to 0.53mg per cent. In the case of tannins, variation 1 contained a maximum of 256µg and variation 3 had a minimum of 51µg per 100g. 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
- The bacteria, yeast and mould counts were found to be below detectable limits in all the four health mixes both initially and after a three months storage period indicating the good keeping quality
- The cost of food mixes was Rs.15.50 per 100g for basic health mix, 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. This was comparably more economical and affordable than allopathic medicines and can be easily prepared at home scale.

Phase IV Impact of Supplementation of Functional Food mixes

- After a four months supplementation the mean body weight of the adults belonging to all the six experimental groups showed a reduction by 0.83 to 2.67 kg with a maximum reduction in variation 3 with soya based mix which were found to be not statistically significant. Control groups showed slight increase in weight
- With regard to BMI, supplementation of health mixes resulted in a reduction ranging from 0.29 to 0.97 with a maximum in soya added

variation 3, but changes were statistically insignificant. Control groups showed slight increase in BMI.

- 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 which were statistically significant at one per cent level. Reduction in the control group was 0.25g/dl haemoglobin level among the adults suffering from Diabetes Mellitus and statistically significant at one per cent level.
- The mean haemoglobin level of experimental group EH fed with basic health mix increased from 8.99g/dl to 13.20g/dl after supplementation and statistically significant at one per cent level. Experimental group EHF fed with flax seed mix showed an increase in haemoglobin values from 9.88g/dl to 13.47g/dl which was highly significant at one per cent level. Control group CH showed a reduction in haemoglobin by 1.76g/dl being statistically significant at five per cent level.
- The mean haemoglobin level among the two experimental groups after supplementation showed an increase by 4.71 g/dl among soya based health mix group (EMS) followed by 3.74g/dl among basic health mix (EM) group and found to be significant at one per cent level. Control group showed a reduction in haemoglobin level by 0.72g per dl which was significant at 5 per cent level.
- Supplementation of basic health mix and variation 1 with amla based mix among the diabetic handloom weavers resulted in a reduction in fasting blood glucose levels by 26.63 and 23.60 mg per dl respectively with a maximum reduction with basic mix.
- The mean post prandial blood glucose level of experimental groups ED with basic health mix and EDA with amla based mix decreased after supplementation by 34.87mg/dl and 24.9mg/dl respectively with a maximum in Basic health mix given. The reductions were statistically significant at one per cent level. Control group CD showed an increase by 3.63mg/dl which was statistically not significant.

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- The group supplemented with the basic health mix (EM) evidenced a maximum increase in the serum calcium levels by 1.42mg per dl, and could be due to the high amount of calcium present because of cauliflower leaves and carrots. Soya incorporated food mix supplemented groups (EMS) showed an increase of serum calcium by 1.60mg per dl. There was a slight reduction in serum calcium levels among the control group (CM)
 - 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 was observed respectively. All the differences were found to be statistically significant at one per cent level.
 - Supplementation resulted in a maximum increase in vitamin D levels by 3.46ng per nl in EM group given basic mix compared to EMS group fed with soya based health mix with an increase of 2.17ng per nl.
 - After the supplementation the experimental groups 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 with a maximum reduction in Basic Health mix group.
 - Four months supplementation had brought about a marginal reduction in the diastolic blood pressure among EH group fed with basic mix and EHF group supplemented with flax seed mix with 8.37mm Hg and 5.37 mm Hg respectively which were statistically significant at one per cent level.
 - Among the 90 weavers 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 weavers 18 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.
 - Clinical symptoms like joint pain, muscle pain, general fatigue and improper digestion showed a reduction after the supplementation among the weavers.

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- The length of cloth woven by handloom weavers supplemented with Basic mix (ED) and amla based mix (EDA) was found to be more ranging from 3.07 to 9.78cm compared to control group which showed a reduction by 1.25 to 4.25cm. The differences were found to be statistically significant.
 - With regard to the length of cloth woven by weavers with hypertension supplemented with Basic mix (EH) and flax seed based mix (EHF) there was an increase ranging from 3 to 6 cm which were significant statistically. In the case of control group (CH) a reduction ranging from 0.67 to 6.15cm of cloth woven was observed.
 - The length of cloth woven by weavers of experimental groups, EM with Basic health mix and EMS with soya based health mix was found to increase ranging from 3 to 5 cm which were statistically significant. Control group (CM) showed a reduction in cloth woven by 0.92 to 5.44cm.

Phase V - Impact of Nutrition Education

- 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. 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.
- In the case of handloom weavers with hypertension 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 which was statistically significant at one per cent level. Control group did not show any improvement
- Among the adults of experimental groups with musculoskeletal disorder fed with basic health mix (EM) and (EMS) soya based mix showed a higher KAP scores by 13.63 and 12.80 which were statistically significant at one per cent level. In the case of control group a reduction in the KAP scores by 3.53 was noted.

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- 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.

The present study among handloom weavers revealed a poor socio economic status, improper dietary management, poor life style pattern and occupational health problems. Diabetes mellitus, hypertension and musculoskeletal disorders were seen more among them. These findings indicate a poor management of non-communicable diseases and improper dietary practices reflecting a need for dietary intervention and knowledge improvement through nutrition education.

On the whole, analysis of the developed functional food mixes for their nutrient content, acceptability and microbial count revealed that the mixes were good sources of protein, fiber, vitamins, and minerals, acceptable for consumption and safe from microbes for up to three months. The anti nutritional factors in Health mixes were found to be within safe levels. The food mixes were found to be nutritious and economically cheaper and suitable for supplementation for individuals with chronic diseases.

Supplementation of the developed functional food mixes to handloom weavers with diabetes mellitus, hypertension and musculoskeletal disorders provided convincing evidence on the beneficial effects of the supplemented food mixes. The experimental groups demonstrated significant reduction in fasting and post prandial blood glucose levels and blood pressure values, a significant increase in haemoglobin, serum calcium, serum phosphorus and vitamin D levels. Nutrition education program provided to the handloom weavers resulted in improvement of KAP scores.

The results of the study also suggest that nutrition education improves the diet, life style pattern, and health and hygiene practices and thereby control the complications of diabetes mellitus, hypertension and musculoskeletal disorder.

Supplementation and nutrition education programs could definitely have immense impact on the quality of life of handloom weavers.

RECOMMENDATIONS

Future studies can be undertaken on the following areas

- Identification of health and nutrition problems among women and children in weaver communities and planning for proper strategies to improve them
- Motivational programmes for women and adolescents to improve their general awareness and socio economic status
- Organizing awareness programmes on nutrition, health and hygiene practices for all the members in the families of handloom weavers using effective methods
- Popularization of functional food mixes based on simple, locally available, inexpensive foods for specific conditions among weaver communities
- Highlighting the relationship between work output and nutritional status and organizing programmes in those lines.
- Promotional activities can be undertaken for physical activities, yoga, Exercise and medical camps to enhance the well being of weavers
- Motivation to cultivate suitable greens, vegetables and fruits at the home scale level wherever infrastructure is available.