Impact of Functional Food Mixes on Serum Calcium and Phosphorous Level – An Interventional Study

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Article History:

Received on: 20 Nov 2020
Revised on: 18 Dec 2020
Accepted on: 22 Dec 2020

Keywords:

handloom weavers, occupational health problems, functional foods and soya

ABSTRACT

Agriculture is the main occupation of the people. Further cultivation, public occupied themselves in weaving, tanning and metallurgy. Among the various occupations weaving is one of the second major occupations in India next to agriculture. A long tradition of excellence in its craftsmanhip, Indian Handloom is said to have dated back to the ancient ages. 15th August 1947, noticeable turnings face for the country’s handloom weavers. 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 everlasting ears hot failure due to revelation to sound. For the interventional study interview schedule was used and screened 90 subjects based on the health problems, subjects divided into 3 groups such as EM–30, EMS-30 and CM-30. Functional food mixes prepared and formulated soya based health mixes and assessed the nutrient content of health mixes, and supplemented to the experimental groups. There is no supplementation for the control group. Then the impact was evaluated by using biochemical parameters. After the supplementation revealed, the soya based health mixes are reduced the risk of osteoporosis.

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ISSN: 0975-7538
DOI: https://doi.org/10.26452/ijrps.v11iSPL4.3822

INTRODUCTION

Clothing is a basic human need as much as food and shelter. Till the nineteenth century, when there was no machinery for the fabrication of material, the handloom trade was the only dealer of cloth for the whole necessitate of the globe. Handloom weaving is India’s biggest cottage and labour intensive sector, which has been playing a very important role in the country’s economy by forming part of India’s rich heritage and exemplifying the rich artistry of the weavers. As economic progress, the handloom sectors occupy a place next only to cultivation in terms of employment. According to the annual Reports of Ministry of Textiles (2011-12), the handloom subdivision with in relation to 23.77 lakh handlooms provides service to 43.31 lakh people (Raju and Rao, 2013).

The art of weaving and spinning has passed from one generation to another generation. The word loom means ‘A weaving machine’ thus the word Handloom means ‘A machine on which weaving is done manually by hands’. The handloom weaving is done through the intersection of warp and weft. The warp is a vertical thread wound on a roller and the weft is a thread at right angles to warp/horizontal thread (Anjum et al., 2009). Handloom weaving is one among such occupations practised by specific castes of people in different parts of India. The weaving sector occupies a distinct and unique place
in the Indian economy. It is the largest generator of non-farm rural employment. India is one of the highest and looms producing country in the world (Apparoo and Rao, 2012).

Research study reported that occupational hazard in textile industries revealed that most of the workers and family members suffering from asthma or allergy or Tuberculosis or frequent attacks of cold. Only a few or negligible people suffered from cancer. Other strange ailments include nose block and throat infection. Further, it is also found that the number of weavers who suffered from skin problem was less than the number of weavers who faced respiratory problems which was the major occupational health hazards (Kim et al., 2009).

Lengthy hours of stagnant work with an uncomfortable position at conventionally premeditated looms can cause a high occurrence of musculoskeletal disorders (MSDs) surrounded by weavers (Chang and Adami, 2006).

Prevalence of dietary calcium insufficiency is not known, but there is evidence suggesting that people of all ages worldwide, including the United States fail to consume adequate amounts of calcium. Decreased level of calcium consumptions is very familiar in the budding country because of the irregular eating of dairy products. Adulthood is a critical time 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). Bone loss in adulthood is widespread and to protect against these losses, high calcium intakes early in life is recommended. A calcium-poor diet during the growing years may prevent a person’s achievement of maximum peak bone mass. Too little calcium packed into the skeleton during childhood and young adulthood strongly predicts susceptibility to osteoporosis later in adulthood (Krause et al., 2005).

Some of the functional foods are amla, flax seeds, soya, blueberry, carrot, cruciferous vegetables, fish, garlic, whole grams, oats, oranges, spinach etc. In the present research, a number of low costs locally available functional foods were selected and used for the formulation and preparation of health mixes.

The beneficial effects of functional foods and nutraceuticals can be concluded that reduced risk of cardiovascular diseases, reduced risk of cancer, weight loss/ management, reduced osteoporosis, improved memory, quicker reaction occasion, enhanced fatality healthiness and condensed risk of many other diseases. Nutraceuticals and Functional Foods will be promising to good healthiness in the expectations; it has been realistically definite to be favourable for their intentional purpose when inspired as a component of a generally well-balanced and healthful diet (Sohaimy, 2012).

With this background, the present study was carried out by the following objectives,

1. Assess the nutritional status and health problems of the selected weavers
2. Prepare and develop the health mix based on the problem.
3. Assess the nutritive value of health mix
4. Supplement the health mix to the selected handloom weavers
5. Assess the impact of supplementation of health mixes

**MATERIALS AND METHODS**

In India, Tamil Nadu is well known for its rich culture and tradition of handloom weaving. In Tamil Nadu, more than 2.17 lakh people are involved in the weaving profession. There are 12414 handloom weavers engaged in weaving profession in Vellore district and Thiruvannamalai district, there are 17100 handloom weavers engagedinweavingactivities (Census of India, 2011). From Tamil NaduThiruvannamalai districts were selected for the general survey since adult handloom weavers are adequately available for the study. In Thiruvannamalai district, 2 urban and 2 rural areas were selected for the study.

For the present study, an interview schedule was developed to collect details from handloom weavers regarding the socio economic background (age, sex, education, income, activity, expenditure pattern etc.) dietary pattern (a type of diet, meal pattern, food frequency, consumption pattern of beverages, oil etc.) health and hygiene, lifestyle pattern (yoga, exercise, smoking and alcohol intake etc.) and nutrition knowledge.

The schedule also included questions on work profile like infrastructure, ventilation, duration of work and occupational health problems. The schedule was pretested among ten handloom weavers and then modifications incorporated, finalized and used for the survey.

**Biochemical Assessment**

Biochemical tests like blood serum calcium related to the health problems musculoskeletal problems of weaver’s were done for a sample of 403 based on age,
gender and clinical examination and health conditions. In addition, for a subsample of 90 weavers serum phosphorus for 90 were done based on the findings for the prevalence of diseased conditions by using standardized procedures.

**Serum Calcium**

The inclusion criteria are male members within the age group of 35 to 60 years and doing weaving profession for more than 10 years and free from other chronic diseases and not taking alcohol. All of them were well informed regarding the objective of the study and their willingness and co-operation throughout the four months supplementation study was confirmed. A subsample of 90 adults suffering from musculoskeletal disorders. Grouping of the adults was done with the help of a physician.

**Serum Phosphorus**

Serum phosphorus levels fall below the normal range of 2.5 to 5.0 mg/dl; it leads to several physical disturbances. Low phosphorus levels, along with low levels of other vitamins and minerals such as calcium and vitamin D may weaken the bones and increase the risk of bone fractures. Hence serum phosphorus levels were estimated for the selected 90 handloom weavers by using phosphorus kit-Molydate UV method.

**Origination and Preparation of Health Mixes based on Functional Foods**

Bengal gram dhal and black gram dhal were roasted and powdered separately. Carrots and tomatoes were sliced. Cauliflower leaves were disembowelled free from foreign matters and thick stems. All the vegetables were sun dried on a clean plastic sheet till the moisture content significantly reduced. Then the ingredients were milled using a pulveriser to obtain the respective powders. All the spices were roasted and powdered using a pulveriser. Various proportions of ingredients were tried out and acceptability tests were done to find out the best proportion. On behalf of 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 mixed equally to get 80g of the mix which had a good satisfactoriness.

Along with basic health mix, 15 g of soya powder were added to get variation. Formulation and development of soya based functional food mix and basic health mix process is given in Figure 1.

**Supplementation of Health Mixes to the selected Handloom Weavers**

The inclusion criteria are male members within the age group of 35 to 60 years and doing weaving profession for more than 10 years and free from other chronic diseases and not taking alcohol. All of them were well informed regarding the objective of the study and their willingness and co-operation throughout the four months supplementation study was confirmed.

There were 5 handloom weavers who dropped out of the study after initial screening due to various reasons. A total of 270 weavers three groups were formed for the supplementation study and group 1 had 90 adults with diabetes mellitus, group 2 comprised of another 90 adults having elevated Blood pressure and group 3 with 90 adults suffering from musculoskeletal disorders. Grouping of the adults was done with the help of a physician.

**RESULTS AND DISCUSSION**

**Table 1: Health Problems Expressed by the Selected Handloom Weavers**

<table>
<thead>
<tr>
<th>Health Problems</th>
<th>Thiruvannamalai N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joint Pain</td>
<td>218</td>
<td>42</td>
</tr>
<tr>
<td>Pain in fingers</td>
<td>239</td>
<td>47</td>
</tr>
<tr>
<td>Muscle pain</td>
<td>88</td>
<td>17</td>
</tr>
<tr>
<td>Blood Pressure</td>
<td>116</td>
<td>23</td>
</tr>
<tr>
<td>Diabetes Mellitus</td>
<td>62</td>
<td>12</td>
</tr>
<tr>
<td>Persistent Cough</td>
<td>91</td>
<td>18</td>
</tr>
<tr>
<td>Breathing Difficulty</td>
<td>19</td>
<td>4</td>
</tr>
<tr>
<td>Ulcer</td>
<td>10</td>
<td>2</td>
</tr>
</tbody>
</table>

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

Table 1 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 the majority of handloom weavers might be due to their posture at the workplace. Handloom weavers need to be educated on proper posture at workplaces 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. The health problems of the handloom weavers are given in Table 1.

Lesser percentage of people expressed health problems like blood pressure (19%), diabetes mellitus (16%), continuous cough (8%), breathing problems
Table 2: Mineral Content of the Developed Functional Food Mixes (In100g)

<table>
<thead>
<tr>
<th>Minerals</th>
<th>Basic Health Mix</th>
<th>Variation-1 (Soya powder)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium (mg)</td>
<td>180</td>
<td>472</td>
</tr>
<tr>
<td>Potassium (mg)</td>
<td>12.1</td>
<td>12.0</td>
</tr>
<tr>
<td>Sodium (mg)</td>
<td>6.0</td>
<td>5.6</td>
</tr>
<tr>
<td>Iron (mg)</td>
<td>2.0</td>
<td>4.4</td>
</tr>
<tr>
<td>Magnesium (mg)</td>
<td>110</td>
<td>135</td>
</tr>
<tr>
<td>Phosphorus (mg)</td>
<td>68.0</td>
<td>88.1</td>
</tr>
</tbody>
</table>

Table 3: Mean Serum Calcium and Phosphorus Levels of the Selected Handloom Weavers with Musculoskeletal Disorder Before and After Supplementation

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

Figure 1: Step in The Preparation of Functional Food Mix
(3%) and an ulcer (2%). Health is very much essential for proper livelihood and work output.

**U trient analysis of the Health mixes**

The mineral content of the developed functional food mixes is given in Table 2.

Among the minerals, variation 1 contained a higher amount of calcium 527mg per 100g. With regard to potassium content, variation 1 had 13.2mg per 100g. Sodium level of variation 1 was originated to be the maximum with 7.2mg per 100g. Other variation and basic health mix had 5.3 to 6.0mg per 100g of sodium. Variation 1 had a higher amount of 4.4mg per 100g of iron, whereas basic health mix had only 2.0 mg.

Magnesium content was found to be more in variation 1 with 206mg. Basic health mix has a lesser amount of magnesium of 110mg per cent only. With regard to phosphorus, the content was more in variation 1 with 80mg. Basic health mix has only 68mg per cent of phosphorus. In general, the functional food variation had more mineral content than the Basic health mix, which might be due to the incorporation of specific functional foods in variation.

**Serum Calcium and Phosphorus levels**

The details on the Serum calcium and serum phosphorus levels among the selected handloom weavers with the musculoskeletal disorder before and after supplementation are presented in Table 3.

At the end of four months supplementation, the group supplemented with the basic health mix (EM) evidenced a maximum increase in the serum calcium level s 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 the control group revealed a statistically significant difference at one per cent level. 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, the 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.

**CONCLUSIONS**

The above study revealed that handloom weavers are facing musculoskeletal disorders. The soya based health mix found to be significant at one per cent level. Comparison between experimental groups showed no statistically significant difference in the serum calcium levels. A comparison of experimental groups with the control group revealed a statistically significant difference at one per cent level. Results showed that a statistically significant increase in serum phosphorus levels at one per cent level. Soya bean is a versatile legume that contains high quality protein, minimal saturated fat and is an essentially unique dietary source of isoflavones.

**ACKNOWLEDGEMENT**

The corresponding author analyzed data and necessary inputs were given towards the designing of the manuscript. All authors discussed the methodology and results and contributed to the final manuscript.

**Funding Support**

This study was funded by UGC Major Research Projects (grant number is F. No. 41-695/2012).

**Conflict of Interest**

The authors declare that they have no conflict of interest for this study.

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