Summary and Conclusion
The study entitled “Physical Stress, Productivity and Perceived Exertion of Women in Charkha Spinning” is an attempt to obtain a clear picture of the work of women in khadi spinning units and to quantify the physical stress and perceived exertion of the spinners working on the three types of charkhas. It aims at identifying the most productive and woman friendly charkha.

The objectives of the study were:

- To make a profile of the women working in charkha spinning units
- To understand the job context and content of charkha spinning
- To identify the occupational and non-occupational health problems of charkha spinners
- To evaluate the man-machine system of charkhas by assessing a) the postural and physical stress, b) productivity, and c) the workers’ perceived exertion in spinning with the three types of charkhas
- To select the most productive and woman-friendly charkha, and,
- To suggest measures for increasing productivity and reducing postural strain in charkha spinning.

An exploratory study design was followed for the present study. A baseline survey was conducted among a sample population of 150 workers to obtain a holistic picture of the spinning units, the background information of the
spinners and their work and working conditions. Data on physical stress, postural discomfort and postural stress were taken from a sub-sample of ten subjects each chosen from the three charkha operators using heart rate measurement, Corlette’s Body Discomfort Mapping Method and assessment of posture using draughtman’s flexicurve.

The study was conducted in Madurai and Dindigul Districts under the Madurai Region of KVIC. From a population of 601 spinners, one fifty spinners were chosen randomly from four khadi spinning institutions. The sub-samples for the detailed work study were chosen purposively from among those working on the three varieties of charkhas chosen from three adjacent units.

Findings

Khadi spinners were all women. Seventy nine percent of them were from rural areas. Most of them (85.3 percent) belonged to Hindu religion. Three fourths belonged to backward community.

The workers belonged mostly to small sized nuclear families with monthly income ranging from Rs.216/- to Rs.7844/- with a mean of Rs.2045.4/- (± 362.31). Fifty nine percent of the families were below the poverty line of Rs.2000/- and less per month.

The workers were in the age range of 16 to 48 with a mean of 29 years. One half of them were either illiterate (23 percent) or literate with primary level
of education (27.3 percent). Fifty three percent of them were either unmarried or widowed or separated. Fifty three percent of the workers had children and their number ranged from one to four with a majority having two and less number of children.

The charkhas used for spinning were of six, eight and twelve spindles. The six spindle charkha is a hand operated simple machine made of wooden frame. The eight spindle charkha with iron frame also is operated by hand. The twelve spindle charkha is a pedal operated spinning machine made of iron. The operator squats on a raised stool to operate this charkha.

The spinners working on six, eight and twelve spindle charkhas constituted 46.7 percent, 27.3 percent and 26.0 percent respectively of the study sample. They had one to twenty five years of experience in charkha spinning. The majority of the workers had less than 10 years of work experience. The aged workers generally opted out of this work giving room to younger ones in their families for work.

The monthly earnings of the spinners ranged from Rs.245/- to Rs.897/- with a mean of Rs.418.1 (± 259.2). Around fifty three percent of them were marginal earners and 36.7 percent were supportive earners. The workers on an average contributed to 28 percent (± 7.3) of their family income.
Garland making, basket making, tailoring and agricultural labour were the supplementary occupations of 13 percent workers. Twenty seven percent of the spinners were active in women’s clubs. Watching television and listening to radio were their main recreational activities.

Regular income yield (76.7 percent), indoor work (76.7 percent), availability of work within the locality (45.4 percent), lack of skill in other jobs, prestige attached to the work, persuasion of family members and the need to supplement the family income were the personal and family reasons reported by women for taking up this economic activity.

The workers reach the units by 8.00 a.m. and work till 5.00 p.m. in the evening. To operate the six and eight spindle charkhas women squat in front of the charkha on the floor with one leg bent at the knee facing the charkha. The handle of the charkha is rotated with the right hand in the clockwise direction. For operating the twelve spindle charkha, the workers sit on a raised stool with its seat sloping downward toward the charkha. The charkha is operated by pedalling. On spinning five hanks of yam, the operator suspends the operation of the charkha for a while to remove the yam.

The spinning work in the unit generally starts at 8.00 a.m. and extends upto 5.00 p.m. The workers get half an hour for lunch break and two short rest pauses. Overtime work is not popular. Forty percent of the spinners had
received short-term formal training in spinning. The others learned the work from their kith and kin through informal work participation. Operation, oiling and maintenance were the skills known to the workers.

The spinners worked for 9 to 27 days with a mean of 19.6 days in a month. The mean daily earnings of the spinners working on six, eight and twelve spindle charkhas were Rs.21.4, Rs.24.3 and Rs.25.3 respectively and the difference was significant.

At the spinning unit, the raw cotton in the form of sliver i.e., untwisted fibre, is supplied to the spinners. The sliver, as its passes through the charkha, comes out as yam. The yam is measured in hanks. One hank is one thousand metres in length. For payment of wages, piece rate system is followed in khadi units. Payment is done either weekly or biweekly or monthly.

The workers reported spinning 5 to 45 hanks of yams per day with a mean of 14.0, 26.9 and 29.0 hanks per day in the six, eight and twelve spindle charkhas respectively. The production potential of the spinners increased significantly with increase in the number of spindles in the charkhas.

The wage of a person and other benefits (Welfare fund and incentives) is calculated from the number of hanks of yam spun as per rates prescribed by KVIC from time to time. For festive occasions like Deepavali, incentives and
money from the welfare fund are given to the spinners in cash or in the form of cloth.

Each spinning unit is housed in a single roomed building with an enclosed stock room and an attached toilet. The floor area of the spinning units ranged from 5 to 12 sqm. and the area of the stockroom 2 to 4 sqm.

The units were seen congested with inadequate moving space between the charkhas. The number of charkhas in a unit ranged from 19 to 30 depending upon the space availability. The space in between two charkhas was 60 cm, 75 cm and 85 cm for six, eight and twelve spindle charkhas respectively.

The mean temperature inside the spinning units was 35ºC. The illumination levels in the units ranged from 22.2 to 174.1 lux with a mean of 41.9 lux in six spindle charkha units, 96 lux in eight spindle charkha units and 81.9 lux in twelve spindle charkha units, a level much below the recommended level of 250 to 300 lux for such units having moderately precise work. The noise levels recorded for the six, eight and twelve spindle charkha units were 77.8, 84.4 and 82.2 dBA respectively i.e., within the permissible limits.

The mean rating of satisfaction of the workers regarding their rest periods, work hours, wages, fringe benefits, status of work, tools and equipment and work environment was the highest for those working on eight spindle charkhas. Light, ventilation, hours of work, rest hours, sanitary facilities,
health problems, seating arrangement and noise were the criteria chosen for identifying the level of physical stress experienced by the spinners working on the three charkhas.

The total mean score of psychological stress was 2.2 for all the three charkhas. Stress due to lack of interest in work was found to be significantly different for the different charkha operators. Those working on twelve spindle charkhas were found to be most interested in the spinning work probably because of the speed of work and higher earning potential.

One out of every two women working on eight spindle charkhas as against one third of those working on six and twelve spindle charkhas did not experience any health problem during the reference period. Respiratory complaints like cold and cough and wheezing were reported by around 10 percent of the spinners. Defective eyesight, chest pain, muscular pain, pain in legs/joints/hands/stomach/shoulders and back pain and diseases like fever, uterus problem, anaemia, ulcer, were the main health problems observed.

Excessive sweating and dryness of throat and mouth was reported by more than 85 percent of the spinners while working. Rapid breathing and headache were reported by more than 60 percent of the respondents. Tiredness, shivering, giddiness and increase in heart rate were the other physiological discomforts of the spinners. Preventive/curative measures undertaken by the
spinners were allopathic treatment (36 percent) and home remedy (11.3 percent) and few of them reported ayurvedic treatment (4 percent) and homeopathic treatment (0.6 percent).

Rest (88 percent), change of hands (60.6 percent), sleeping/lying down (54.6 percent), change of posture (24 percent), massaging (5.3 percent) and taking pain killers/application of pain relieving oils (5.3 percent) were the self care activities undertaken while at work in order to relieve fatigue.

The mean body discomfort scores of the spinners estimated by Corlett’s body discomfort mapping method show that in six spindle charkha, the body discomfort was the highest (2.0) at the shoulders and it reached its peak by the time they were to finish the day’s work. The pain level was significantly different from lunch break. Upper arm followed by lower back were the next most commonly reported painful parts of the body.

Those working on eight spindle charkha reported lower back and shoulders as the most painful parts of the body. The lower back (1.3) and thighs (1.1) were the body parts reported to be experiencing the highest level of discomfort among twelve spindle charkha operators. The pain was so severely felt at the end of work that nobody could work overtime. The other parts of the body experiencing discomfort were leg, foot, mid-back and upper back. Since
the twelve spindle charkha is pedal operated, exertion is mostly felt on the thighs and legs.

In the case of six spindle charkha significant increase in pain level was noticed in three different parts of the body, (shoulders, upper arm, and lower back). The comparison of the mean discomfort scores shows low pain levels in the upper arms among eight spindle Charkha operators. The total body discomfort scores showed a significant difference in the pain levels of the three categories of charkha spinners.

The body angle and lumbar angle of the hand extended and hand down posture differed significantly from the straight sitting posture in both six and eight spindle charkhas. In the case of twelve spindle charkha operators, the body angle and lumbar angle differed significantly even while sitting in the straight sitting posture. Thus an additional stress on the spine to maintain the straight posture for a long period of time was evident in this category of workers.

The paired ‘t’ test done on the heart rate of the workers at different periods of the work day showed a significant difference. The mean working heart rate of the six, eight and twelve spindle charkha spinners was 85.8, 94.8 and 91.1 beats/minute respectively. A significant difference was noticed between the heart rate of spinners working on the three varieties of charkhas.
The working heart rate however did not vary significantly at different intervals indicating that there is no accumulation of fatigue.

According to the workload classification the work on the six spindle charkha is a very light activity while work on the eight spindle and the twelve spindle charkhas is a light one. The mean rating scores of perceived exertion experienced while operating the six, eight and twelve spindle charkhas were 2.02, 2.95 and 2.71 respectively on a scale with values ranging from zero to four.

The total cardiac cost of the subjects working on the three varieties of charkhas was not statistically significant. The mean cardiac cost of spinning one hank of yarn on six spindle charkha was the highest (292.0) and the lowest (191.8) in the eight spindle charkha.

The analysis of the yarn production data of the workers collected over a 90 day period showed a mean spinning rate of 11.37, 17.65 and 25.28 hanks of yarn/day on the six, eight and twelve spindle charkhas respectively. An increase in yarn production by 2.2 times was observed with shift from the six spindle charkha to the twelve spindle charkha.

The man-machine system for spinning was found most appropriate in the case of twelve spindle charkha followed by eight spindle charkha. A shift in the position of its handle in the hand wheel so as to bring it close to the body of the
worker may reduce the effort of operation of six spindle charkha. Any reduction in the diameter of the wheel though advisable to reduce the effort of spinning, may retard the speed of spinning and cannot be considered a welcome change though some of the workers suggested this change.

Low income, high workload, low speed of production and loss of income due to wastage/fineness of yam were the major problems encountered by women in charkha spinning. Though many of the workers could not suggest any change in the charkha for making it more worker friendly, the modifications suggested were increase in handle length, proper fixing of the wooden portion of the handle and its power operation. The twelve spindle charkha workers suggested increase in the length of the pedal and the attachment of a wooden piece to the pedal of the charkha to increase its length to facilitate ease of pedalling.

Twenty five percent of the respondents wanted the charkha to be mechanised with electrical power. Nineteen percent of the respondents demanded regular supply of raw materials for optimising income from this job. The other suggestions given by the spinners were addition of more spindles to the charkha, proper maintenance of the charkha, increase in the speed of rotation of the spinning wheel and the height of the charkha and the seat. The major reasons reported by the respondents for not doing overtime work were
their tiredness and pain due to continuous work. One third of the respondents complained of personal problems like household responsibilities as factors discouraging production work. Ageing and health related discomforts reduced the production potential of a few workers.

To reduce the stress of women in six spindle charkhas the handle of the charkha may be shifted toward the front of the charkha. Provision for alternate left/right hand operation is desirable in both the six and the eight spindle charkhas to facilitate the use of both right and left hands without awkward operation of the handle on the right side by the left hand.

The length of the handle in the case of eight spindle charkha is to be reduced to one half to prevent undue stretch of the hand during forward and backward motions. Pedal operation can bring further reduction in the postural stress of the workers.

For operating the twelve spindle charkha, the stool used by the operator can be given a back support. Poised sitting posture is to be ensured through worker education. Increase in pedal length of the charkha and adjustable work height for the stool is desired for helping short persons to sit comfortably and work. Light and ventilation in the work units are to be improved to reduce physical stress at work site.
5.2 Conclusion

Charkha spinning is done solely by women. Though the work is light it poses postural strain because of the defective posture at work and long hours of work. The twelve spindle charkha is the most productive woman friendly charkha. A shift from the older models of charkha to the twelve spindle charkha is felt appropriate.

53 Recommendations

It would be better to abandon the use of the six spindle charkha which is found to be the least productive and the most strenuous to work on. A policy decision on this is desired.

The eight spindle charkha, though not as productive as the twelve spindle charkha, may be retained to help elderly women to take up spinning as a vocation.

There is need to modernise the charkha spinning units with twelve spindle charkhas and the rooms need to be well lit and ventilated. The operation of 12 spindle charkha needs to be analysed and studied further in depth to arrive at propositions for work improvement.