A STUDY ON SWEEPING AND MOPPING OPERATIONS

By

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Thesis submitted to the Chaudhary Charan Singh Haryana Agricultural University in partial fulfilment of the requirements for the degree of:

MASTER OF SCIENCE

in

FAMILY RESOURCE MANAGEMENT

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HISAR

1997


DEDICATED
To my
BELOVED PARENTS

CERTIFICATE I

This is to certify that this thesis entitled, "A study on sweeping and mopping operations", submitted for the degree of Master of Science in the subject of Family Resource Management of Chaudhary Charan Singh Haryana Agricultural University, Hisar, is a bonafide research work carried out by Ms.Alka Gupta under my supervision and that no part of this thesis has been submitted for any other degree.

The assistance and help received during the course of investigation have been fully acknowledged.

5/2/97

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CERTIFICATE II

This is to certify that this thesis entitled, "A study on sweeping and mopping operations", submitted by Ms. Alka Gupta to the Chaudhary Charan Singh Haryana Agricultural University, Hisar, in partial fulfilment of the requirements for the degree of Master of Science, in the subject of Family Resource Management, has been approved by the Student's Advisory Committee after an oral examination on the same.

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(Alka Gupta)

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CHAPTER 1

INTRODUCTION

INTRODUCTION

Management of resources required for accomplishment of work at family, community and other levels. Management of household level work and work simplifications go side by side. Time, money and energy as a resources of home-makers are directly affected by these two aspects at household level. Any change in knowledge or skills of home-makers regarding management of household work have direct bearing on home conservation of time, money and energy of home-makers.

The home-makers act as managers and workers at domestic level who face taxing in terms of resources particularly time, energy and money. If they do not follow the techniques of household management and work simplication in effective manner, the situation become more critical. Generally speaking most of home-makers waste lot of time and energy while carrying out domestic work due to unplanned and unorganised arrangement of equipments and supplies used to perform the job. To put a dent on the problem in positive direction knowledge and application on scientifically base technologies have served the home-maker in big way. The difference in working efficiency and comforts of rural and urban home-makers are due to availability of scientific appliances to perform the household activities and tells the story of same event.

Careful planning and organising of the home activities can save the home-maker from backache, arm strain, shoulder strain and overall tiredness.

The good posture during work does not damage the body. Inturn it reduces the physiological cost of work and minimize the fatigue, while the poor posture increase the muscular effort which results in a higher physiological cost of the body and fatigue.

Any household activity require physical effort and work is performed at the expense of energy. The account of energy spent, however, depends on the level of physical activity. The energy expenditure a physiological parameter has been in extensive use in the evaluation of muscular effort. The efficiency of any physical activity varies according to the type of activity and the manner in which it is performed. The dimensions of equipments used for performing household activities effect the body posture. The activity in itself may not be strenuous one, but the distorted posture can cause not only discomfort but also bring about some adverse changes in the body.

There is variation in energy expenditure with the change in the posture. It was also reported that bending require more energy than reaching out for and working at a convenient height (Longworthy and Barott, 1920; Aterya, 1987).

The total energy consumption of domestic work on an average day i.e. 2600 to 2700 kilocalories which may increase upto 2800 to 3000 kilocalories on wash day (Grandjean, 1973).

There is a dire need of the day to study the household activities from ergonomics point of view to find out some right method of work, working

postures, equipments and working environment, so as to minimise the energy expenditure on household activities and to protect the muscles from over stresses. It has been observed that in every home the home-maker daily spends a major portion of her time on the routine kitchen chores and other household activities. Out of these home activities the task of cleaning the house is also considered one of the most important and can not be avoided.

Brooming and mopping are the two sub-unit of this activity. It has been observed that the method of cleaning did not change for centuries and hand made brooms and mops are used until today. In the past generations the characteristics of domestic equipment were not considered seriously in terms of comfort, speed and quality along with good posture. For brooming and mopping activities one has to consider the dimensions of the worker the posture maintained while performing the task. The home-makers may not be aware of the fact that the postures in which they work may be detrimental to their health. Besides, they might not be knowing the energy or exertion cost of such activities in a particular posture.

Keeping in view the above facts, the present study has been performed with the following specific objectives:

1. To know the availability and use-pattern of different types of brooms and mops in market and urban homes.
2. To determine the physiological stress of commonly used brooms and mops in different postures.

3. To study the acceptability of improved model of broom and mop among the home-makers.

Scope of the study

The findings of this investigation may be helpful in selecting right method of brooming and mopping, right use of posture and right choice of equipment which minimise the energy expenditure of home-maker during floor caring activities. The saved energy can be used for other household activities.

Limitations of the study

The present study had a few limitations.

1. The researcher faced some practical difficulties in getting the responses from the respondents during the survey. Inspite of this, every care has been taken in collecting the required data.
2. Due to limited number of different types of brooms and mops, replications were done on different days rather than different model.
3. Due to shortage of time, the acceptability of the improved model of mop has been restricted to limited respondents.

CHAPTER 2

REVIEW OF LITERATURE

REVIEW OF LITERATURE

A brief resume of work done related directly or indirectly to the present study has been reviewed under the following sub-heads:

2.1 Posture at work

2.2 Energy expenditure during work

2.1 Posture at work

The knowledge of correct postures, adequate working heights and the right method of work performance can help in reducing the physiological cost of work to the minimum. The improvement in working conditions in the home can enable the homemaker to reduce energy expenditure in domestic activities and increase the working capacities of the homemaker whereas the poor body posture increases the muscular efforts and results in a higher physiological cost of the body. The physiology of different postures has been discussed here.

Among the earliest studies some researchers reported that there was a great effect of posture on energy expenditure. They found that bending required more energy whereas working at a correct height required the least energy. However, in carrying loads up and down stairs, most of the energy is utilised in maintaining the posture of the body. It was also concluded that there was a gradual increase in energy expenditure as more and more organs of the body were involved in the work (Longworthy and Barott, 1920 and Orsini and Passmore, 1951).

Other investigators identified that working position (Sitting or standing) must permit which relies on the natural balance and not a distorted posture. They compared different postural conditions and found that small changes in sitting and standing postures have a significant effect on muscular tension. It was concluded that standing posture was more favourable for arm motions than the sitting posture (Snorrason, 1955, Bratton, 1959 and Grey *et al.*, 1966).

Different conclusions have been attributed to these results in different studies conducted so far. Fahrni (1966) identified that sitting on cushion on the floor with or without the back against the wall while hugging the knees was not only a good relaxation of the spine but also comfortable. However, the feeling of heaviness in the legs and distension of the feet which appeared during prolonged sitting posture were due to the increase of the volume of the lower limbs. The compression of the backside of the thigh produced a greater increase of the foot volume. Three factors responsible for this increase were hydrostatic pressure, vasodilation and disturbances of the venus blood return (Pottier *et al.*, 1969).

Vos (1973) found that bending and kneading requires less energy and were less strenuous, when one hand (arm) is used as a support to balance the trunk. At high forward movement frequencies (more than 4 metres per minute or 5 movements per minute) the bending posture without arm support is less strenuous than squatting and sitting on one legged stool. At low movement frequencies the squatting posture is preferable. Heart rate and energy

consumption were slightly higher than that when sitting, but performance and also the gradient of the heart rate were slightly more favourable. A remarkable increase in the work load was observed in the bending posture only when the working level was lower than the level of the feet. If work had to be carried out on the ground itself than squatting appears to be the most favourable posture.

Jain (1973) calculated the human energy expenditure while brooming the floor with brooms of various lengths. It was found that from the study that brooming with 122 cm long fur Jharu in erect standing posture is least tiring for the body as compared to 97 cm and 70 cm long fur jharu and bamboo stick jharu, respectively. Out of the three postures i.e. erect standing, standing cum bending and sitting cum bending, erect standing posture took the minimum energy and sitting cum bending the maximum.

Jindal (1974) studied that the physiological costs while ironing during sitting and standing positions, reported that light iron increased the heart rate more than the heavy iron. This may be so, because with the heavy iron the homemaker had to exert less of pressure for ironing. There was a small difference in the energy requirements between sitting and standing at the 69 cm height. However, marked differences were seen between the two standing positions during ironing i.e. ironing at the 69 cm height and at 82 cm height respectively. The maximum amount of energy was required in the sitting position followed by ironing at the 69 cm height and then ironing at 82 cm height.

Dhesi and Chahal (1975) observed the effects of stages of chapati making and angles of body bend on heart rate during sitting and standing postures. They found that heart rate was maximum during rolling stage of chapati making both in sitting and standing postures and increase in heart rate was more in sitting position than standing position.

Coreett and Bishop (1976) recorded that standing and sitting position without lumbar support gave rise to pain in feet and lumbar region. Sitting without support of back lead to a pain in the erect or spinal muscles. Sitting without good foot rest of the correct height gave rise to pain in the knee, legs and lumbar region.

Jyoti (1980) studied the physiological cost of chapati making in squatting and standing positions and analysed that energy expenditure was more for kneading the dough and chapati making in squatting position than in standing position.

Dhillion (1982) while studying the physiological costs of dish washing in different postures conclude that among the various body positions, dish washing while standing at sink level was found least fatiquing followed by sitting on *Patra* and *stool*. However, squatting on the ground was found to be tiresome as compared to other body postures.

Mehta (1982) studied the physiological cost of mopping the floor in different body postures. She reported that mopping in erect posture (when done with long handled mop) consumed minimum energy and had minimum

effect on heart rate. The area of floor mopped in erect posture was also doubled at the same time as compared to squatting posture.

Bala (1984) concluded in her study that mean energy expenditure for churning of milk (curd) was significantly higher during standing near working counter as compared to sitting on *patra*. The mean pulmonary ventilation rate was higher in standing near working counter than sitting on *patra* or *pihri*. Therefore, it was concluded that among various body positions, churning while sitting on *patra* was found least fatiguing followed by sitting on *pihri*.

Kaur (1985) while assessing ergonomics of washing the floor, with brooms of different lengths. It was concluded that energy expenditure and pulmonary ventilation rate of the subject of varied heights were minimum, when floor was washed with 90 cm long broom used in squatting posture as compared to 50 cm or shorter broom length used in squatting cum bending postures.

Sidhu (1985) compared the time consumed and distance travelled with postural variations for cooking in existing and in improved kitchens of rural homes. She found that the reduction of sitting and bending postures while working in the improved standing level kitchen was 1.5 times (58.7%) and 4.0 times (36.0%) respectively, while bending and standing postures were reduced by 5.0 times (41.5%) and 1.6 times (98.0%) while working in the improved sitting level kitchens.

Hanspal (1985) made a study of kitchen surfaces and storage spaces suited for Punjabi ladies. The results showed that elbow height increased with the increase in the height of the person. The suitable heights for persons of 150 cm were 75 cm (for boiling, kneading, rolling, puffing, frying and dish washing) and 85 cm (for peeling and cutting of vegetables) and 6.2 cm when working in standing posture.

Atreya (1987) concluded that the physiological cost of work during the performance of activities i.e. cutting, grinding and cooking at two different heights (standard and preferred height) of the kitchen platform was different. The results have shown that the energy expenditure was more at standard height compared to preferred height. She also found that grinding is an activity which has high physical cost of work and there is significant change in energy expenditure due to the height of the kitchen platform, body types and activities.

Report of AICRP of PAU (1985-87) concluded that postural changes (sitting and standing) level kitchen respectively and it was 0.2 times and 0.7 times in the improved kitchens. Bending in the existing sitting level kitchens was on the average 11.9 times and 10.9 times in the standing level kitchens while the same activity was 6.8 times and 6.9 times in improved sitting and standing level kitchens respectively.

Oberoi *et al.* (1987a,b) reviewed the ergonomics assessment of household activities and concluded that all household activities should be performed in the right postures initiated by less bending of the back since it puts less

strain on muscles and ligaments of backbones and reduce the physiological cost of work.

Singal and Srinivasan (1991) while conducting a study in Hisar district with a sample of 120 rural women from nuclear household indicated that the commonly adopted postures for performing selected domestic tasks were squatting and/or sitting on the ground and bending. The physiological cost of work was maximum in the postures adopted by the subjects. The study further revealed that they were increasing the drudgery of the household work due to lack of knowledge of work simplification techniques which can save time and energy.

Puri (1992) analysed that grinding of masala while sitting on *pihri* among various selected body postures is least fatiguing and requires minimum energy and minimum stress on other physiological conditions of the body such as heart rate, blood pressure, pulse rate, respiration frequency pulmonary ventilation rate, are muscular fatigue and grip fatigue during activity followed by sitting on *patra* and standing at counter level. But squatting on ground is relatively more tiresome position for the selected activity.

2.2 Energy expenditure during work

The physical costs of the work of the home are thought in terms of effects on all the systems of the body that function during work. Energy expenditure is relatively light for many of the jobs in today's homes and is unlikely to be correlated with fatigue. The maintenance of working position is sometimes the most fatiguing aspect of the job. Movements made during

working may constitute beneficial exercise that are fatiguing or deterimental to general human being.

The worker's body constitutes her most important item of household equipment. The entire body involved in the work is the focus in work study for the homemaker. A relation between the amount of work performed, muscular activity, Blood pressure, grip fatigue and energy metabolism with respect to heart rate/ECG has been recognised long ago. The work done earlier in this respect has been reported here:

Before 1960's it was reported that light works such as reading and hemming increased the metabolism from 3 to 22% above resting on a chair. Dusting and sweeping being strenuous caused a metabolism increase of about 15 % above resting which require about 50 additional calories and the energy cost varied with the use of different methods and tools for same activity (Benedict and Johnson, 1919; Hoppes and Patten, 1943).

It was also showed that age, sex and race had no significant effect on the physiological cost of work. The study on the effect of different surfaces on energy cost while walking revealed that the type of surface had slight effect on the energy cost unless the surface was markedly rough, and the effect did not exceed more than 10 % than walking on a flat surface. (Glassow and Muller, 1951; Passmore and Durnin, 1955).

The vertical position caused a retardation of blood flow. This retardation was more marked when the home makers were passively tilted to the vertical position than when they stood even with as little motion as possible

(Mayerson, 1959). Tuttle and Horvath (1957) conducted experiments for dynamic work only, the systolic pressure increased but in case of static work diastolic pressure also, thus effectively lowering the pulse pressure. This was an indication that static work interfered with normal circulatory process which provide for muscle activity.

In decade of 1960-70's it was found that emotions and other physiological conditions cause the heart rate to increase and also showed that there was increase of 31 % in energy expenditure in case of ironing while sitting than sitting at rest. The increase was only 28 % in case of ironing while standing as compared to standing quietly. Later it was reported that working at the sitting, kneeling, squatting and standing positions consumed 0.3, 0.5, 0.6 and 0.8 Kcals/min respectively and excessive bending of leg and abdominal muscles increased the energy cost (Lehmann and Muller, 1962; Park and Rodbard, 1962).

The energy costs of making bed at different heights by employing the different techniques it was reported that the amount of energy decreased as the height of the bed increased up to a desirable extent. It was revealed that during any physical activity there was an increase in the systolic pressure whereas the diastolic pressure was increased only in case of strenuous activities (Singer, 1960; Best and Taylor, 1961).

It was concluded that there was a large increase in the heart rate when the static component was added. This could be due to nervous regulation of the heart rate indicated by unknown stimulus (Hansen and Maggio, 1963).

However, Andrews (1963) did not observe a significant relationship between the energy expenditure and heart rate during the static and dynamic arm work.

Some of the earlier workers stated that emotions increased the heart rate at rest and in light exercise, but had little influence on maximal heart rate. Other researchers further mentioned that preliminary increase in heart rate usually showed a tendency to level off after few seconds. It was emphasised that stretching of muscles caused vasoconstriction in muscles which resulted in the resistance to the blood flow and increased the systolic pressure. The pooling of blood in any part caused vasodilation in muscles and thus, increased the diastolic pressure (Guyton, 1963; Morehouse *et al.*, 1963 and Brouha, 1967).

It was reported that energy consumption in washing the floors was maximum and was minimum in sweeping the floors depending upon the type of floor (Koshy, 1964).

Nirmala (1965) studied the time and energy expenditure of ironing a sari at different work heights. At the commercial ironing board the oxygen consumption was less than at the study table. At floor level less oxygen was consumed per minute during sitting and ironing than during kneeling and ironing. However, it was stated that during rest, the energy consumption was 1 Kcal per minute during light work like sewing, knitting, peeling potatoes and for reaching for objects 56-183 cms on above the floor level, the energy expenditure was 1-2 Kcal per minute. For walking, sweeping, dusting, cleaning floor with long handled equipment and playing the piano, the energy

consumption was 2-3 Kcal per minute. The energy cost for washing floors, polishing floors, making beds, holding objects 10 cm above the floors and cleaning stair carpets was 3-4 Kcal per minute climbing stairs, lifting loads from the floor, dancing and gardening took about 4 Kcal/min or even more (Steidl and Bratton, 1968).

Later it was also stated that during cooking, the pulse rate ranged between 82 to 116 beats per minute as compared to 69 to 79 when at rest. Values above 100 beats per minute were registered during baking. This was considered to be the most fatiguing work. During washing by hand, the pulse rate ranged from 84-120 beats per minute when stacking the dishes in a dish washer, it was 93-111 beats per minute. Window cleaning gave rise to pulse rates between 97-136 beats per minute. While scrubbing floors in a kneeling position with brush and floor cloth the pulse rate varied from 98-117 beats per minute when cleaning in a standing position using a long handled scrubber and cloth, the pulse rate reached 107-137 beats per minute (Kilbom and Astrand, 1969).

Some authors compared the relationship between heart rate and body temperature during muscular exercise in hot environment. They found that on an average when the body temperature increased by 1°C, the heart rate increased by 32.2 beats per minute. There was a sharp rise in heart rate during the very first 15 seconds of exercise and than gradually heart rate became constant but in case of severe exercise, the secondary increase in heart rate may occur. Researchers investigated the effect of sex on heart rate using

light work on a bicycle ergonometer and concluded that men's heart rate were lower than women's during work, although their recovery patterns were almost similar (Brouha, 1967; Jones and Reeves, 1968 and Pirnay *et al.*, 1969).

However, it was also reported that the heart rate differed significantly among many of the postures. The return of the venous blood to heart was reduced in a bending posture, consequently the cardiac output decreases and there was an increase in heart rate. The highest mean heart rate when the subjects squatted on the ground may be due to the greater degree of body bend as compared to the other posture where the body bend was lesser (Astrand and Rodahl, 1970).

Charti (1971) studied the working heights of cooking units and revealed that there was increase in heart beats and blood pressure when the heights of the cooking units were uncomfortable. More physical fatigue developed due to higher energy cost on the uncomfortable heights. She recommended 81 cms the best cooking height for average Indian homemaker to work comfortably.

Chahal (1972) and Bala (1980) calculated the physiological cost of chapati making in sitting and standing postures and revealed that rolling stage of chapti making was more strenuous as compared to other operations of chapati making. It had maximum effect on the heart rate. The energy expenditure for kneading the dough and chapati making was found to be more, when done in squatting position than that of standing position.

Raja Gopal and Roy (1977) conducted a study on Indian adolescents to assess the energy cost of some selected activities like sweeping the floor, mopping, cleaning the table cover, walking with a load of 10 kg, sitting and reading, sitting and writing revealed that the average energy cost for these activities was reading 1.2 cal per minute, writing 1.3 cal per minute, sweeping the floor 2.4 cal per minute. The study further revealed that energy cost increased with increase in body surface area for heavy activities but not for light activities.

Mittal (1981) estimated the physiological cost while sewing clothes with hand and foot sewing machine and reported that energy expenditure was higher at ground level as compared to sitting on chair. Energy expenditure was more for sewing with hand sewing machine at 13.7 cm height as compared to sewing with foot sewing at the same height.

Oberoi (1981) did a comparative study on the physiological cost of washing clothes manually and by machine. The study revealed that energy cost and other physiological conditions of the body like heart rate, blood pressure, respiration frequencies and pulmonary ventilation rate while washing the selected load of clothes manually by sitting on *patra* and standing on platform (33 cm high) near sink were statistically comfortable. However, the arms and grip muscular fatigue were significantly low while washing the clothes in machine than manual washing in all postures.

Surabathula (1986) found that the heart rate values of the home makers for sweeping and mopping shows that the cardiac output rate for mopping

was higher as compared to sweeping. Sweeping by using traditional broom, the energy expenditure was higher and lowest by using vacuum cleaner whereas mopping by using ordinary cloth mop, the energy expenditure was higher and lowest by long wooden handle mop. She also stated that there was a significant effect in energy expenditure due to age, height, weight, body surface area of the homemakers and heavy work load had significant effect on light work load but the time of the day did not effect the energy expenditure.

Oberoi and Miglani (1987) measured cardiovascular responses while washing clothes manually and by machine. The highest mean systolic pressure during manual washing found when subjects were squatting on the ground and the lowest mean systolic pressure was while standing at sink level. The highest mean diastolic pressure during manual washing was also found when subject were squatting on the ground and the lowest mean diastolic pressure was found while sitting on 13 cm woven seat stool (pihri) and the lowest mean heart rate was found while sitting on a 61.5 cm stool (patra).

Singal *et al.* (1991) measured energy requirement while grinding dry spices manually. The highest average energy expenditure during manual grinding was found while squatting on the ground and the lowest was for grinding while sitting on *pihri* and *patra*. The later values were not significantly different from those found during standing at sink level and squatting on floor while dry grinding of spices.

Sandhu *et al.* (1991) conducted an ergonomic study of muscular fatigue (hand grip and arms) during manual grinding of dry spices in different postures. The lowest arm muscular strength was needed while sitting on *pihri* and the highest while grinding spices in squatting posture. Similarly, the significant lowest decrease of muscular strength of right hand while grinding in sitting position. *Pihri* induced less fatigue as compared to maximum fatigue produced in squatting position. Mean muscular fatigue (hand grip and arms) while sitting on *pihri* and standing at sink level was most significantly different from the muscular fatigue experienced while sitting on *patra* and squatting on floor during dry grinding.

Parvathi *et al.* (1993) conducted a study on energy expenditure for household activities i.e. meal preparation, house keeping, cleaning utensils, washing clothes, grinding masala and fetching water. They revealed that maximum time was spent by rural women on cooking followed by cleaning utensils and fetching water. The energy expenditure for the household activities such as meal preparation, house keeping, cleaning utensils, washing clothes, grinding masala and fetching water were 901.6, 43.3, 282.6, 248.4, 192.8 and 296.1 Kcal per day respectively. The average energy spent by the rural women for meal preparation and washing clothes was 5.6 Kcal per minute and for other activities it was lower. Meal preparation and washing clothes were more fatiguing operations for rural women than other household chores.

Critical appraisal of the review

The above review suggests that the household tasks is a complex phenomena and is a combination of static and dynamic muscular efforts which require several types of body postures like squatting, standing cum bending, standing, squatting cum bending and sitting etc. when these postures are kept for longer period it may cause damage to body muscles and joints. Improper heights of work place and equipments/tools puts more strain on the muscles and ligaments of backbone and thus increases the physiological cost and energy expenditure of the homemaker. The output of the homemaker can be increased with the same inputs if proper posture is maintained.

CHAPTER 3

MATERIAL AND METHODS

MATERIAL AND METHODS

This chapter deals with the methodological procedure and techniques used for conducting the present study. The study was conducted in three phases discussed as follows:

Phase-I: Availability of different types of brooms and mops in market and use pattern urban homes were studied through field survey.

Phase-II: Physiological stresses of women while performing the tasks of sweeping and mopping under laboratory conditions were evaluated. A model of mop was further improved upon and tested under laboratory conditions.

Phase-III: The acceptability of improved model of mop was tested in adopted field situation.

The research procedure followed has been described under the following subheads:

3.1 Locale of study

3.2 Sampling procedure

3.3 Variables and their measurements

3.4 Tools for data collection

3.5 Data collection

3.6 Analysis of data and statistical tools applied

3.1 Locale of the study

The first phase and third phase were undertaken in purposively selected Hisar district of Haryana state for the convenience and accessibility of the

researcher. Four localities i.e. New Campus, Old Campus of CCS HAU, 15-A Sector and Housing Board Colony from Hisar city were chosen for collection of urban sample (Fig.1).

The second phase was carried out in the Department of Family Resource Management, I.C. College of Home Science, Chaudhary Charan Singh Haryana Agricultural University, Hisar.

3.2 Sampling procedure

In first phase, a total sample of 100 home-makers were selected randomly using random sampling technique. To have representative sample from each locality, twenty five households were selected randomly.

In third phase, interested twenty home-makers from previously selected sample were taken for adoption of improved model of mop (Fig.2).

3.2.1 Procurement of models

In phase first, market survey was conducted and different types of brooms and mops available in the market was collected.

3.3 Variables and their measurements

3.3.1 Independent variables

3.3.1.1 Socio-personal variables

Age: Age refers to number of full years completed by the home-maker at the time of interview. They are placed under different age groups as follows viz., below 25 years, 25 to 50 years and 51 years and above.

Height: It refers to the height of the home-maker which were divided into two categories viz., 120 to 150 cms and 151 to 180 cms.

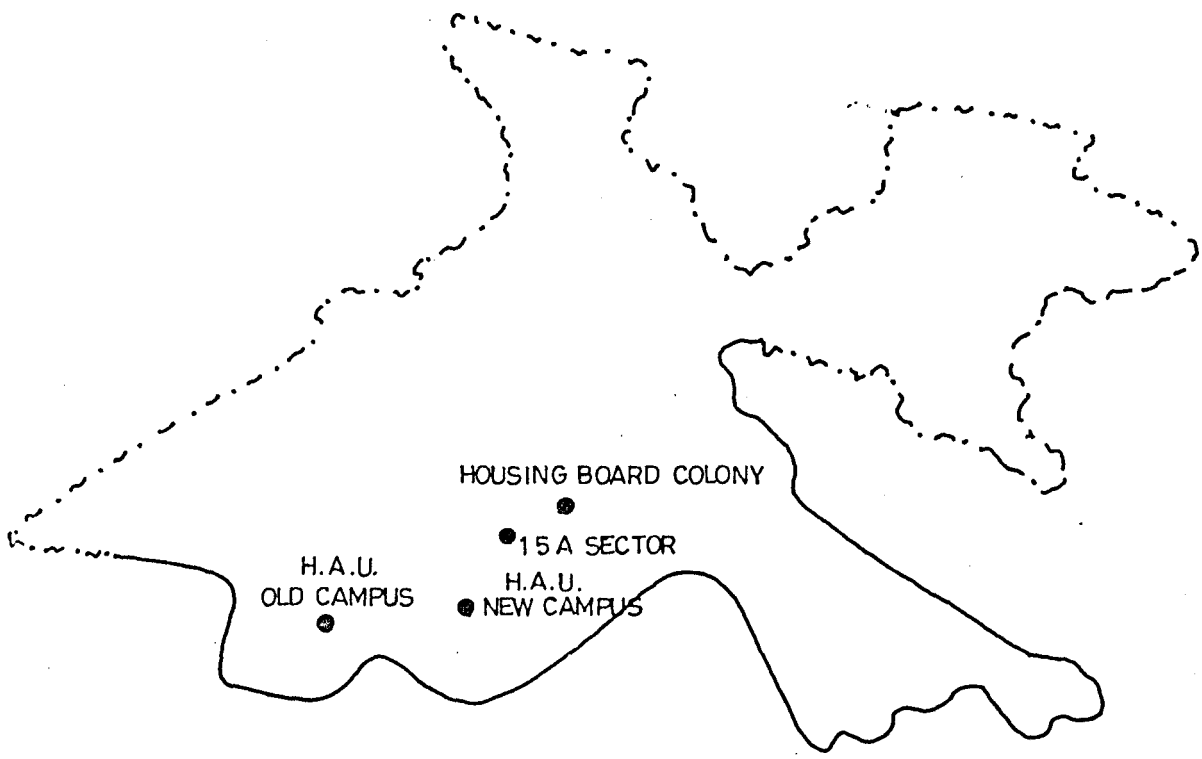
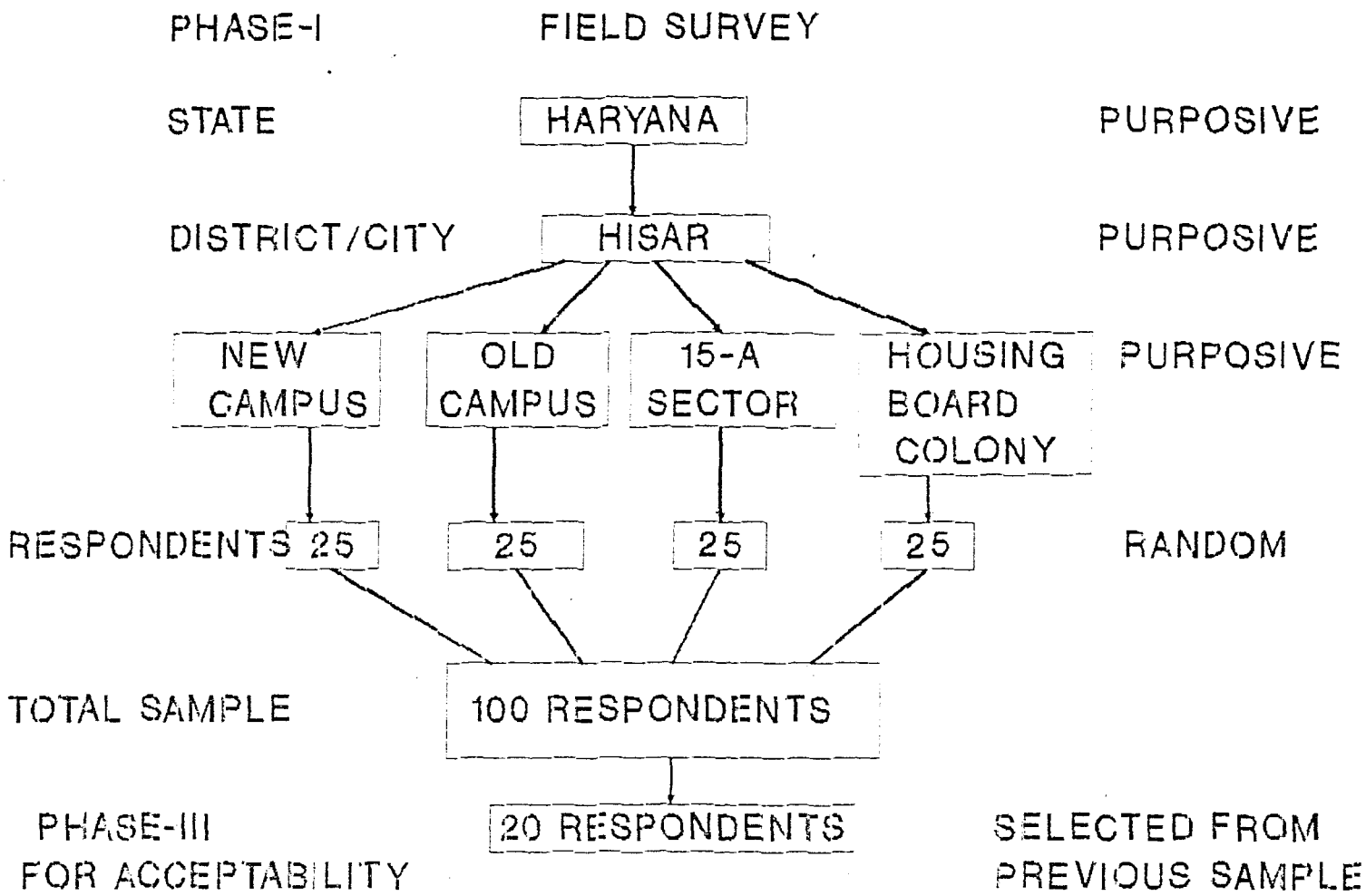


Fig. 1. MAP SHOWING SELECTED LOCALITIES OF HISAR CITY

Fig 2. SAMPLING PROCEDURE



Weight: This refers to the weight of the home-maker which were divided into two categories viz., 35 to 50 kg and 51-65 kg.

Employment status: It refers to the employment status of home-maker. They were classified into two categories i.e. employed and unemployed.

3.3.1.2 Socio-economic variables

Occupation of family: occupation refers to the head of the family as means of livelihood. These were divided into three categories i.e. business, service and independent profession.

Type of family: Type of family refers to joint or nuclear family. This variable was operationally measured by Modified Trivedi SES Scale.

Family size: It refers to the total number of members in the family. The home-makers were divided into three categories i.e. upto 3 members, 3 to 5 members 6 members and above.

Family education status: On the basis of calculation of cumulative frequencies this had been divided into three categories viz., low, medium and high. This variable was measured by Narwal Index.

Caste: Caste refers to the class on distinct hereditary order of society. The operation measure of caste was taken from the SES scale developed by Trivedi with slight modification. They are placed under three categories viz., low, medium and high caste.

Monthly income: It refers to the total monthly earnings of the family from all sources. These were divided into three categories viz., upto Rs.5,000, Rs.5,001 to 10,000 and 10,001 and above.

3.3.2 Dependent variables

Use pattern: Interview schedule for the use pattern of the home-makers regarding sweeping and mopping operations was developed (Annexure-I).

Different types of brooms and mops: Fur broom, palm broom, ordinary mop (made up of waste cloth material), ordinary mop in handle and sponge mop were collected and tested.

3.4 Tools for data collection

The interview schedules for phase-I and III were constructed after selecting the independent and dependent variables for assessing the use pattern of different type of brooms and mops in urban homes and its acceptability (Annexure-I & II). The interview schedule was constructed after bringing out the necessary changes.

In phase-II, different types of brooms and mops to determine the physiological stresses of women were collected. Tulaman balance for weighing dirt (Plate 3); measuring tape for measuring the floor space; stop watch for measuring time pulse rate and respiration rate; sphygnomanometer for recording blood pressure and grip dynamometer for measuring the grip strength (muscular fatigue of hand grip) were used.

3.5 Data collection

3.5.1 For phase-I and III the data were collected with the help of the pretested interview schedule so as to minimize the error. Pretesting was done on 20 respondents. The responses were recorded and tabulated.

Collection of experimental data:

The subjects were made acquainted with the different equipments and their functions for the study. The detailed procedure of sweeping and mopping were explained by the researcher. The subjects were asked to do work in relaxed mood to avoid any mental disturbance during the experimental procedure. They were also asked to come in comfortable dress for performing the activity.

Each experiment was lasted for 5 minutes and the three replications were conducted on each subject. The physiological parameters were observed within two minutes after the completion of each activity. Similarly, after the gap of three months the physiological parameters were recorded from the improved model of mop for comparing the physiological stress.

Phase-II: Experimental procedure

In laboratory, experiments were conducted in following procedure:

The physiological cost of sweeping and mopping activities were experimentally determined by using two different types of brooms (Plate 1) and three different types of mops (Plate 2), identified as the most frequently used in urban homes.

Brooms:

1. Fur broom
2. Palm broom

Mops:

1. Ordinary mop (made up of waste cloth material)
2. Ordinary mop in handle
3. Sponge mop

Plate 1: Different types of brooms (Palm broom, Fiwe broom)

Plate 2: Different types of mops (ordinary mop, ordinary mop in handle, sponge mop)

Plate 3: Reasearcher weighing the dirt

Plate 4: Measurement of Blood Pressure

Later on, improvements were made on the basis of their performance under laboratory conditions. The best features of these types of mops were combined to get an improved model of mop.

However, In case of brooms, the home-makers did not find any ergonomical difficulty in using the brooms so there was no necessity for improving the existing brooms.

Selection of subjects

Five home-makers were selected for the laboratory study approximately of a similar structure and age group.

Standardization of the activity

Two post graduate Family Resource Management students were participated in the laboratory trials. On the basis of broom and mop length, the different postures used were standardized i.e. sweeping with fur and palm brooms standing and squatting postures were used respectively. While and in mopping, with ordinary mop, squatting cum bending posture was used. standing cum bending posture was used both in ordinary mop in handle and sponge mop.

Seven hundred grams of dirt was collected and was scattered on a floor space of 21 x 13 square metres to be cleaned during experiment.

The two selected post-graduate students swept this area with two different brooms and mopped with three different mops. They took 5 minutes for each activity with an intermittent period of 5 minutes of rest in between each brooming and each mopping. Prior to and immediately succeeding each

activity the blood pressure, grip strength, respiration rate and pulse rate were recorded.

Measurement of physiological conditions

At rest: Before the start of the actual experiment, the subject was asked to take rest on a chair for 15 minutes. When the subject was in a steady state, her blood pressure, grip strength of hand (either right or left), respiration rate per minute and pulse rate per minute were recorded.

During activity: The data on various physiological conditions during sweeping and mopping were assessed with the help of different equipments. An attempt was made to record the data of various parameters of physiological conditions within two minutes after the completion of each sweeping and mopping activity. The parameters of physiological conditions of the body measured were blood pressure, muscular fatigue of hand grip, respiration rate and pulse rate. The detail of the parameters is given below:

***Blood Pressure*:** The blood pressure was measured with the help of sphygnomanometer. The upper level, of blood pressure was recorded as systolic pressure (mm Hg) and lower level was recorded as diastolic pressure (mm Hg). The reading was taken before and after the activity (Plate 4).

Muscular fatigue of hand grip: The grip strength of both the hands was measured with the help of grip dynamometer. It consisted of a handle for hand grip connected with a spring to a pointer on a marked dial. The subject was asked to pull the grip handle with right or left hand and the

reading given on the dial in kg was noted. The reading was taken before and after the activity (Plate 5).

Respiration rate: The respiration rate per minute was measured by counting the number of air inhaled and exhaled. It was measured with the help of stop watch (Plate 6).

Pulse rate: The pulse rate per minute was measured by counting the number of pulses of right or left hand with the help of stop watch (Plate 7).

3.6 Analysis of data and statistical tools applied

The data collected from 1st and IIIrd phase were coded, tabulated and analysed by using frequencies, percentage and mean scores.

After conducting the experiments, the data on all different parameters were compiled and tabulated. Analysis of variance (ANOVA) test technique was used to test the significance of differences.

Calculated value of variance ratio 'F' was compared with the corresponding table value.

Further, the mean differences were compared with their corresponding critical differences (C.D.) values. The C.D. was calculated with the following formula :

$$C.D. = \sqrt{\frac{2 \text{ Error mean sum of squares}}{\text{Number of replications}}} \times \text{'t' value at 0.05/0.01 levels}$$

Plate 5: Measurement of Griping

Plate 6: Measurement of Respiration Rate

Plate 7: Measurement of Pulse Rate

Plate 8: Sweeping with fur broom in standing posture

Contructional details of different models of mops are presented below :

Ordinary mop: Cotton cloth material is used for this type of mop. It is almost free of cost and changed whenever required. However, more bending occurs while using this mop.

Ordinary mop in handle: It consists of a round iron handle. Its length is about 95 cm and has a diameter of about 1.50 cm. The handle is attached with a horizontal plastic rod of 38 cm long with screws holding cotton cloth for mopping. It requires less bending however it does not have squeezing system. Its costs about Rs.35 (Fig.3).

Sponge mop: It consists of a round iron handle. Its length is about 116 cm and has a diameter of about 2 cm. The handle has two parts. The upper part having a length of 40 cm and is detachable. The rod of the handle is attached with horizontal plastic rod of about 24 cm long containing a sponge for mopping. This mop has squeezing system having a lever attached to the handle. However, it is costlier (Rs.65) and heavy in weight (Fig.4).

Improved mop: The best features of these types of mops were combined to get an improved model of mop. The improved mop consisted of an aluminium handle having a length of about 135 cm and 15 cm diameter. The aluminium rod is passed through an hollow iron rod of about 20 cm long and having a diameter of 2 cm. The one end of cloth is attached with a nail fixed with the lower end of hollow iron rod and another end of the cloth is attached with the bottom of aluminium rod. The cloth can be squeezed by rotating the aluminium rod in clockwise direction. The cloth is twisted and water is

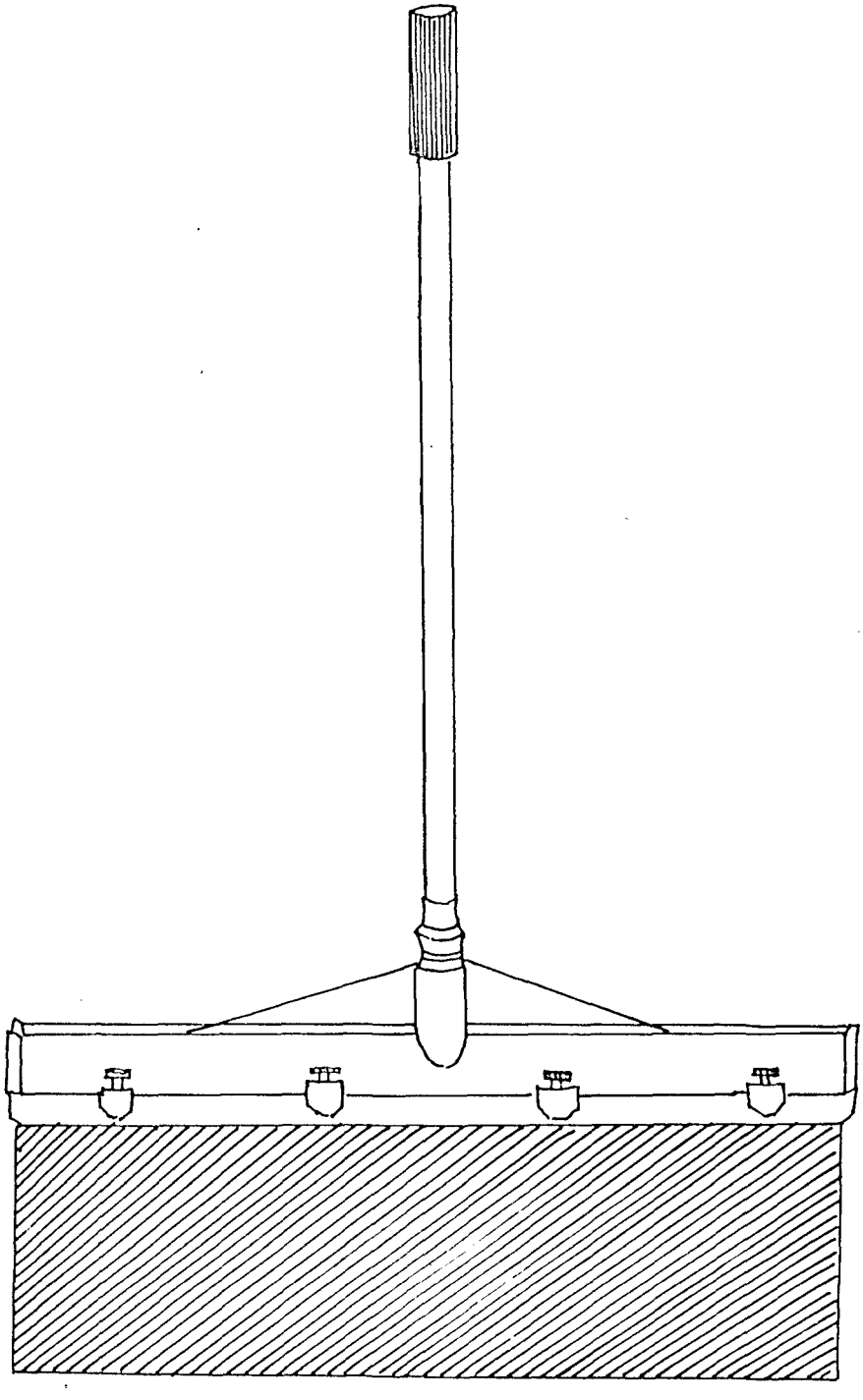


Fig. 3. ORDINARY MOP IN HANDLE

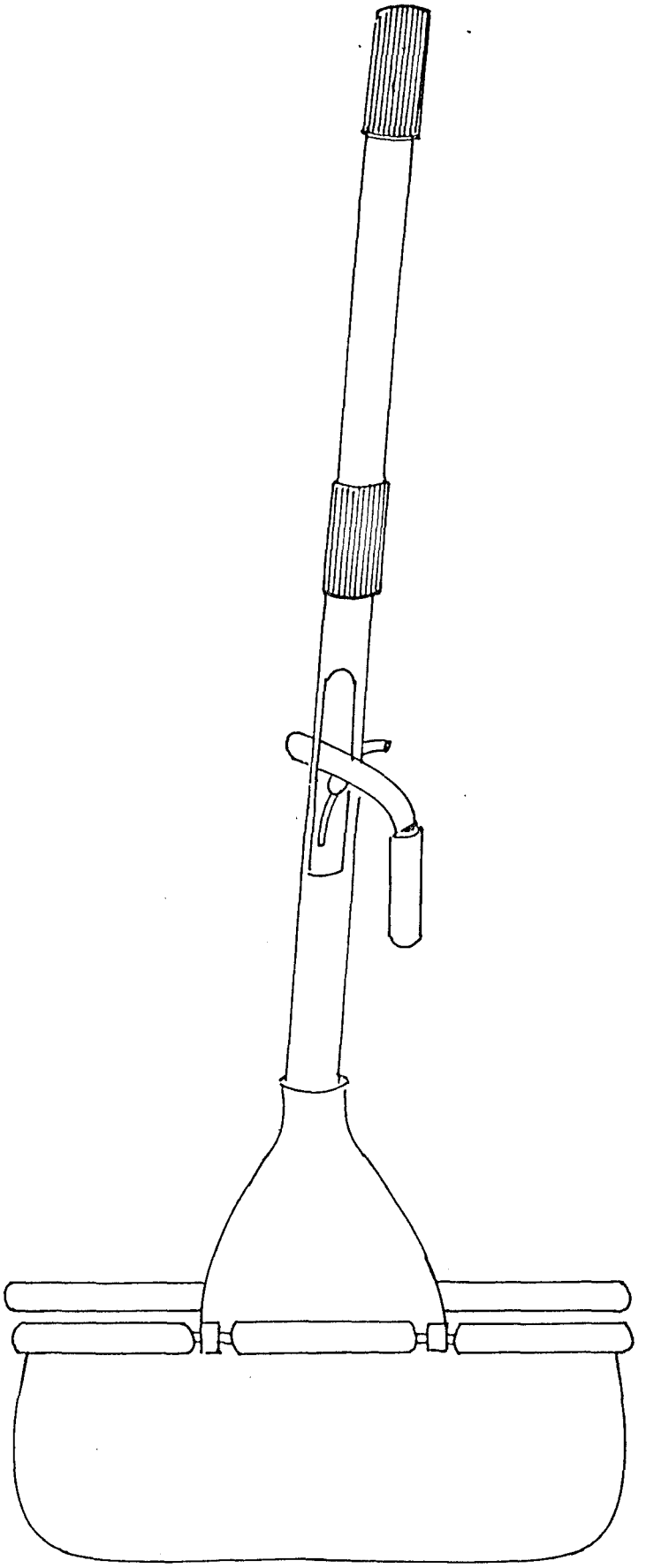


Fig. 4. SPONGE MOP

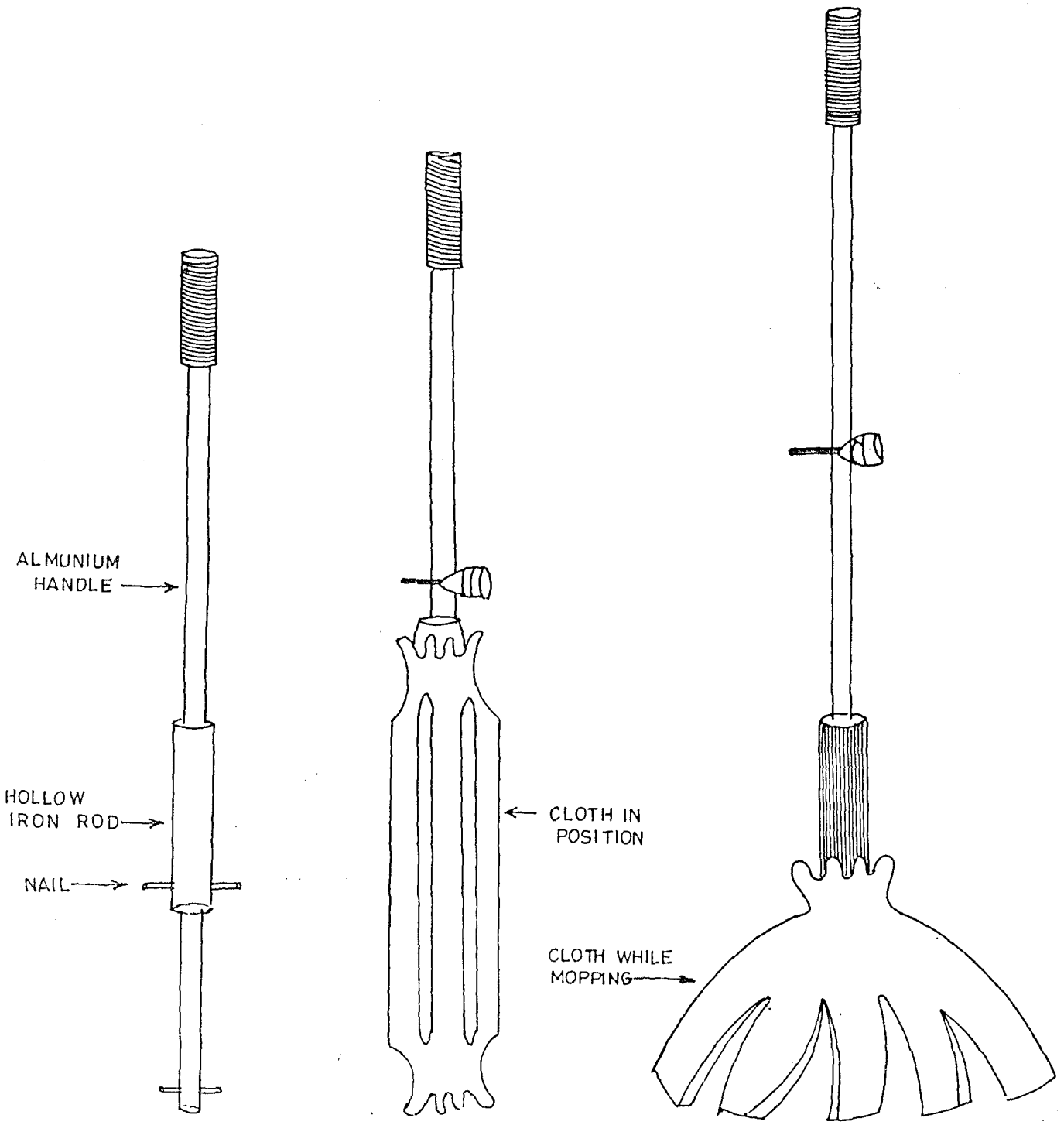


Fig. 5. IMPROVED MOP

squeezed out. The merits of the mop is that it can be constructed at home, and the cloth is changeable. It requires less bending while mopping due to its long and light handle. Its cost is about Rs.30/- (Fig.5).

CHAPTER 4

RESULT AND DISCUSSION

RESULTS AND DISCUSSION

This chapter deals with the results and discussion of the study which has been presented under the following sections

4.1 Availability of different types of brooms and mops in market

4.2 Background information of the respondents

4.3 Use pattern regarding sweeping and mopping operations

4.4 Effect of different types of brooms and mops on certain physiological parameters

4.5 Acceptability of the improved model of mop

4.1 Availability of different types of brooms and mops in market

Market survey was conducted to know the availability of different types of brooms and mops. The following types of brooms and mops are available in the market.

Brooms:

1) Fur broom
2) Straw broom
3) Small fibre broom
4) Palm broom

Mops:

1) Ordinary mop in handle
2) Sponge mop
3) Floor wiper

4.2 Background information of the respondents

To study the background information of the respondents, data on the relevant characteristics were collected. The findings concerning the attributes i.e. age, height, weight, employment status of woman, education, occupation, type of family, size of family, caste and total monthly income of the family are presented in Tables 4.1.

Age of the respondents: Table 4.1 shows that majority of the respondents (86%) were of middle age that is between 25 to 50 years followed by 51 years and above (9.00%) and only 5.00 per cent were in the age group of below 25 years.

Height and weight of the respondents: The data in Table 4.1 indicated that most of the respondents i.e. 68.00 per cent were having height between 151 to 180 cms while 32.00 per cent were having height between 120 to 150 cms and nearly two third of the respondents i.e 65.00 per cent were having weight between 51 to 65 kg followed by 35 to 50 kg (35.00%).

Employment status of home-maker: It is noted that a large majority of the respondents (62.00%) were full time home-maker i.e. were not employed anywhere while 38.00 per cent were employed outside home.

Family occupation: Regarding family occupation it was observed that 81.00 per cent were having service as family occupation followed by business and independent profession i.e. 14.00 and 5.00 per cent respectively.

Caste of family: As is depicted in Table 4.1 the distribution of the respondents on the basis of the caste showed that nearly two third of the respondents

Table 4.1: Distribution of home-makers according to their personal socio-economic variables

N=100

Attribute	Category	Frequency	Percentage
1. Personal variables			
Age	Below 25 years	5	5.00
	25-50 years	86	86.00
	51 years and above	9	9.00
Height	120-150 cms	32	32.00
	151-180 cms	68	68.00
Weight	35-50 kg	35	35.00
	51-65 kg	65	65.00
Employment status of home-maker	Employed	38	38.00
	unemployed	62	62.00
2. Socio-economic variables			
Family occupation	Business	14	14.00
	Service	81	81.00
	Independent profession	5	5.00
Caste of family	Low	2	2.00
	Medium	31	31.00
	High	67	67.00
Type of family	Nuclear	76	76.00
	joint	24	24.00
Size of family	Upto 3 members	29	29.00
	3-5 members	62	62.00
	6 members and above	9	9.00
Family education level	Low (2.00-3.00)	28	28.00
	Medium (3.00-4.00)	51	51.00
	High (4.00-5.00)	21	21.00
Monthly income	Upto Rs.5000	4	4.00
	5,001-10,000	48	48.00
	10,001 and above	48	48.00

(67.00%) belonged to high caste followed by medium (31.00%) and low caste (2.00%).

Type of family: A large majority of the respondents (76.00%) were having the nuclear family system than joint families (24.00%).

Size of family: Maximum number of the respondents (62.00%) had a family size of 3 to 5 members followed by 29.00 per cent who had upto 3 members in the family. Remaining 9.00 per cent of them had 6 members and above in the family.

Family education status: The data contained in Table 4.1 show that more than half of the respondents (51.00%) were having medium family education status while rest were having either low or high i.e. 28.00 and 21.00 per cent respectively.

Family income: Equal percentage i.e 48.00 per cent of the respondents had income between Rs.5,001 to 10,000 and Rs.10,001 and above per month. Only a few of the respondents i.e. 4.00 per cent had income upto Rs. 5,000 per month.

4.3 Use pattern regarding sweeping and mopping operations

This section again has been sub-divided into three categories to study the use pattern of home-makers regarding sweeping and mopping operations.

4.3.1 Preference of home-maker for different household activities

4.3.2 Help received for performing household work and their liked and disliked household activities.

4.3.3 Cleaning pattern with regard to space, time, type of broom and mop used, posture used and problems faced by home-maker while using different brooms and mops.

4.3.1 Preference of home-maker for different household activities

The rank order of extent of preference of home-makers in the household activities was assessed on the basis of total mean scores for each activity. Table 4.2 revealed that cooking was the most preferable task (m = 12.08) and received first rank. Dusting and cleaning utensils received second and third rank as they got mean scores 8.59 and 8.32 respectively. Attending to children's study at home, mending and account keeping were the tasks that earned low mean scores 5.71, 5.14 and 4.75 respectively. The other tasks i.e. mopping, ironing, shopping, sweeping, washing and child care had mean scores ranging from 6.10 to 7.83. Sewing clothes had the least mean score 4.37 and therefore was given lowest rank i.e. 13 (Fig.6). This could be attributed to one fact that the home makers did not have proper skill to perform this activity and might be getting the work done from the other paid sources.

4.3.2.1 Help received by home-makers in task performance: Table 4.3 depicts that more than half (59.00%) of the respondents cooked the meals themselves whereas 13.00 per cent households performed it jointly by the home-maker and her daughter. Only in 11.00 per cent cases it was done entirely by full time servants. As regards cleaning utensils a little less than half (48.00%) of the home-makers performed the task of cleaning utensils

HOME-MAKERS

HOUSEHOLD ACTIVITIES

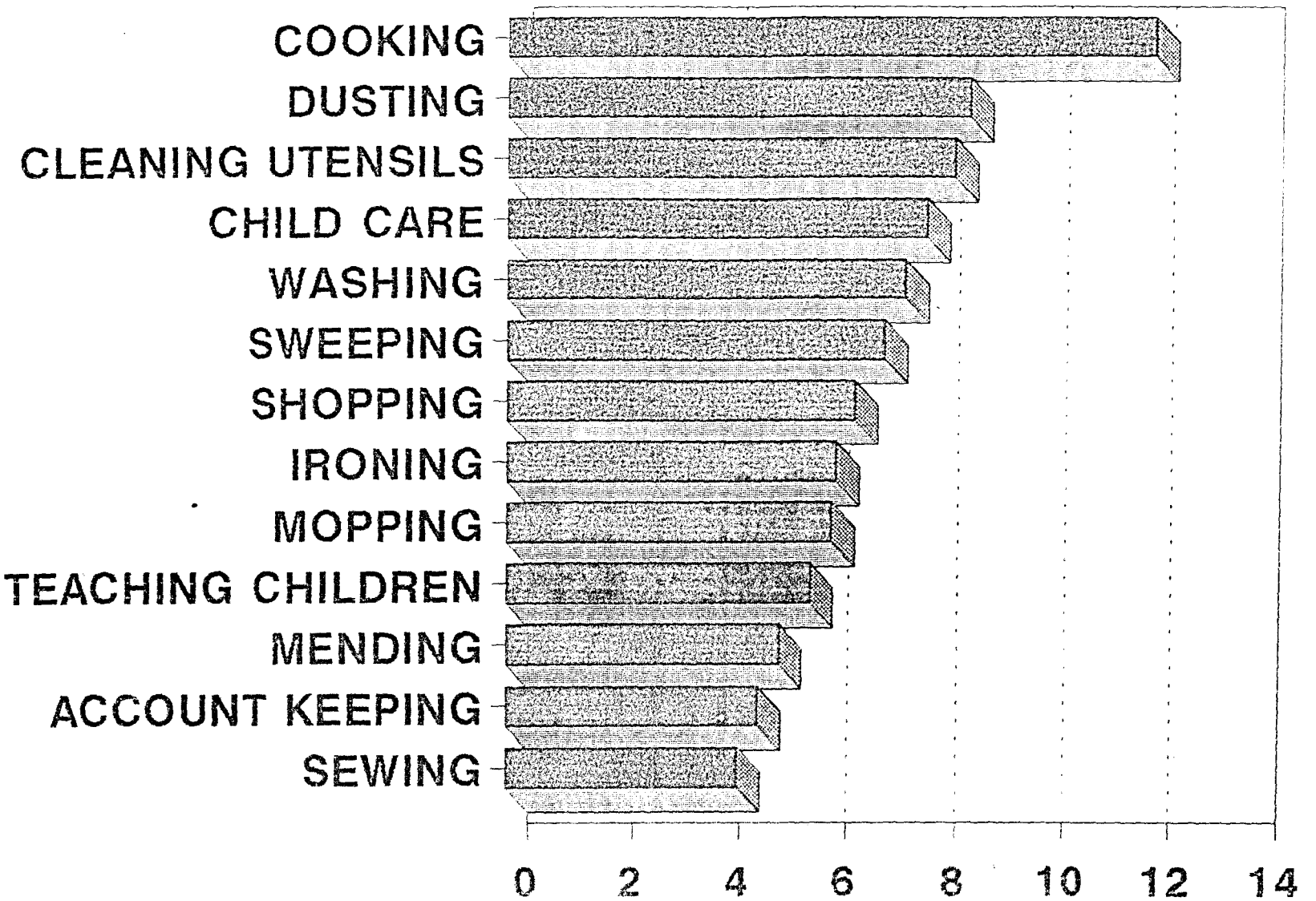


Table 4.2: Household activities preferred by the home-makers in order of performance

N=100

S.No.	Activities	Total mean score	Rank
1.	Cooking	12.08	I
2.	Cleaning utensils	8.32	III
3.	Dusting	8.59	II
4.	Sweeping	7.06	VI
5.	Mopping	6.10	IX
6.	Washing	7.44	V
7.	Ironing	6.18	VIII
8.	Mending	5.14	XI
9.	Sewing	4.37	XIII
10.	Shopping	6.52	VII
11.	Account keeping	4.75	XII
12.	Looking after the children	7.83	IV
13.	Helping in their studies	5.71	X

Table 4.3: Distribution of home-makers according to help taken by them in doing different household activities

N=100

Sr. No.	Helptaken Activities	Self	Husband	Daughter	Son	Full time servant	Part time servant	Any other	Self+ Husband	Self+ Daughter	Self+ Son	Self+ FTS	Self+ PTS	Self+ AO	Total
1.	Cooking	59 (59.00)	1 (1.00)	8 (8.00)	-	11 (11.00)	-	-	2 (2.00)	13 (13.00)	-	1 (1.00)	-	5 (5.00)	100
2.	Cleaning utensils	48 (48.00)	-	6 (6.00)	-	12 (12.00)	16 (16.00)	3 (3.00)	-	11 (11.00)	-	1 (1.00)	2 (2.00)	1 (1.00)	100
3.	Dusting	46 (46.00)	1 (1.00)	8 (8.00)	1 (1.00)	11 (11.00)	1 (1.00)	5 (5.00)	-	19 (19.00)	3 (3.00)	-	3 (3.00)	2 (2.00)	100
4.	Sweeping	27 (27.00)	-	8 (8.00)	-	13 (13.00)	29 (29.00)	7 (7.00)	-	9 (9.00)	1 (1.00)	-	5 (5.00)	1 (1.00)	100
5.	Mopping	24 (24.00)	-	13 (13.00)	-	13 (13.00)	29 (29.00)	7 (7.00)	-	9 (9.00)	-	-	4 (4.00)	1 (1.00)	100
6.	Washing	60 (60.00)	1 (1.00)	7 (7.00)	-	9 (9.00)	6 (6.00)	1 (1.00)	2 (2.00)	8 (8.00)	2 (2.00)	-	-	4 (4.00)	100
7.	Ironing	30 (30.00)	1 (1.00)	8 (8.00)	8 (8.00)	4 (4.00)	22 (28.00)	-	5 (5.00)	9 (9.00)	9 (9.00)	1 (1.00)	1 (1.00)	2 (2.00)	100
8.	Mending	48 (48.00)	-	7 (7.00)	-	3 (3.00)	31 (31.00)	2 (2.00)	-	7 (7.00)	-	-	-	2 (2.00)	100
9.	Sewing	56 (56.00)	-	4 (4.00)	-	2 (2.00)	30 (30.00)	2 (2.00)	-	4 (4.00)	-	-	-	2 (2.00)	100
10.	Shopping	25 (25.00)	49 (49.00)	1 (1.00)	-	6 (6.00)	-	1 (1.00)	10 (10.00)	6 (6.00)	2 (2.00)	-	-	-	100
11.	Account Keeping	34 (34.00)	43 (43.00)	3 (3.00)	-	-	-	-	19 (19.00)	-	-	-	-	1 (1.00)	100
12.	Looking after the children	46 (46.00)	7 (7.00)	1 (1.00)	-	-	-	-	37 (37.00)	-	-	-	-	3 (3.00)	94
13.	Helping in their studies	31 (31.00)	22 (22.00)	1 (1.00)	-	-	-	-	36 (36.00)	-	-	-	-	-	91

Figures in parenthesis indicate percentage

themselves without any help from outside or within home. It was observed that only 12.00 per cent home-makers were getting the work done by full time servants. Dusting was done by 46.00 per cent of home-maker themselves and 19.00 per cent home-maker performed it jointly with her daughter.

A large majority of home-makers (60.00%) performed the task of washing clothes themselves and only 9.00 per cent home-makers were getting the work done by full time servants. Regarding sweeping and mopping, it was observed that 42.00 per cent home-makers received the help of full and part time servants and 27.00 per cent of home-makers do these tasks themselves.

Out of the total respondents only 30.00 per cent home-makers did their ironing themselves while 22.00 per cent got it done by part time servants. In mending and sewing, home-makers received the help of part time servants i.e. 31.00 per cent and 30.00 per cent respectively. In half of the respondents case shopping for household goods was found to be the exclusive duty of husbands alone (49.00%) while one-fourth home-makers were performing this duty all alone (25.00%).

In 43.00 per cent cases the husbands alone performed the task of account keeping and in 34.00 per cent cases home-maker alone performed this task. A little less than half of the home-maker (46.00%) looked after the children where as in 37.00 per cent cases it was performed jointly by the husband and wife. Regarding education of their children home-makers along with their husbands shared the responsibility i.e. 36.00 per cent. The results were the same as reported by Rachel and Ogale (1986).

4.3.2.2 Liked and disliked household activities of the home-maker: The liked and disliked tasks were ascertained on the basis of the total mean scores computed on each task (Table 4.4). The liked task was the one with the highest total mean score and ranked first while the disliked task was with the lowest total mean score and hence the lowest in rank. The task of cooking, child care and shopping earned total mean scores of 2.80, 2.80 and 2.70 respectively, while mending, sweeping and mopping earned total mean scores of 1.77, 1.82 and 1.85 respectively. With the rest of the tasks i.e. cleaning utensils, account keeping, sewing, ironing, washing, dusting and teaching children having mean scores between 1.88 and 2.66. On the basis of these observations it was concluded that cooking was the most liked task (Fig.7). This observation was found to be in good comparison with that of Ronald *et al.* (1971).

The most prominent reasons for liking these tasks were reported to be 'interesting', 'satisfying' and give 'pride in results' while reasons for disliking the tasks were 'not interesting', dirty work and repetitive in nature. The characteristics of tasks, for the present investigation was adopted from Maloch's (1963) study with slight modifications. In order to know the reasons of disliking sweeping and mopping, cleaning pattern in urban homes were studied.

4.3.3 Cleaning pattern with regard to sweeping and mopping operations

4.3.3.1 Space available for cleaning in the house

Number of floors: Nearly two third of the home-makers (65.00%) had single floor where as 27.00 per cent and 8.00 per cent of the home-makers had two floors and more than two floors in their houses, respectively.

Fig. 7.

Liked and Disliked Activities of the Homemaker

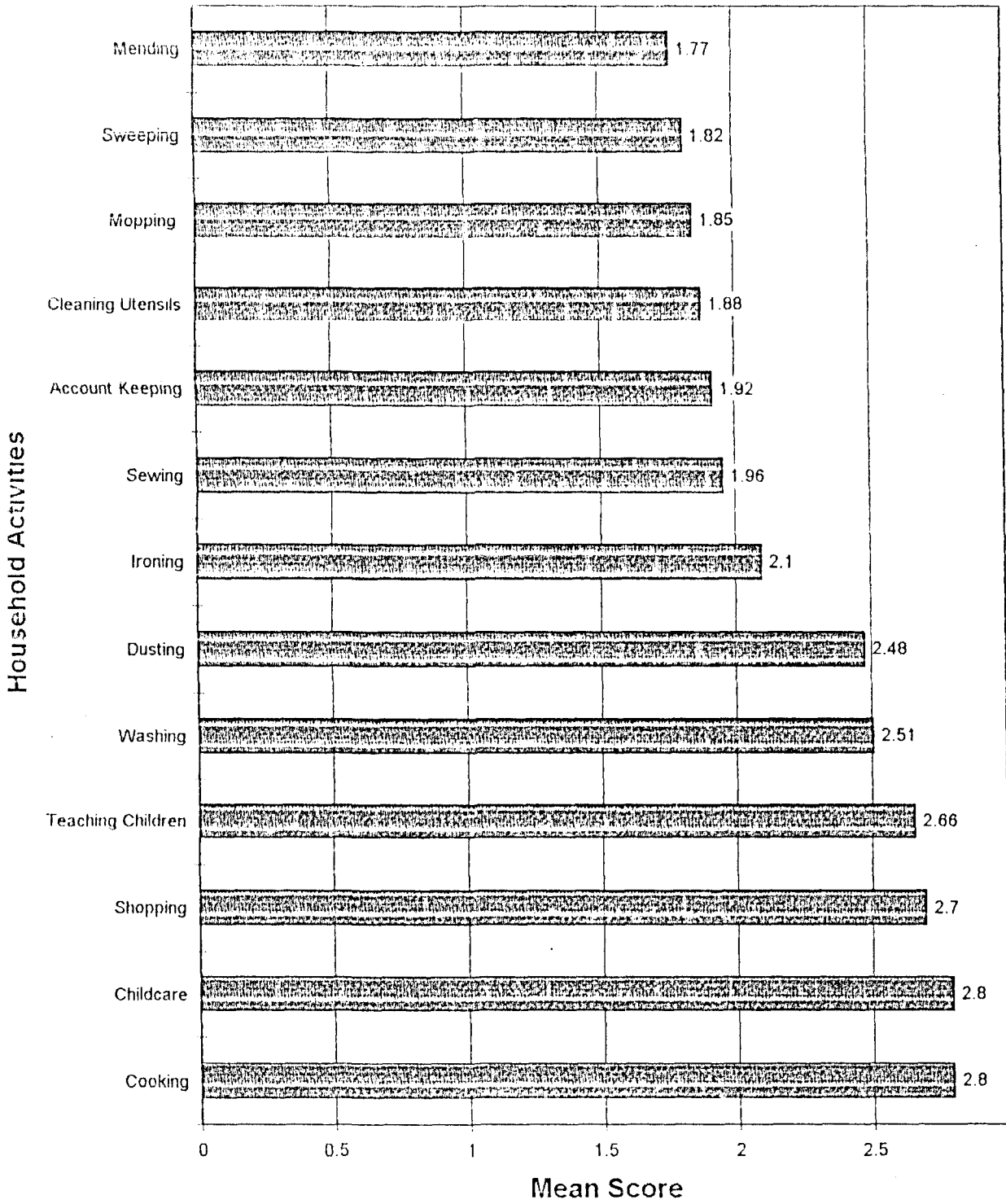


Table 4.4: Liked and disliked household activities of the homemakers

N=100

S.No.	Household activities	Total mean score	Rank
1.	Cooking	2.80	I
2.	Cleaning utensils	1.88	IX
3.	Dusting	2.48	V
4.	Sweeping	1.82	XI
5.	Mopping	1.85	X
6.	Washing	2.51	IV
7.	Ironing	2.10	VI
8.	Mending	1.77	XII
9.	Sewing	1.96	VII
10.	Shopping	2.70	II
11.	Account keeping	1.92	VIII
12.	Looking after the children	2.80	I
13.	Helping in their studies	2.66	III

Open space: It was observed that majority of the home-makers (75.00%) had less than 200 square feet open space in the house. Only 17.00 per cent of the home-makers had the open space in between 300 to 400 square feet followed by 8.00 per cent who had more than 400 square feet open space in the house.

Number of rooms: A little more than half of the home-makers (56.00%) had 2 to 3 rooms whereas only 27.00 per cent of the home-makers had 4 to 5 rooms followed by 17.00 per cent who had more than 5 rooms in the house.

Type of floor: The data in Table 4.5 indicated that majority of the home-makers (74.00%) having chips floor followed by marble and cemented floor in the house i.e. 12.00 per cent and 11.00 percent respectively. Only 3.00 per cent home-makers had tiles in their house.

4.3.3.2 General informations regarding sweeping and mopping operations

Type of broom and mop used: In sweeping, cent per cent of the home-makers were using fur broom (100.00%) followed by palm broom (74.00%) while in mopping 94.00 per cent home-makers were using ordinary mop (made up of waste cloth material) followed by ordinary mop in handle, floor wiper and sponge mop i.e. 4.00 per cent, 3.00 per cent and 2.00 per cent respectively.

Reasons for using that particular broom and mop: Cent per cent of the home-makers were using particular broom and mop for sweeping and mopping as they clean better (Table 4.6). But other reasons most commonly spelled out was cost factor (i.e. cheaper) by more than half (57.00%) of the home-makers (Sweeping 18.00%, and mopping 39.00%) followed by lightness

Table 4.5: Distribution of home-makers according to space available for cleaning

N=100

S.No.	Informations	Category	Frequency	Percentage
1.	Number of floors in the house	1	65	65.00
		2	27	27.00
		> 2	8	8.00
2.	Open space in the house (sq. ft)	< 200	75	75.00
		300-400	17	17.00
		> 400	8	8.00
3.	Number of rooms in the house	2-3	56	56.00
		4-5	27	27.00
		> 5	17	17.00
4.	Type of floor in in the house	Cemented	11	11.00
		Chips	74	74.00
		Tiles	3	3.00
		Marbles	12	12.00

Table 4.6: Distributions of home-makers according to informations regarding sweeping and mopping operations

N=100

S.No.	Informations	Sweeping		Mopping	
		Frequency	Percentage	Frequency	Percentage
1.	**Type of broom used***				
(a)	Palm broom	74	74.00		
(b)	Fur broom	100	100.00		
2.	**Type of mop used***				
(a)	Ordinary mop (made up of waste cloth material)	-	-	94	94.00
(b)	Ordinary mop in handle	-	-	4	4.00
(c)	Floor wiper	-	-	3	3.00
(d)	Sponge mop	-	-	2	2.00
3.	**Reasons for using that particular broom and mop***				
(a)	Clean better	85	85.00	67	67.00
(b)	Light	17	17.00	14	14.00
(c)	Good functional design	6	6.00	9	9.00
(d)	Cheaper	18	18.00	39	39.00
4.	**Time spent**				
(a)	< 15 minute	39	39.00	15	15.00
(b)	16-30 minute	43	43.00	57	57.00
(c)	31-1 hour	12	12.00	20	20.00
(d)	> 1 hour	6	6.00	8	8.00

Contd.....

Table 4.6 (Contd.....)

S.No.	Informations	Sweeping		Mopping	
		Frequency	Percentage	Frequency	Percentage
5.	**Posture used***				
(a)	Standing cum bending	82	82.00	3	3.00
(b)	Squatting cum bending	11	11.00	59	59.00
(c)	Sitting	9	9.00	39	39.00
(d)	Standing	4	4.00	4	4.00
6.	**Reasons for using that particular posture***				
(a)	Less tiring	38	38.00	41	41.00
(b)	Clean more area in one stroke	36	36.00	24	24.00
(c)	Habitual	21	21.00	45	45.00
(d)	Quick	19	19.00	19	19.00
7.	**Removing the furniture**				
(a)	Yes	88	88.00	88	88.00
(b)	No	12	12.00	12	12.00
8.	**Separate broom and mop used for different parts**				
(a)	Yes	70	70.00	46	46.00
(b)	No	30	30.00	54	54.00

* Multiple responses

(31.00%) [Sweeping 17.00% and mopping 14.00%] and good functional design (15.00%) [Sweeping 6.00% and mopping 9.00%].

The findings of the results were in the line of Dhesi (1975) who had also reported the same reasons for sweeping.

Time spent: In sweeping, maximum number of the home-makers (43.00%) spent between 16 to 30 minutes followed by less than 15 minutes (39.00%), between 31 minutes to 1 hour (12.00%) and more than 1 hour (6.00%).

In mopping, more than half of the home-makers (57.00%) spent between 16 to 30 minutes followed by between 31 minutes to 1 hour (20.00%), less than 15 minutes (15.80%) and more than 1 hour (8.00%), respectively (Fig.8).

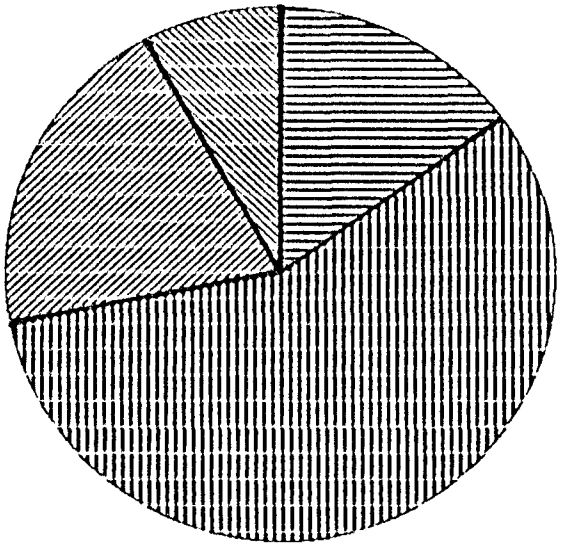
Posture used: In sweeping, a large majority of the home-makers (82.00%) used standing cum bending posture followed by squatting cum bending (11.00 %), sitting (9.00%) and standing (4.00%) posture. While in mopping, a little less than three fifth of the home-makers (59.00%) used squatting cum bending posture followed by sitting (39.00%), standing (4.00%) and squatting cum bending (3.00%) postures (Fig.9).

Therefore, it is concluded that most of the home-makers use standing cum bending posture for sweeping and squatting cum bending posture for mopping.

Reasons for using that particular posture: In sweeping, a little less than two fifth of the respondents (38.00%) were using the particular position as it was less tiring. But other reasons spelled out for using the particular

Fig. 8.

Time Spent by the Homemaker During Mopping and Sweeping



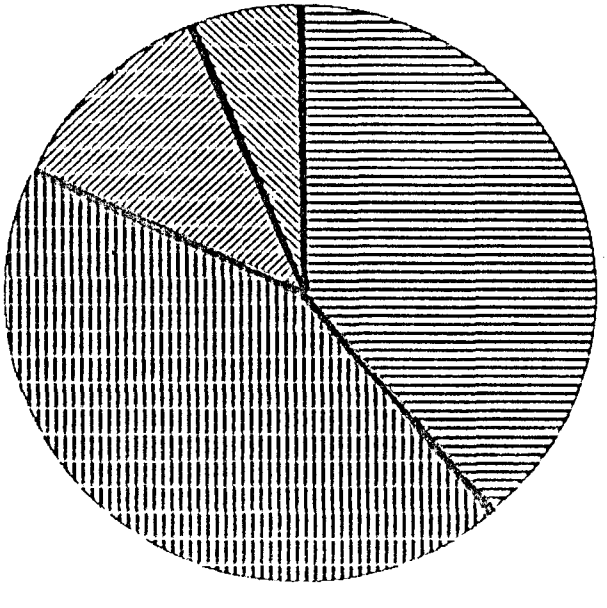
Mopping

less than 15 mins

15 min - 30 min

30 min - 1 hr

more than 1 hr



Sweeping

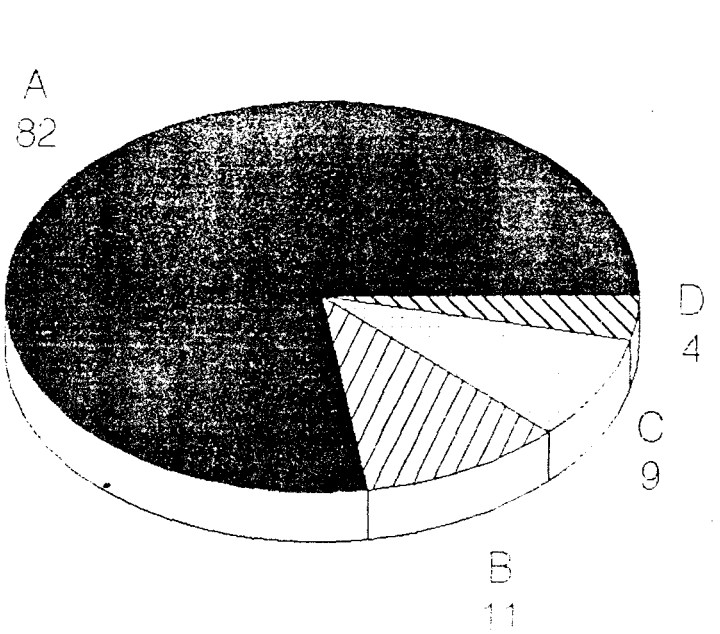
less than 15 mins

15 min - 30 min

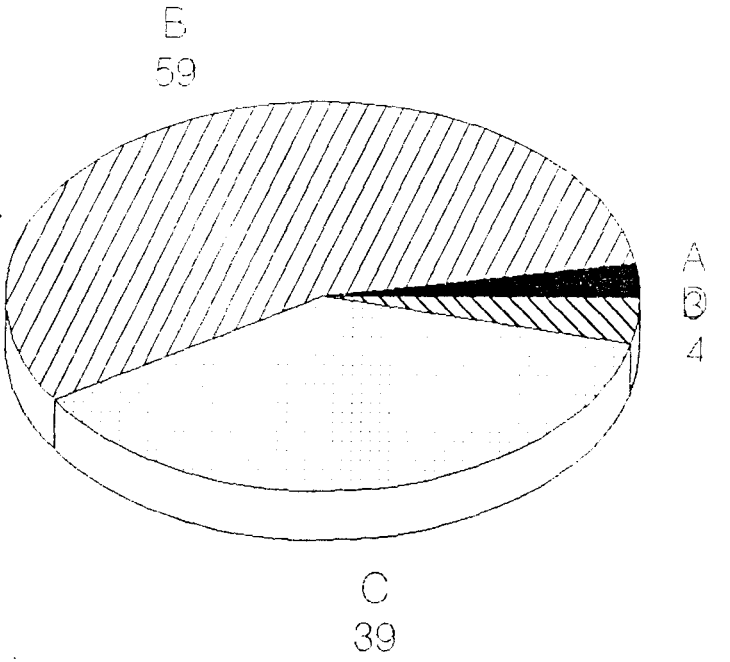
30 min - 1 hr

more than 1 hr

FIG. 9: POSTURES USED BY HOME-MAKERS WHILE SWEEP[NG AND MOPPING



SWEEPING



MOPPING

A = STANDING-CUM-BENDING,
B = SQUATTING-CUM-BENDING
C = STANDING,D = SITTING

position were reported as they clean more in one stroke (36.00%) followed by due to habit (21.00%) and quickness (19.00%).

In contrast, to mopping 45.00 per cent of the home-makers were using the particular position as they were habitual. But 41.00 per cent of the home-makers spelled out the reasons for using particular position were less tiring, clean more in one stroke (24.00 %) and quickness (19.00%).

The findings of the study are in agreement with those of Jain (1973) who also found that standing cum bending posture was less tiring during sweeping.

4.3.3.3 Frequency of sweeping and mopping in different parts of house: The data presented in Table 4.7 depict that in most of the households sweeping and mopping were done, once a day except in kitchen where it was done twice a day both in summer and winter.

More than half of the home-maker (55.00%) sweep the living room twice-a-day followed by once a day (44.00%) and alternately (1.00%) and mopping was done once a day (56.00%) followed by twice a day (41.00%) and alternately (20.00%) in summer. While in winter sweeping and mopping were also done once a day i.e. 87.00 per cent and 89.00 per cent respectively.

Two third of the home-makers (68.00%) sweeps the bedroom once a day followed by twice-a-day (32.00%). Similar results were observed in mopping in summer while in winter 96.00 per cent of the home-makers swept and mopped bedroom once a day.

Table 4.7: Frequency of sweeping and mopping done in different parts of house by the homemakers

N=100

S.No.	Part/Room	Category	Summer		Winter	
			Sweeping Frequency/ Percentage	Mopping Frequency/ Percentage	Sweeping Frequency/ Percentage	Mopping Frequency/ Percentage
1.	Living Room	(a) Once a day	44	56	87	89
		(b) Twice a day	55	41	10	8
		(c) Alternately	1	2	1	2
		(d) Weekly	-	1	2	1
2.	Bedroom	(a) Once a day	68	69	96	96
		(b) Twice a day	32	31	4	4
3.	Kitchen	(a) Once a day	26	28	64	65
		(b) Twice a day	73	71	35	34
		(c) Alternately	1	1	1	1
4.	Bathroom	(a) Once a day	70	74	85	83
		(b) Twice a day	23	22	7	9
		(c) Alternately	2	2	3	3
		(d) Weekly	5	2	5	5
5.	Verandha	(a) Once a day	58	72	86	91
		(b) Twice a day	40	27	11	6
		(c) Alternately	1	-	1	1
		(d) Weekly	1	1	2	2

Maximum number of home-makers sweep and mop the kitchen twice a day i.e. 73.00 per cent and 71.00 per cent, both followed by once a day i.e. 26.00 per cent and 28.00 per cent respectively in summer. In winter, they sweep and mop the kitchen only once a day i.e.64.0 per cent and 65.0 per cent, respectively.

Nearly three fourth of the home-makers sweep (70.00%) and mop (74.00%) the bathroom once a day followed by twice a day in summer.

Maximum number of the home-makers sweep (85.00%) and mop (83.00%) the bathroom once a day in winter.

More than half of the home-makers (58.00%) sweep the Verandha once a day followed by twice a day (40.00%) and mopping was also done once a day (72.00%) followed by twice a day (27.00%) in summer while in winter sweeping and mopping were done once a day i.e. 86.00 per cent and 91.00 per cent, respectively.

4.3.3.4 Problem faced while sweeping and mopping: It is evident from Table 4.8 that majority of the home-makers (60.00%) face the problem of tiredness followed by bodyache (26.00%) and Backache (25.00%) respectively, while sweeping and mopping. Only 17.00 per cent and 15.00 per cent of the home-maker face the problem of legache and headache respectively. The findings of the study are in agreement with the results of Grandjean (1973) who also found that the problem of tiredness and backache often occurred in static and dynamic work as there was some damage to the intervertebral discs.

Table 4.8: Distribution of home-makers according to problems faced by them while sweeping and mopping

N=100

S.No.	Problems	Frequency	Percentage
1.	Bodyache	26	26.00
2.	Legache	17	17.00
3.	Headache	15	15.00
4.	Backache	25	25.00
5.	Tiredness	60	60.00

4.3.3.5 Problem faced with respect to broom and mop: Data presented in Table 4.9 that regarding brooms half of the home-makers (50.00%) face the problem of short life time followed by cost factor (43.00%) and poor quality of straws (35.00%). In contrast to the mops, a little more than half of the home-makers (51.00%) face the problem of more bending during mopping followed by problem in squeezing (36.00%) and poor soaking capacity (29.00%).

4.4 Effect of different types of brooms and mops on certain physiological parameters

4.4.1 Brooms

The effect of different types of brooms viz., fur broom and palm broom were evaluated in terms of pulse rate, respiration rate, griping and blood pressure of previously selected home-makers under laboratory conditions. The results obtained are discussed below:

Pulse rate: Data presented in Table 4.10 indicated that the mean values of pulse rate had increased while sweeping with different types of brooms in comparison to the resting position ($P > 0.05$). The findings of the present study is in agreement with those of Kilbom and Astrand (1969) and Puri (1992).

The highest mean pulse rate (92.00 per minute) was observed with palm broom followed by the fur broom (87.60 per minute)

The highest mean pulse rate with palm broom may have been due to bending of back required for this particular broom.

Table 4.9: Distribution of home-makers according to problems faced by them with respect to broom and mop

N=100

S.No.	Problems	Frequency	Percentage
1.	**Broom**		
(a)	Short life time	50	50.00
(b)	Poor quality of straws	35	35.00
(c)	Unadjustable handle	10	10.00
(d)	Cost factor	43	43.00
(e)	More bending	27	27.00
II.	**Mop**		
(a)	Poor soaking capacity	29	29.00
(b)	Unadjustable handle	8	8.00
(c)	Improper size	8	8.00
(d)	Cost factor	2	2.00
(e)	More bending	51	51.00
(f)	Problem in squeezing	36	36.00

Table 4.10: Effect of different types of brooms on certain physiological parameters

S.No.	Parameters	Resting	Brooms		CD	
			Fur	Palm	5%	1%
1.	Pulse rate (minute^{-1})	82.93^{b} ±1.15	87.60^{a} ±1.51	92.00^{c} ±1.66	4.15	5.56
2.	Respiration rate (minute^{-1})	29.33^{b} ±1.09	32.60^{a} ±0.91	34.06^{a} ±0.86	2.75	3.68
3.	Griping (kg)	11.80 ±0.77	10.06 ±0.80	9.86 ±0.82	NS	NS
4.	Blood pressure (mm Hg)					
	Systolic	115.33^{b} ±1.65	120.27^{a} ±0.87	122.27^{a} ±0.67	3.27	4.37
	Distolic	80.66^{b} ±0.37	82.13^{a} ±0.60	83.46^{a} ±0.49	1.42	1.90

Each value is a mean of 15 observations
abc values in row bearing different superscripts differ significantly ($P < 0.05$)

The analysis of variance for pulse rate (Annexure-IV) indicated that there were significant differences with different types of brooms ($P > 0.05$). The maximum difference in pulse rate was found between the resting and sweeping with palm broom ($P > 0.05$). The difference in pulse rate between fur broom and palm broom while brooming was also significant ($P < 0.05$).

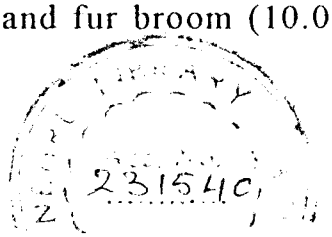
Respiration rate: It is evident from Table 4.10 that the mean values of respiration rate had increased while sweeping with different brooms in comparison to the resting position. The findings of the study supports the results obtained by Oberoi and Miglani,1985.

The highest mean respiration rate (34.06 per minute) was observed with palm broom followed by the fur broom (32.60 per minute).

The analysis of variance for respiration rate (Annexure-IV) indicates that there were non-significant differences in respiration rate while sweeping with palm and fur brooms. However, the difference in respiration rate between two brooms while sweeping and in resting position were significant ($P < 0.05$).

Griping: The mean values of griping (Table 4.10) of hand (either right or left) indicated that the maximum decrease occurred while sweeping with palm broom from 9.86 to 11.80 kg and this may be due to more stress and static contraction of grip muscles with bending back.

Analysis of variance (Annexure-IV) shows that there were statistically non significant difference ($P < 0.05$) between resting position (11.80 kg) and sweeping with palm (9.86 kg) and fur broom (10.06 kg). Smith and Smith



(1962) also reported that the stress and static contraction of grip muscles is considerably low when the person is working in a convenient posture which reduces the grip fatigue.

Blood pressure

Systolic pressure: The data presented in Table 4.10 indicated that the mean values of both systolic and diastolic pressure had increased while sweeping with different types of brooms in comparison to the resting posture (Fig.10).

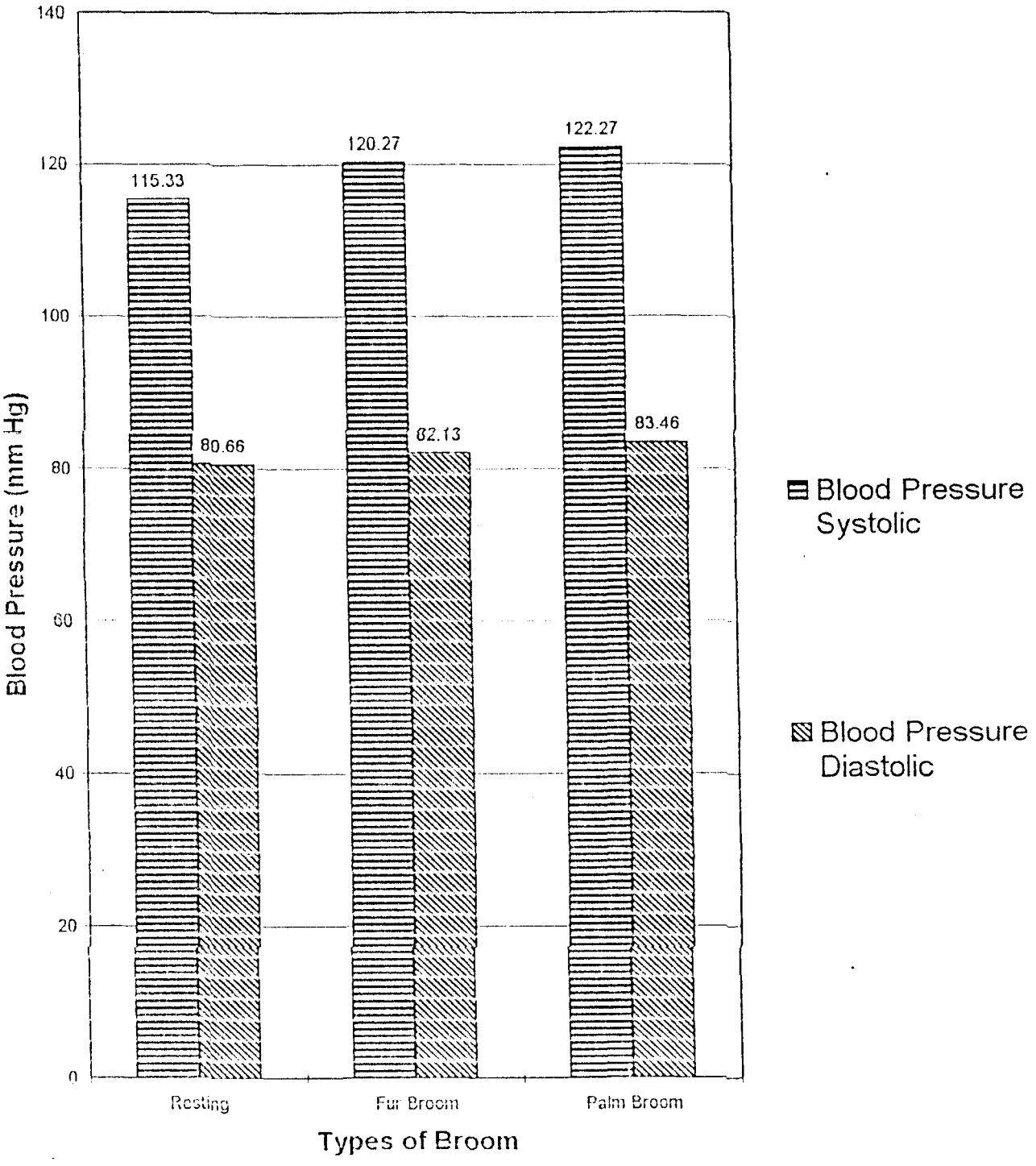
The observations on increase in systolic pressure and diastolic pressure to varying degree is in agreement with the findings obtained by Best and Taylor (1961), Oberoi (1981) and Dhillion (1982). All of them reported that during the high physical activity, there was an increase in systolic pressure, where as diastolic pressure increases only in case of strenuous activities. The highest mean systolic pressure viz., 122.27 mm Hg was observed for the palm broom followed by fur broom 120.27 mm Hg.

The analysis of variance for systolic pressure (Annexure-IV) indicates that statistically non significant ($P < 0.05$) difference exists while working with palm and fur broom but there was a significant difference between the values of these two brooms and values in resting position.

Diastolic pressure: The highest mean diastolic pressure (83.46 mm Hg) was observed while sweeping with palm broom followed by fur broom (82.13 mm Hg).

Fig. 10

Mean Values of Blood Pressure during Sweeping



The highest mean diastolic pressure may be due to the heavy work load on the back muscles, because of the excessive bending in sweeping with palm broom (Fig.10).

The analysis of variance of diastolic pressure (Annexure-IV) indicated that there was significant ($P < 0.05$) increase in diastolic pressure while sweeping with palm broom while observing the differences it was noted that maximum difference was found between resting position and sweeping with palm broom ($P > 0.05$) and minimum ($P < 0.05$) between palm and fur broom (Plates 8 & 9).

It is thus, concluded that the pulse rate, respiration rate and systolic and diastolic pressure are increased when sweeping with palm broom as it is done in squatting posture which require bending of back. Bending of back contracts the abdominal muscles and stretches in back muscles which causes vasocontriction muscles. The findings of the study are in agreement with those of Guyton (1963).

The maximum decrease in griping while sweeping with palm broom may be due to more stress and contraction of grip muscles with bending back.

4.4.2 Mops

The effect of different types of mops viz., ordinary mop (made up of waste cloth material), ordinary mop in handle, sponge mop and improved mop were evaluated in terms of pulse rate, respiration rate, griping and blood pressure of previously selected home-makers under laboratory conditions.

Plate 9: Sweeping with palm broom in squatting posture

Plate 10: Mopping by using ordinary mop in squatting cum bending posture

Pulse rate: Data presented in Table 4.11 indicated that the mean values of pulse rate had significantly increased while mopping with different types of mops in comparison to the resting position ($P > 0.05$). The findings of the present study is in agreement with those of Kilbom and Astrand (1969) and Puri (1992).

The highest mean pulse rate (96.80 per minute) was observed with ordinary mop followed by the ordinary mop in handle (91.47 per minute). The lowest mean pulse rate, viz., 87.60 per minute was obtained while mopping with improved mop followed by sponge mop (88.53 per minute). The highest mean pulse rate with ordinary mop may be due to bending of back required for this particular mop.

The analysis of variance for pulse rate (Annexure-V) indicated that there were significant differences with different types of mops ($P > 0.05$). The maximum difference in pulse rate was found between the resting position and mopping with ordinary mop ($P > 0.05$). The minimum difference in pulse rate was found between the sponge mop and improved mop ($P < 0.05$). However, the difference in pulse rate between improved mop, sponge mop and ordinary mop in handle while mopping was also non-significant ($P < 0.05$).

Respiration rate: It is evident from Table 4.11 that the mean values of respiration rate had increased while mopping with different mops in comparison to the resting position. The findings of the study supports the results obtained by Oberoi (1981).

Table 4.11: Effect of different types of mops on certain physiological parameters

S.No.	Parameters	Resting	Mops				CD	
			Ordinary	Ordinary mop in handle	Sponge mop	Improved mop	5%	1%
1.	Pulse rate (minute^{-1})	82.93^{c} ±1.15	96.80^{a} ±1.57	91.47^{b} ±1.74	88.53^{b} ±1.34	87.60^{b} ±0.92	3.89	5.16
2.	Respiration rate (minute^{-1})	29.33^{c} ±1.09	36.53^{a} ±0.92	35.33^{a} ±0.86	35.20^{a} ±0.81	31.93^{b} ±0.15	2.35	3.12
3.	Griping (kg)	11.80^{a} ±0.77	9.50^{b} ±0.62	9.40^{b} ±0.42	8.87^{b} ±0.38	8.93^{b} ±0.41	1.53	2.04
4.	Blood pressure (mm Hg)							
	Systolic	115.33^{c} ±1.65	123.07^{a} ±0.55	122.80^{ab} ±0.43	121.47^{ab} ±0.24	120.67^{b} ±0.25	2.30	3.05
	Distolic	80.66^{c} ±0.37	84.40^{a} ±0.70	82.66^{b} ±0.54	81.33^{c} ±0.46	81.33^{c} ±0.46	1.51	2.01

Each value is a mean of 15 observations
abc values in row bearing different superscripts differ significantly ($P < 0.05$)

The highest mean respiration rate (36.53 per minute) was observed with ordinary mop followed by ordinary mop in handle (35.33 per minute). The lowest mean pulse rate viz., 31.93 per minute was obtained while mopping with improved mop followed by sponge mop (35.20 per minute).

The analysis of variance for respiration rate (Annexure-V) indicates that there were statistically non-significant differences in respiration rate while mopping with ordinary mop, ordinary mop in handle and sponge mop ($P < 0.05$). However, the differences in respiration rate while mopping with these three mops and improved mop were significant ($P > 0.05$) as the respiration rate was decreased in improved mop.

Griping: The mean values (Table 4.11) of griping of hand (either right or left) indicated that maximum decrease occur while mopping with sponge mop (8.87 kg) followed by improved mop (8.93 kg). The minimum decrease occur while mopping with ordinary mop (9.50 kg) followed by ordinary mop in handle (9.40 kg).

Analysis of variance (Annexure-V) shows that there were statistically significant ($P > 0.05$) difference between resting position and mopping with ordinary mop, ordinary mop in handle, sponge mop and improved mop. However, there was non-significant ($P < 0.05$) difference between all the four mops. But the griping fatigue was decreased in improved mop. Smith and smith (1962) also reported that the stress and static contraction of grip muscles is considerably low when the person is working in a convenient posture which reduces the grip fatigue.

Blood pressure

Systolic pressure: The data presented in Table 4.11 indicated that the mean values of both systolic and diastolic pressure had increased while mopping with different types of mops in comparison to the resting posture (Fig.11).

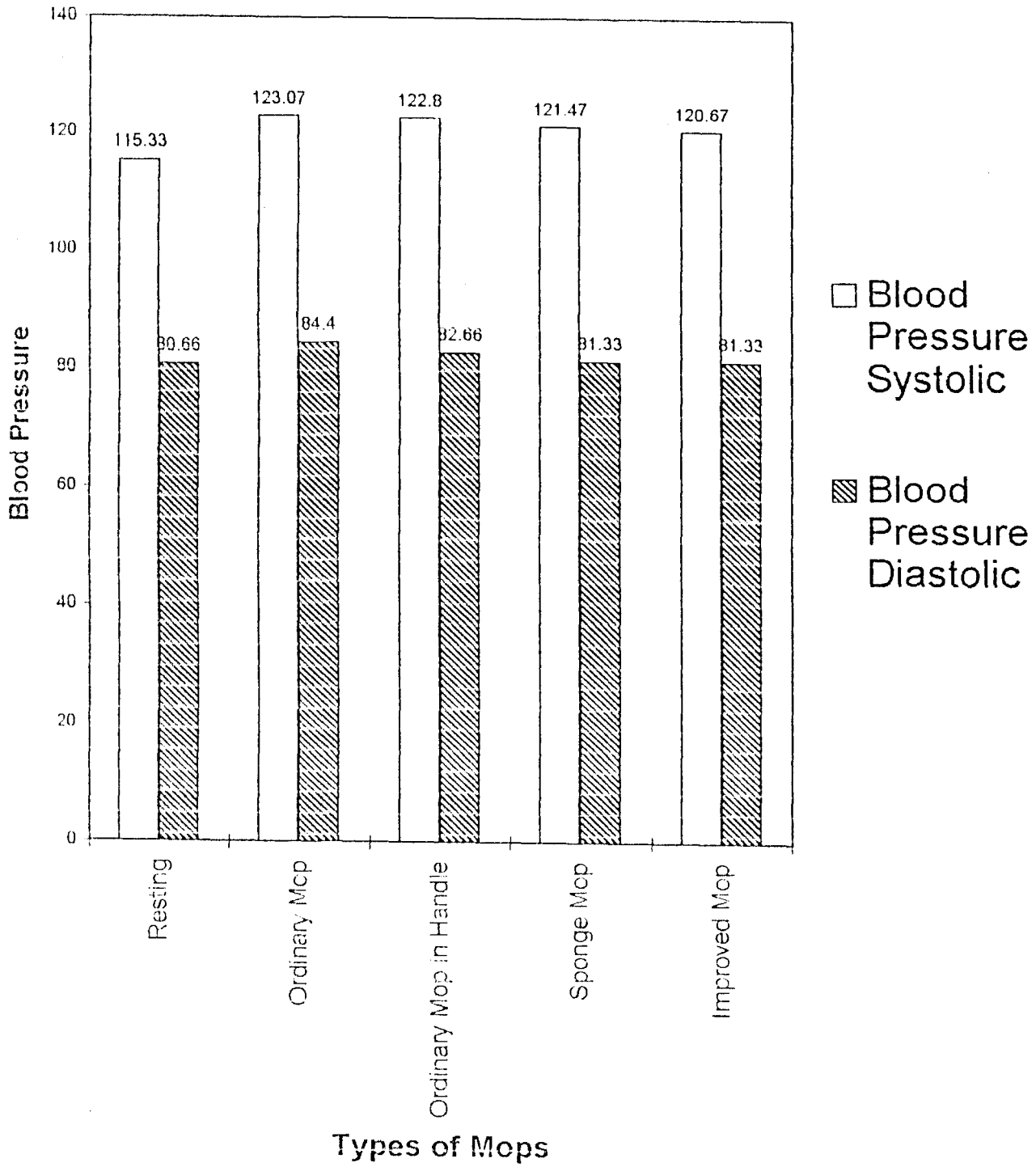
The observations indicated an increase in systolic pressure and diastolic pressure to varying degrees, which is in agreement with the findings obtained by Best and Taylor (1961), Oberoi (1981) and Dhillion (1982). All of them reported that during the light physical activity, there was an increase in systolic pressure, whereas the diastolic pressure increassed only in case of strenuous activities.

The highest mean systolic pressure, viz., 123.02 (mm Hg) was observed while mopping with ordinary mop. The lowest mean systolic pressure, viz., 120.67 (mm Hg) was obtained while mopping with improved mop.

The highest mean systolic pressure with ordinary mop may be due to bending of back required for this mop. Bending of back contracts the abdominal muscles and streches the back muscles which causes vasoconstriction of muscles. According to Guyton (1963) vasoconstriction results in restricted supply of blood to the venous system, thus increased the systolic blood pressure. The minimum increase in systolic pressure was observed while mopping with sponge mop 121•47 (mm Hg) and improved mop 120.67 (mm Hg). This may be due to straight back which decreases the systolic pressure. The higher increase in systolic pressure by ordinary mop

Fig. 11.

Mean Values of Blood Pressure during Mopping



and ordinary mop in handle could also be associated with the fact that during vasoconstriction, there is an increase in stimulation of sympathetic system which accelerates the liberation of sympathomimetic amines. These harmones increase the cardiac output and in turn the blood pressure.

The analysis of variance for systolic pressure (Annexure-V) indicates that there was statistical difference while mopping with all the four types of mops in comparison to resting position. The difference in systolic pressure between ordinary mop in handle and sponge mop was non significant ($P < 0.05$). Similarly, the difference between ordinary mop in handle, sponge mop and improved mop was also non-significant ($P < 0.05$).

Diastolic pressure: The highest mean diastolic pressure (84.40 mm Hg) was observed while mopping with ordinary mop and ordinary mop in handle (82.66 mm Hg). The lowest mean diastolic pressure was observed both in sponge mop and improved mop (81.33 mm Hg).

The significant increase in diastolic pressure while mopping with ordinary mop and ordinary mop in handle may be due to the pooling of blood in lower extremities which led to vasodilation in the lower leg muscles and therefore, increased the diastolic pressure. The findings of the study is in agreement with those of Guyton (1963).

The lowest diastolic pressure was observed while mopping with sponge mop and improved mop (Fig.11).

The analysis of variance of diastolic pressure (Annexure-V) indicated that the differences between four types of mops was significant as compared

to resting position. The difference between ordinary mop and ordinary mop in handle was statistically significant ($P > 0.05$). However, the difference between sponge mop and improved mop was similar but statistically significant when compared with ordinary mop in handle (Plates, 10,11, 12,13).

From the forgoing discussion it was concluded that improved mop was better as compared to other mops based on certain physiological parameter(s) especially with respect to respiration rate.

4.5 Acceptability of improved model of mop *

The acceptability of improved model of mop was studied (Plate 14) under following sub heads i.e. structure, working efficiency, cost factor, and physical drudgery. Table 4.12 shows that physical drudgery was major reason for acceptance (Total mean score 28.80) of improved mop followed by its working efficiency (Total mean scorre 24.25), cost factor and structure of improved mop were getting 10.9 and 6.7 total mean score.

4.5.1 Structure

Under this subhead, the maximum mean score (m=3.9) was obtained by acceptance, "Any member can use it" followed by "Light in weight" (m=2.8).

4.5.2 Working efficiency

Among working efficiency maximum mean score (m=4.4) was reported to be for "Changeable mop" followed "Touching not required while squeezing" (m=4.0) and "easy to use" and "handling" i.e. (m=4.0) and (m=3.7)

* The model of broom was not improved as the home-makers did not find any ergonomical difficulty in using the brooms.

Plate 11: Mopping by using ordinary mop in handle in standing cum bending posture

Plate 12: Mopping by using sponge mop in handle in standing cum bending posture

Plate 13: Mopping by using improved mop in laboratory

Plate 14: Acceptability of improved mop by home-maker

Table 4.12: Acceptability of improved mop according to different parameters

N=20

S.No.	Parameters	Mean score (m)	Rank	Total mean score	Overall rank
I.	**Structure**				
(a)	Any member can use it	3.9	I		
(b)	Light in weight	2.8	II		
II.	**Working efficiency**			6.7	V
(a)	Easy to use	4.0	II		
(b)	Convenient to handle	3.7	IV		
(c)	Can be used on any type of floor	2.8	V		
(d)	No problem in squeezing	2.7	VI		
(e)	Touching not required while squeezing	4.0	III		
(f)	Good soaking capacity	2.6	VII		
(g)	Changeable mop	4.4	I		
III.	**Cost factor**			24.25	II
(a)	Low cost	3.6	II		
(b)	Can be constructed at home	3.4	III		
(c)	Less water consumption	3.9	I		
IV.	**Physical drudgery**			10.9	IV
(a)	Saves time	3.0	VII		
(b)	Less energy consumption	3.6	V		
(c)	Increases work efficiency	4.0	II		
(d)	Reduces health problems	3.7	IV		
(e)	Less bending	4.4	I		
(f)	Lesser fatique	3.2	VI		
(g)	Removal of furniture is not required	3.9	III		
(h)	Could easily reach under the furniture pieces	3.0	VII		
V.	**Any other**			28.8	I
(a)	Results are observable	4.0	III		
(b)	Can be tried out easily	4.1	II		
(c)	Easy to keep or store	4.3	I		
(d)	Culturally more acceptable	3.0	IV	15.4	III

respectively. "Can be used on any type of floor", "No problem in squeezing" and "Good soaking capacity" having least mean scores i.e. (m=2.8), (m=2.7) and (m=2.6), respectively.

4.5.3 Cost factor

"Less water consumption" (m=3.9) was the main reason for acceptance of improved mop under the cost factor followed by the "Low cost" (m=3.6) and "cna be constructed at home" (m=3.4)

4.5.4 Physical drudgery

Among physical drudgery maximum mean score (m=4.4) was reported for "Less bending" followed by "increases work efficiency" (m=4.0) and "removal of furniture is not required" (m=3.9). "Reduces health problems" (m=3.7), "Less energy consumption (m=3.6) and "Lesser fatigue" (m=3.2) were had least mean scores.

"Saves time" and "could not reach under the furniture pieces" both have same mean score (m=3.0).

On the basis of the study of acceptability of the improved model of the mop, it can be concluded that this model is more acceptable as it require less physical stress, having working efficiency and low cost.

CHAPTER 5

SUMMARY AND CONCLUSIONS

SUMMARY AND CONCLUSIONS

To minimise the energy expenditure and to protect the muscles from over stresses it is necessary to study the household activities from ergonomics point of view to find out some right method of work, working postures and equipments tools. Two floor caring activities such as sweeping and mopping are considered as most strenuous activities among household tasks. The method of cleaning did not change for centuries and hand made brooms and mops are used until today. The purpose of this study is to ascertain the change in the posture/equipment used for floor caring activities has significant effect in reducing the physiological cost of work. The present study has been conducted with the following objectives.

1. To know the availability and use pattern of different types of brooms and mops in market and urban homes.
2. To determine the physiological stress of commonly used brooms and mops in different postures.
3. To study the acceptability of improved model of broom and mop among the home-makers.

Methodology

The present study was carried out in three phases.

Phase-I: Through field survey availability and use-pattern of different types of brooms and mops in market and urban homes were found.

Phase-II: Through laboratory experiment, physiological stresses of women while performing tasks of sweeping and mopping were evaluated. Out of the three models of mops studied, a model of mop was further improved and tested.

Phase-III: The acceptability of the improved mop was tested under previously selected field situations.

The first and the third phase of the study were carried out in Hisar city of Haryana state which was selected purposively, while for second phase laboratory in the Department of Family Resource Management was selected. From four localities i.e. New Campus, Old Campus, 15-A Sector and Housing Board Colony, twenty five home-makers were selected randomly from each locality for the first phase. For the third phase twenty interest home-makers were selected from the previously studied sample in the first phase.

Findings of the study

Results of the first objective revealed that majority of the respondents belong to age group of 25 to 50 years (86.00%), having height between 151 to 180 cms (68.00%), and weight between 51 to 65 kg (65.00%) and are unemployed (62.00%). Majority of the respondents had nuclear family (76.00%) of high caste (67.00%) having family size between 3 to 5 members belong to service class (81.00%) and have medium educational status (51.00%) and with the family income between 5,001 to 10,000 and above (48.00% each group).

With the help of pretested interview schedule, it was found that most of the home-makers prefer cooking and dusting and least interested in account keeping and sewing among house household activities. They like the cooking and childcare the most and dislike the sewing, sweeping and mopping activities due to dirty work and repetitive task. Most of the home-makers did their household work themselves and had single floor houses (65.00%) with 2 to 3 rooms (56.00%) having chips floor (74.00%) and less than 200 square feet open space (75.00%) in the house for cleaning.

Regarding sweeping and mopping operations, most of the home-makers use fur broom (100.00%) and ordinary mop (94.00%) as they clean better and take 16 to 30 minutes for each activity. Standing cum bending posture for sweeping and squatting cum bending posture for mopping were used by most of the home makers. In most of the households the sweeping and mopping were done once a day except in kitchen. Where it was done twice a day both in summer and winter. While sweeping and mopping majority of the home-makers face the problem of tiredness (60.00%). Regarding brooms and mops half of the homemakers face the problem of short life time (50.00%) and more bending (51.00%), respectively.

Under laboratory experiment, certain physiological parameters i.e. pulse rate, respiration rate, griping (kg) and blood pressure (mm Hg) were measured prior and after sweeping and mopping operations with different brooms and mops. On the whole, the fur broom was found better than palm broom because

it had less strain and its operation of was done in standing posture while for sweeping with palm broom squatting posture was used. The squatting posture requires bending of back which contracts the abdominal muscles and stretches the back muscles and causes vasoconstriction of muscles. *

The effect of mopping on above physiological parameters with different types of mops i.e. ordinary mop, ordinary mop in handle and sponge mop were studied. Later on, an improved model of mop was developed by combining the best features of these three mops. The performance of improved model of mop was found better with respect to physiological parameters in comparison with the other three mops. The ordinary mop requires squatting posture which is more strenuous in comparison with ordinary mop in handle, and sponge mop which are used in standing cum bending posture. However, the operation of improved mop is done in standing posture which is comparatively less strenuous.

The improved mop was tested by the home-makers for its acceptability and found that the improved mop has more working efficiency and less physiological stress due to its long and light handle. Besides, it has squeezing system, and can be constructed at home at a cheaper cost.

* The model of broom was not improved as the home-makers did not find any ergonomical difficulty in using the brooms.

BIBLIOGRAPHY

BIBLIOGRAPHY

AICRP, PAU, 1985-1987. A report on All India Co-ordinated Research Project -in Home Science, Department of Home Management, Punjab Agricultural University, Ludhiana.

Andrews, R.B. 1963. An investigation of some properties of the energy expenditure rate and muscular work. Ph.D. Dissertation, University of California, Los Angels, California, U.S.A.

Astrand, Per-Olef and Rodahl Kaare,1970. *Text Book of Work Physiology.* McGraw Hill Book Company, New York, pp.249-322.

Atreya, N. 1987. A methodological investigation of energy expenditure for selected household activities. M.H.Sc. dissertation, S.V.T. College of Home Sci., S.N.D.T. University, Bombay, pp.82-87.

Bala, J. 1980. A comparative study of physiological cost of chapati making in squatting and standing positions. M.Sc. Thesis, Punjab Agricultural University, Ludhiana.

Bala, R. 1984. A comparative study of physiological measures, while churning milk (curd) manually and by machine. M.Sc. Thesis, Punjab Agricultural university, Ludhiana.

Benedict, F.G. and Johnson, A. 1919. Energy Loss of Young Women During the Muscular Activity of Light Household Tasks. *Proceedings of Physiological Society.* **58**: 89-96.

Best, C.H. and Taylor, N.B. 1961. The physiological basis of Medical Practice. 7th ed. William and Wilkins, Baltimore, pp.169-176.

Bratton, Esther Crew. 1959. Concepts of Energy and Work in Home Management. *J. of Home Economics,* **4**: 198-206.

Brouha, L. 1967. Physiology in Industry. International series of Monographs on pure and applied Biology. Modern Trends of Physiological Sciences, Vol. IV. Pergamon Press, New York.

Chahal, Hardip Kaur. 1972. Relationship of heart rate and angles of body bend during chapati making at standing level kitchens. M.Sc. Thesis, Punjab Agricultural University, Ludhiana.

Charti, G. 1971. Working heights of cooking units. M.Sc. Thesis, University of Nagpur, Nagpur.

Coreett, E.N. and Bishop, R.P. 1976. A technique for assessing postural discomfort. *Ergonomics,* **19**: 175-182.

Dhesi, J.K. and Chahal, H.K. 1975. Effects of stages of chapati making and body bend on heart rate during sitting and standing postures. *Indian J. Home Sci.*, **9**: 7.

Dhillion, M.K. 1982. Comparative study of physiological cost in different postures of dish washing. Ph.D. Thesis, Punjab Agricultural University, Ludhiana.

Fahrni, H.W. 1966. Backache relieved through new concepts of posture. Charles C. Thomes, Springfield, Illinois (cited from Dhillion, M.K. 1982).

Glassow, K. and Muller, M. 1951. As quoted by passmore *et al.* (1955). Human Energy Expenditure. *Physiological Review*, **4**: 801-840.

Grandjean, E. 1973. Ergonomics of the Home. Tayler and Francis Ltd., London, pp.15-35.

Grey, F.E.; Hanson, J.A. and Jones, E.P. 1966. Postural aspects of neck muscle tension, Ergonomics, Vol.9, pp.245-246.

Guyton, A.C. 1963. Circulatory Physiology : Cardiac Output and its Regulation. W.B. Saunders Philadelphia, pp.312, 326-365.

Hanspal, N. 1985. A study of the kitchen work surfaces and storage spaces suited for punjabi ladies. M.Sc. Thesis, Punjab Agricultural University, Ludhiana.

Hansen, O.E. and Maggio, M. 1963. Static work and heart rate. International Zeits. Fur Angrew J. Physiol., **18**: 242-247.

Hoppes, J.R. and Patten, M.B. 1943. Energy expenditure of home-makers performing floor-care activities and an evaluation of floor-appearance. *Research Bulletin* No. **946**. Ohio Agricultural Experiment Station. Wooster, Ohio, pp.22-24.

Jain, S.P. 1973. Human energy expenditure while brooming with brooms of different kinds and lengths. M.Sc. Thesis, Punjab Agricultural University, Ludhiana.

Jindal, V. 1974. Comparison of the physiological costs while ironing during sitting and standing positions. M.Sc. Thesis, Punjab Agricultural University, Ludhiana.

Jones, J.B. and Reeves, T.J. 1968. Total cardiac output during four minutes of exercise. *Amer. Heart J.*, **76**: 209-216.

Jyoti, B. 1980. A comparative study of the physiological cost of chapati making in squatting and standing positions. M.Sc. Thesis, Punjab Agricultural University, Ludhiana.

Kaur, J. 1985. An ergonomics study of washing floor with brooms of different lengths. M.Sc. Thesis, Punjab Agricultural University, Ludhiana.

Kilbom, A. and Astrand, I. 1969. Pulse rates of female subjects during the performance of various household tasks. (cited from Grandjean, E. 1973).

Koshy, M.M. 1964. Energy expenditure in cleaning of floors. M.Sc. Thesis, St. Taresa College, Ernakulum.

Lehmann, G. and Muller, E.A. 1962. Praktische Arbeitsphysiologie. 2. AtFlage Stuttgart; Thieme (cited from Grandjean, E. 1973).

Longworthy, C.F. and Barott, H.G. 1920. Energy expenditure in household tasks. *Amer. J. of Physiol.*, **52**: 400-408.

Maloch, F. 1963. Characteristics of most and least liked household tasks. *J. Home Economics*, **55**: 413-416.

Mayerson, H.S. 1959. Posture of the trunk during lifting of weight. *Br. Med. J.*, **26**: 685-687.

Mehta, A. 1982. A study on the physiological cost of mopping in different-body postures. M.Sc. Thesis, Punjab Agricultural University, Ludhiana.

Mittal, A. 1981. To study the physiological costs while sewing the clothes with hand and foot sewing machine. M.Sc. Thesis, Punjab Agricultural University, Ludhiana.

Morehouse, L.E. and Muller, A.T. 1963. Physiology of exercise. The C.V. Mosby Company, Saint Luis, 3rd Ed. p.205.

Nirmala, B. 1965. Time and energy cost of ironing a sari, at different work heights. M.Sc. Thesis, Queen Mary's College, Madras.

Oberoi, K. 1981. A comparative study on the physiological cost of washing the clothes manually and by machine. Ph.D. Thesis, Punjab Agricultural University, Ludhiana.

Oberoi, K. and Miglani, S.S. 1985. A study of physiological responses during manual and machine washing of clothes. *J. Res. Punjab Agricultural University,* **22**: 369-374.

Oberoi, K. and Miglani, S.S. 1987. A study on the cardiovascular responses during manual and machine washing of clothes. *Indian J. Physiol. Allied Sci.*, **41**: 141-146.

Oberoi, K.; Sharma, K.K. and Miglani, S.S. 1987a. Ergonomics assessment of household activities. *J. Maharashtra Agric. Univ.*, **12**: 364-366.

Oberoi, K.; Sharma, K.K.; Sharma, V.K. and Miglani, S.S. 1987b. An ergonomics study of muscular fatigue during manual and machine washing of floor. *Indian J. Physiol. Allied Sci.*, **41**: 87-93.

Orsini, D. and Passmore, R. 1951. The energy expended in carrying loads up and downstairs; Experiments Using Kofranyi Michaelis Calorimeter. *J. Physiol.* Vol.115, p.95.

Park, S.R. and Rodbard, G. 1962. Effects of load and duration of tension on pair induced by muscular contraction. *Amer. J. Physiol.*, **203**: 737-738.

Parvathi, S.; Vijayaraghavan, N.C. and Swaminathan, K.R. 1993. Energy expenditure for household activities, Energy Management, Oct.-Dec., 1993, pp.29-32.

Passmore, R. and Durnin, J.V.G.A. 1955. Human Energy Expenditure. *Physiological Review*, **4**: 801-840.

Pirnay, F.; Patel, J.M. and Deronne, R. 1969. Compared evolution of heart rate and body temperature during muscular exercise in hot environment. *Ergonomics*, **28**: 23-30.

Pottier, M.; Dubrevil, A. and Monod, H. 1969. The effects of sitting posture on the volume of foot. *Ergonomics*, **12**: 753-758.

Puri, S. 1992. Physiological costs of grinding masala (Wet.) in different body postures. M.Sc. Thesis, Punjab Agricultural University, Ludhiana.

Rachel, G. and Ogale, N. 1986. Likes and dislikes of urban home-makers towards household tasks. *Indian J. Home Sci.*, **16**: 170-177.

Rajagopal, L.S. and Roy, S. 1977. Energy cost of selected activities. *Indian J. Home Sci.*, **11**: 62.

Ronald, P.Y.; Senger, M.E. and Maloch, F. 1971. Rating scale for household tasks. *J. of Home Economics*, **63**: 177-179.

Sandhu, P.; Oberoi, K. and Singal, S. 1991. An erogonomic study of muscular fatigue during manual grinding of spices in different postures. *J. Res. Punjab Agricultural University*, **28**: 298-304.

Sidhu, J. 1985. A comparative study of time consumption and distance travelled with postural variation for cooking in existing and improved kitchens of rural homes. M.Sc. Thesis, Punjab Agricultural University, Ludhiana.

Singal, S.; Sandhu, P. and Oberoi, K. 1991. Energy expenditure while grinding dry spices in different postures. *Urja.*

Singal, S. and Srinivasan, K. 1991. Drudgery of women's household work in rural areas. *Haryana Agricultural University J. Res.*, **21:** 168-172.

Singer, N.E. 1960. Energy expenditure and its relationship to working heights, space and methods of work in the performance of a household task. Ph.D. Dissertation, Ohio State University, Wooster, Ohio, U.S.A.

Smith, K.U. and Smith W.H. 1962. Perception and motion (an analysis of space structured behaviour). W.B. Saunder & Co., Philadelphia, pp.2-7.

Snorrason, E. 1955. Work chairs and work tables. Vol.33. As cited by Bratton, E.C. 1959. Sitting to work for household tasks. New York. College of Home Economics at Cornell University, Research Report No.4.

Steidl, R.E. and Bratton, E.C. 1968. Work in the home. John Wiley, New York, London. Sydney, pp.107-161.

Surabathula, P. 1986. Ergonomical study of energy expenditure of women performance floor caring activities. M.H.Sc. Dissertation, S.V.T. College of Home Sci., S.N.D.T. University, Bombay, pp.79-86.

Tuttle, W.M. and Horvath, S.W. 1957. Comparison of effects of static and dynamic work on blood pressure and heart rate. *J. Appl. Physiol.*, **10**: 294-296.

Vos, H.W. 1973. Physical work load in different body postures while working near to or below ground level. *Ergonomics,* **16**: 817-829.

ANNEXURE

ANNEXURE-I

A STUDY ON SWEEPING AND MOPPING OPERATION

Sr.No. :

Date :

Address :

(A) GENERAL INFORMATION

1. Name of the Respondent

2. Age

a) Below 25 years
b) 25-50 years
c) 51 years and above

3. Height

a) 120 to 150 cms
b) 151 to 180 cms

4. Weight

a) 35 to 50 kg
b) 51 to 65 kg

5. Family Occupation

a) Business
b) Service
c) Independent profession

6. Type of family

a) Nuclear
b) Joint

7. Size of family

a) Upto 3 members
b) 3 to 5 members
c) 6 members and above

8. Family education status

S.No.	Relationship	Age	Education

9. Employment status of women

a) Employed
b) Unemployed

10. Monthly income of family from all sources

a) Upto Rs. 5,000/-
b) Rs.5001 to 10,000
c) !0,001 and above

B) SPECIFIC INFORMATION:

11. Do you perform any household activity

Yes/No

If yes, Rank the activities performed by you in order of preference

Sr.No.	Activities	Order of Preference
a)	Cooking	
b)	Cleaning utensils	
c)	Dusting	
d)	Sweeping	
e)	Mopping	
f)	Washing	
g)	Ironing	
h)	Mending	
i)	Sewing	
j)	Shopping	
k)	Account keeping	
l)	Looking after the children	
m)	Helping in their studies	

12. With whom you take help in doing these activities

Sr. No.	Activities	Self	Husband	Daughter	Son	Full time servant	Part time servant	Any other
a)	Cooking							
b)	Cleaning utensils							
c)	Dusting							
d)	Sweeping							
e)	Mopping							
f)	Washing							
g)	Ironing							
h)	Mending							
i)	Sewing							
j)	Shopping							
k)	Account keeping							
l)	Looking after the children							
m)	Helping in their studies							

13. What are the most liked and disliked activities ?

Sr.	Activities	Like		Neutral	Dislike		Reason for	
		Per-forming	Not per-forming		Per-forming	Not per-forming	Like	Dislike
I.	**Kitchen Activity**							
a)	Cooking							
b)	Cleaning utensils							
II.	**Cleaning the house**							
a)	Dusting							
b)	Sweeping							
c)	Mopping							
III.	**Clothing**							
a)	Washing							
b)	Ironing							
c)	Mending							
d)	Sewing							
IV.	**Marketing**							
a)	Shopping							
b)	Account keeping							
V.	**Child care**							
a)	Looking after the children							
b)	Helping in their studies							

Reasons:	Liking	Reasons:	Disliking
(a)	Satisfying	(A)	Not interesting
(b)	Interesting	(B)	No pride in results
(c)	Pride in results	(C)	Not satisfying
(d)	Appreciation by family members	(D)	Dirty work
(e)	Good supplies	(E)	Repetitive task

C) SPACE AVAILABLE FOR CLEANING

14. Number of floors in the house 1/2/3/>3

15. Open space in the house (sq. foot) 100/200/300/400/>400

16. Number of rooms in the house 2/3/4/5/>5

17. Type of floor in the house

a) Kacha
b) Brick
c) Tiles
d) Chips
e) marble
f) Any other (specify)

D) INFORMATION REGARDING SWEEPING AND MOPPING OPERATIONS:

18. Type of broom used

a) Straw broom (Seekh)
b) Palm broom
c) Ordinary broom (fur)
d) J-shape with small handle

19. Why do you like that particular broom

a) Clean better
b) Good functional design
c) Cheaper
d) Dust does not scatter
e) Any other (Specify)

20. Do you sweep the area continuously/Discontinously

21. Do you remove the furniture while sweeping **Yes/No**

22. What is the frequency of removing the furniture.

Materials	Always	Sometime	Never
a) Small furniture			
b) Heavy furniture			
c) Carpet			
d) Accessories			

23. How much time spent on brooming

a) 15 minutes
b) 30 minutes
c) 1 hour
d) > 1 hour

24. Type of posture used for brooming

a) Standing cum bending
b) Squatting cum bending
c) Sitting
d) Standing
e) Any other (specify)

25. Why you use that particular position ?

a) Less tiring
b) Cleaning more area in one stroke
c) Habitual
d) Quick
e) Any other (specify)

26. Type of mop used

a) Ordinary mop (waste cloth material)
b) Ordinary mop in handle
c) Floor wiper
d) Sponge mop

27. Why do you use that particular mop

a) Clean better
b) Light
c) Good functional design
d) Cheaper
e) Any other (specify)

28. Do you mop the area continuously/Discontinuously

29. Do you remove the furniture while mopping Yes/No

30. What is the frequency of removing the furniture materials

Materials	Always	Sometime	Never
a) Small furniture			
b) Heavy furniture			
c) Carpet			
d) Accessories			

31. How much time spent on mopping

a) 15 minutes
b) 30 minutes
c) 1 hour
d) > 1 hour

32. Type of posture used for mopping

a) Standing cum bending
b) Squatting cum bending
c) Sitting
d) Standing
e) Any other (specify)

33. Why you use that particular position

a) Less tiring
b) Clean more area in one stroke
c) Habitual
d) Any other (Specify)

34. How many time do you change water for mopping a room

a) Once
b) Twice
c) Thrice
d) > Thrice

35. Do you switch 'on' the fan during mopping in summer **Yes/No**

36. How frequently do you broom and mop your house

Rooms	Summer		Winter	
	Brooming	Mopping	Brooming	Mopping
I. Living Room				
a) Once a day				
b) Twice a day				
c) Alternately				
d) Weekly				
II. Bedroom				
a) Once a day				
b) Twice a day				
c) Alternately				
d) Weekly				

Rooms	Summer		Winter	
	Brooming	Mopping	Brooming	Mopping

III.Kitchen
a) Once a day
b) Twice a day
c) Alternately
d) Weekly

IV. Bathroom
a) Once a day
b) Twice a day
c) Alternately
d) Weekly

V. Verandha
a) Once a day
b) Twice a day
c) Alternately
d) Weekly

37. Do you use separate broom and mop for different parts of house

(A) Brooms

a) Yes
b) No

(B) Mops

a) Yes
b) No

38. Problems faced by you while brooming mopping

a) Bodyache
b) Legache
c) Headache
d) Backache
e) Tiredness
f) Any other (specify)

39. Problems faced with respect to brooms

a) Short life time
b) Poor quality of straws
c) Unadjustable handle
d) Cost factor
e) More Bending
g) Any other (specify)

40. Problems faced with respect to mops

a) Poor soaking capacity
b) Unadjustable handle
c) Improper size
d) Cost factor
e) More bending
f) Problem in squeezing
g) Any other (specify)

ANNEXURE-II

Physiological parameters of women while performing the tasks of sweeping and mopping from different brooms and mops

Parameters	Resting			Fur Broom			Palm Broom			Ordinary mop			Ordinary mop in handle			Sponge mop			Improved mop		
	Rep. ①	Rep. ②	Rep. ③	Rep. ①	Rep. ②	Rep. ③	Rep. ①	Rep. ②	Rep. ③	Rep. ①	Rep. ②	Rep. ③	Rep. ①	Rep. ②	Rep. ③	Rep. ①	Rep. ②	Rep. ③	Rep. ①	Rep. ②	Rep. ③
Respondent-1																					
1. Pulse Rate (minute^{-1})	88	88	80	88	88	80	92	92	88	104	104	96	88	88	92	88	88	80	84	84	84
2. Respiration rate	33	32	33	38	35	35	36	38	38	40	42	42	38	40	40	38	40	40	33	32	32
3. Griping (kg)	10	10	10	6	7	6	7	6	6	7	6	6	10	9	9	10	9	9	10	9	9
4. Blood pressure (mm Hg)																					
Systolic	110	110	120	120	120	122	122	122	124	124	124	126	122	124	124	120	122	122	120	120	120
Diastolic	80	80	80	82	82	82	84	82	84	84	82	84	82	80	84	82	80	86	82	82	84
Respondent-2																					
1. Pulse Rate (minute^{-1})	78	88	82	80	88	84	88	88	84	92	92	96	88	88	92	88	88	88	88	92	84
2. Respiration rate	32	25	30	29	26	32	40	30	33	42	35	34	41	34	33	39	32	33	32	32	31
3. Griping (kg)	18	17	17	16	14	16	14	14	16	13	13	12	12	12	12	12	11	11	12	12	11
4. Blood pressure (mm Hg)																					
Systolic	120	120	120	122	122	122	124	124	124	122	122	122	124	124	124	122	122	122	122	120	120
Diastolic	80	82	82	82	84	84	82	86	86	84	88	88	82	84	84	80	82	82	80	82	82
Respondent-3																					
1. Pulse Rate (minute^{-1})	88	80	80	82	88	84	88	92	100	96	92	92	88	96	88	84	96	96	92	92	94
2. Respiration rate	29	26	26	29	30	29	30	30	33	33	31	35	32	30	31	35	36	33	32	32	33
3. Griping (kg)	10	12	12	10	11	11	9	8	8	9	11	11	8	10	10	8	8	8	8	8	8
4. Blood pressure (mm Hg)																					
Systolic	110	120	120	120	122	122	122	124	124	124	124	124	122	124	124	120	122	122	120	120	120
Diastolic	80	80	80	82	82	82	82	82	82	82	82	82	80	82	82	80	80	80	80	80	80

Contd.....

(ANNEXURE-II Contd.....)

Parameters	Resting			Fur Broom			Palm Broom			Ordinary mop			Ordinary mop in handle			Sponge mop			Improved mop		
	Rep. ①	Rep. ②	Rep. ③	Rep. ①	Rep. ②	Rep. ③	Rep. ①	Rep. ②	Rep. ③	Rep. ①	Rep. ②	Rep. ③	Rep. ①	Rep. ②	Rep. ③	Rep. ①	Rep. ②	Rep. ③	Rep. ①	Rep. ②	Rep. ③
Respondent-4																					
1. Pulse Rate (minute^{-1})	76	80	80	88	84	88	88	88	88	92	92	92	84	84	88	84	84	88	84	84	88
2. Respiration rate	21	26	25	30	35	34	39	32	34	34	34	35	35	35	36	36	36	36	31	32	32
3. Griping (kg)	11	11	11	9	9	9	12	12	12	11.5	10	10	7	8	8	7	8	8	7	8	8
4. Blood pressure (mm Hg)																					
Systolic	100	110	120	110	116	120	116	118	120	118	120	122	118	122	122	120	122	122	120	120	120
Diastolic	78	80	80	80	80	80	82	82	82	82	82	82	80	82	82	80	80	78	80	80	78
Respondent-5																					
1. Pulse Rate (minute^{-1})	88	80	88	100	96	96	96	108	100	100	112	100	100	108	100	88	100	88	88	88	88
2. Respiration rate	32	35	35	37	35	35	32	33	33	35	38	38	33	36	36	32	30	32	31	32	32
3. Griping (kg)	10	9	9	9	9	9	8	8	8	8	7	8	10	8	8	8	8	8	8	8	8
4. Blood pressure (mm Hg)																					
Systolic	120	110	120	122	120	124	122	122	126	124	124	126	122	122	124	122	120	122	122	122	120
Diastolic	82	88	84	84	84	88	84	84	88	88	88	88	84	84	88	82	84	84	82	84	84

Rep. = Replications

ANNEXURE-III

Sr.No.:
Name of the judge:

Acceptability of the improved mop

		SA	A	N	DA	SDA
I.	**Structure**					
a)	Any member can use it					
b)	Light in weight					
II.	**Working Efficiency**					
a)	Easy to use					
b)	Convenient to handle					
c)	Can be used on any type of floor					
d)	No problem in squeezing					
e)	Touching not required while squeezing					
f)	Good soaking capacity					
g)	Changeable mop					
III.	**Cost Factor**					
a)	Low cost					
b)	Can be constructed at home					
c)	Less water consumption					
IV.	**Physical drudgery**					
a)	Saves time					
b)	Less energy consumption					
c)	Increases work efficiency					
d)	Reduces health problems					
e)	Less bending					
f)	Lesser fatigue					
g)	Removal of furniture is not required					
h)	Could easily reach under the furniture places					
V.	**Any other**					
a)	Results are observable					
b)	Can be tried out easily					
c)	Easy to keep or store					
d)	Culturally more acceptable					

Note: SA= Strongly Agree; A = Agree; N = Neutral; DA = Disagree; SDA = Strongly disagree

ANNEXURE-IV

Analysis of variance of effect of different types of brooms on certain physiological parameters

S.V.	d.f.	MSS				
		Pulse rate	Resp. rate	Griping	Syst. BP	Dia BP
Treatment	2	308.36**	88.07**	16.96^{NS}	191.02**	29.420**
Error	42	31.82	13.94	9.64	19.70	3.733

NS = Not significant; **P < 0.01

ANNEXURE-V

Analysis of variance of effect of different types of mops on certain physiological parameters

S.V.	d.f.	MSS				
		Pulse rate	Resp. rate	Griping	Syst. BP	Dia BP
Treatment	4	393.07**	131.73**	21.83**	322.68**	33.15**
Error	70	28.73	10.42	4.43	10.00	4.33

**P < 0.01