ILLUSTRATIVE MATERIAL FOR CORRECT WORKING ARRANGEMENTS AND GOOD POSTURAL PRACTICES IN HOMEMAKING TASKS

by

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INTRODUCTION

It is important for the homemaker to use her body and her working arrangements to maintain correct posture and to reduce effort which results in fatigue. This importance is further emphasized when it is known that she spends an average of almost 50 hours each week in homemaking tasks.

Many factors, some physical and others subjective, contribute to the feeling of fatigue. In some industrial and homemaking tasks, measurable physical fatigue reactions have been studied and it has been demonstrated that working arrangements which encourage good postural practices are important factors in decreasing fatigue reactions.

Good posture is an asset that is as much to be desired for its health benefits as it is for good appearance. Specialists in body mechanics emphasize that poor posture is one of the major causes of fatigue, and, conversely, that fatigue is an important cause of poor posture.

Working arrangements should enable the homemaker to maintain correct posture and to reduce effort and resulting fatigue. She should be able to stand or sit at a workplace that facilitates good posture, and does not require her to stoop, stretch, or climb to do the work at hand or to obtain materials.

Although dimensions suited to the requirements of the average homemaker have been developed, there is as yet no reliable formula by which the homemaker may know which dimension is best suited to her own physical requirements for maintaining good

posture in the performance of homemaking tasks. She needs to be made aware of the importance of her working arrangements and to be shown how to experiment to select her own most favorable dimensions for working arrangements.

As a Home Economics Extension worker, the writer found that many homemakers seemed unaware that fatigue and minor ailments often result from poor postural practices, frequently induced by incorrect working arrangements. Adequate illustrative material was not available to develop this subject with rural homemakers, who were and will be building or remodeling their homes.

For these reasons, the following objectives were set up for this study:

I. To develop illustrative material to emphasize the importance of determining work arrangements suited to the physical requirements of the individual homemaker.

II. To summarize accepted standard heights of working arrangements and compare with the heights preferred by a selected group of young women.

III. To show a relationship between the performance of certain household tasks and correct postural practices.

IV. To produce photographs and/or charts illustrating the performance of certain household tasks in accordance with correct postural practices.

V. To develop a popular interpretation of the illustrative material, suitable for use with homemakers.

METHODS AND MATERIALS

Wise choices of working arrangements for homemaking tasks depend on the homemaker's interest in, and knowledge of, the factors which determine correct working arrangements. In order that illustrative material resulting from this study should interpret

those factors accurately, the literature was summarized concerning women's preferences of heights for work areas, energy requirement, and fatigue reactions from the performance of homemaking tasks.

To determine whether or not the requirements and preferences of young women were significantly different from previously reported data for homemakers, a portion of a form developed for the 'House' class at Kansas State College was used. The form (Appendix) was based on a study by Wilson, Roberts, and Thayer in Oregon and Washington. Data were recorded during class periods, following discussion and demonstration of procedures.

The data included four types of measurements:

I. Body measurements including standing and sitting heights, and standing and sitting eye levels.

II. Measurement of reaches.

   A. Comfortable reaches upward with one hand and with both hands, with and without obstruction, standing.

   B. Reaches upward with one hand and with both hands, without obstruction, sitting.

III. Preferences for heights of working surfaces for:

   A. Standing to wash dishes at the sink, beat with a rotary beater, pare potatoes, roll dough, iron, and cut out a garment.

   B. Sitting to iron, work at a desk, and use a lap table.

IV. Preferences for the height of a stool for working at the selected work surface for standing to wash dishes, pare potatoes, beat with a rotary beater, roll dough, and iron.

Heights and reaches were taken at a wall measurement chart. Comfortable upward reaches were interpreted as reaches which did not necessitate raising the shoulder.

Preferences for heights for the homemaking tasks were ascertained by performing the task at various levels. Wooden platforms were arranged on a table to provide levels of one inch variation from 26 to 42 inches. The equipment for each task was manipulated until the most comfortable level was determined. For example, a dishpan of approximately the same depth as a standard sink was moved from level to level and dishes and dishcloths were used to make the task realistic.

An adequate adjustable stool was not available, and the height of a seat desired for working at a sink and at other work surfaces for the several tasks was ascertained by building up an ordinary kitchen stool or a chair to the desired height.

The data, as recorded by 135 young women, were tabulated, compared with the Wilson, Roberts, and Thayer findings, and charted.

Conferences with members of the Physical Education faculty from Kansas State College and from Columbia University School of Nursing were held to assure accurate interpretation of correct postural practices and correct body mechanics in the performance of household tasks.

The types of activities used in homemaking tasks were classified as those involving standing, sitting, reaching, stretching, stooping, lifting, carrying, pushing, and seeing. A summary of correct body mechanics in these activities was made.

Typical illustrations for the principles of body alignment, for the method of determining the correct working arrangements, and representative tasks in each classification were selected and

a series of photographs was made.

The illustrations selected were:

I. Illustrations for the principles of body alignment.

A. A picture of balanced weights.
B. A drawing of the lateral body, with landmarks for postural alignment identified.
C. Three pictures of the model, lateral, anterior, and posterior views, with landmarks for postural alignment.
D. One picture of the model, illustrating correct sitting posture.

II. Illustrations for method of determining correct working arrangements.

A. Measuring to determine comfortable reach upward with no obstruction.
B. Measuring to determine comfortable reach downward without bending.
C. Four pictures of the model ironing at three different levels to determine her preferred height.
D. Measuring to determine comfortable upward and lateral reach when there is a base cabinet.
E. Two pictures of the model cutting out a garment at preferred and at low levels.

III. Illustrations of representative tasks in each classification.

A. Standing.
1. Ironing at a board of preferred height.
2. Preparing vegetables at a sink of preferred height.

B. Sitting.
1. Preparing sandwiches at a lap table.
2. Sewing at an ironing board at a preferred height for sitting to iron and sew.

C. Reaching.
1. Hanging a sheet within area of comfortable reach upward, and with basket within area of comfortable reach downward.
2. Showing supplies stored within area of comfortable reach.

D. Stretching.
1. Stretching to reach a lightweight package above the area of comfortable reach.

2. Using a step ladder to minimize stretching for heavy articles.

E. Stooping and lifting.
1. Working at a low level. Two-knee kneel to clean spot on rug.
2. Working at a low level. One-knee kneel to wash baseboards.
3. Lifting a small child using a correct stooping position.
4. Lifting a davenport with assistance.
5. Lifting a window sash.

F. Carrying.
1. Carrying shopping bags with divided load.
2. Carrying a tray of dishes, near body as a part of the body weight.

G. Pushing.
1. Pushing a baby carriage.
2. Pushing a chest of drawers.

H. Seeing.
1. Seeing labels at eye level.
2. Seeing to cut out a garment at the preferred height.
3. Seeing downward into a base cabinet with cut-away shelf.

I. Relaxing.
1. One picture showing complete relaxation between tasks.

A young woman, skilled in body mechanics, was selected to pose for the photographs. She was instructed and practiced in the performance of these tasks, before the photographs were made.

A brief popular interpretation was developed to explain each illustration to enable extension and other workers to use the material as a teaching device.

REVIEW OF LITERATURE

A new idea, introduced before public opinion is ripe for its acceptance, may require considerable time for its development.

So it has come about that research effort has been slowly progressing for almost 40 years in the study of working arrangements to enable the worker to reduce fatigue by lessening the onergy costs of his tasks. The present conception, summarized by Agan (1948), concerning the creation of working arrangemonts in the home is:

> . . . To create as desirable a product as possible, with a low cost in time and energy and with the maintenance of good posture which helps in reducing fatigue and maintaining health.

Fatigue, a term of many meanings, may be dofined as a state of wearinoss, a sense of exhaustion, or depletion of muscular capacity. Rathbone distinguished between true or physiological fatigue and false or subjective fatigue. True fatigue is a physiological state resulting from continued activity. Its physiology is explained by Rathbone (1949):

> Each muscle twitch has two phases, a period of contraction and a period of relaxation. The muscle, finally, fails to respond to stimulation because of the depletion of immodiately available glycogen precurser, or becauso of the need for oxygen to convert the by-products of muscular work (lactic acid) into glycogen precurser. As physiological fatigue develops, a longer period of relaxation is necessary.

Any activity of muscular cells tends to produco an inhibition of that activity. Continued stimulation of muscles causes physiological fatiguo in the end platos or synapses of the norves before it affects the muscle tissuo. The norves, thon, act as "fusos" which "blow-out" before tho muscles have become exhausted.

Physiological fatigue is measured in terms of lactic acid accumulation in the muscles and in the blood stream, a difficult measurement to make. Oxygen consumption, variously oxpressed as onergy cost, energy requiremont, or calorie requirement, is the

convenient measurement most commonly used to indicate the fatiguing effects of an activity.

Subjective fatigue is a state of weariness and is the result of mental attitude toward the work, postural strain, muscle tension, amount of concentration or skill required by the job, or other factors. Satisfaction from work is universally accepted as an important factor in the elimination of subjective fatigue. No satisfactory measurement for it has been found, because individuals differ so widely.

The idea of conservation of energy when working began in industry and led to the improvement of working conditions as a means of increasing production. Investigating working methods and arrangements, Frank B. and Lillian M. Gilbreth (1916) developed equipment to enable the industrial worker to perform his task with a minimum of fatigue. As a homemaker with a growing family, Mrs. Gilbreth applied the techniques of industry to her own homemaking tasks. Her philosophy was that improved working arrangements and methods in the home made her work more satisfying.

Interest in nutritional requirements led to studies of calorie requirements for many tasks. Langworthy, chief of the Office of Home Economics, United States Department of Agriculture, and Barott, in charge of the Respiration Calorimeter Laboratory, (1920) measured the calorie requirements of two subjects sitting at rest and performing a number of household tasks. The calorie requirements, as determined in this study, were:

Sitting at rest	60.7 Calories
Average for light tasks Knitting Crocheting Hand sewing	69.8 Calories
Average for moderate tasks Dishwashing Ironing Dressing an infant	84.0 Calories
Average for heavier tasks Sweeping or scrubbing a floor Washing towels by hand	100.0 Calories

So far as the writer could discover, this study was the first to demonstrate the relation between the height of the workplace and the energy cost to the worker. For one subject it was observed that a variation of 15 per cent in the height of the table used for dishwashing resulted in an increased calorie requirement of 20 to 40 per cent. Their findings further indicate that, for this subject, 85 cm (using 20.3 calories above rest) was the optimum height for this activity, inasmuch as both a higher table (100 cm, using 24.2 calories) and a lower table (65 cm, using 30.0 calories) required a greater number of calories. Interest in nutrition overshadowed the implications of this observation, and more than a decade passed before the idea was further developed.

Home economists have attempted to discover a formula by which the homemaker might determine her own most favorable heights for homemaking activities. First attention was given to the height for a work table. Formulas suggested were:

> 1. An easy test for the worker to apply to her working surface is to stand erect and place her hands with palms flat on the table. If she can do this with-

out bending her back, this height should give her the least strain while working at the table (Warner, 1920).

2. A working surface with a height equal to one-half the worker's height is good for practically any kind of kitchen work (Smith and Fegle, 1925).

3. Stand erect. Rest arms comfortably against the side of the body, making a right angle at the elbow. Now measure from the floor to the elbow at its lowest point. Subtract six inches to allow for a drop from the elbow to the hand. This slant of the arm will allow one to wash dishes in comfort (Bell, 1927).

More recently the search for a formula has been abandoned. The idea first suggested by Gray (1926) that the heights of working surfaces should be determined by personal experimentation rather than by physical measurements, has been accepted. This idea has been summarized by Knowles (1945):

> Just how one goes about choosing a comfortable height is an individual problem. If women were all 'made by the same pattern' we could give a formula, but so far none of the rule-of-thumb methods suggested by various authors for the best height for a job holds 100 per cent true. Body height is the least reliable measure. . . . Near-sightedness and bi-fecal glasses add still other problems.

The first study of energy costs as a basis for improving working arrangements was made by Swartz (1933). Her purpose was two-fold: "to discover how much human energy a woman uses in her homemaking duties . . . and to compare the effect of table height on the energy requirement of the worker."

Using the basic energy requirement for lying at rest, she classified tasks as light, moderately heavy, and heavy. Her findings are summarized as follows:

Light tasks - less than 100 per cent above rest.
Paring potatoes.
Ironing, both standing and sitting.
Beating a batter.

Moderately heavy tasks - 100 to 150 per cent above rest.
Kneading dough.
Most laundry tasks using power equipment.
Wringing clothes by hand.
Hanging clothes from a basket on a utility table.
Emptying and cleaning a washing machine.
Putting up and removing a clothes line.

Heavy tasks - 150 to 200 per cent above rest.
Rinsing clothes.
Hanging clothes from a basket on the floor.
Washing clothes by hand.
Using a hand-powered wringer.

She substantiated the findings of Langworthy and Barott, that there is an optimum height for working arrangements. In an experiment using ironing boards at three heights, beginning with the normal work table height and building up four inches higher, she found that the high board required about 15 per cent less energy than the normal board. She further found that sitting to iron saved 35 per cent of the energy required to stand at the normal board. Although individual differences of energy requirements were great, the pattern for saving of energy was the same for all.

Added evidence that working arrangements should be designed to meet the requirements of the individual worker was offered by Wilson, Roberts, and Thayer (1937). Because they recognized that homes were built for rent or sale as well as for owner occupancy, they studied physical measurements of 562 homemakers in Oregon and Washington to determine a standard of dimensions for working arrangements, based on average measurements. Data from this study demonstrated the importance of having work surfaces of varying heights for the performance of different tasks. They established measurements for dishwashing at the sink, working at a mixing

table, sitting to work at a surface, and reaching to a high shelf.

The average height for dishwashing was found to be 32½ inches. Placement of the sink at this level required a counter level adjoining the sink rim higher than the optimum height for mixing or beating, found to be 32 inches. Two provisions for sitting to work were tested. When using a chair of correct height, a surface 25 inches high was found suitable. For working at the levels fixed for standing, it was found necessary to provide an open space under the work surface for knees and thighs of the worker. A stool, preferably adjustable in height, with an adjustable footrest, was recommended.

Measurements for maximum reaches furnished the data which determined their recommendations for maximum heights for storage facilities. The recommendations were:

72 inches for lightweight articles which may be reached with one hand (no obstructing base cabinet).

69 inches, when there is an obstructing base cabinet.

66 inches, for objects requiring both hands to reach.

Concurrent with the later studies of energy costs of homemaking tasks were surveys of the attitudes of homemakers toward their jobs. Wilson (1929), Knowles (1937), Perkins, Beyer, and Bane (1945), and others found that homemakers frequently consider fatiguing those tasks that are moderate in energy costs, as well as those that are heavy in energy cost.

The task generally regarded as most fatiguing was laundry, including ironing, the latter established as only a moderately heavy task. Knowles (1944) continued her previous work with a

further study of energy costs and other physiological responses of the worker when ironing. She found that posture as well as other physiological responses were factors in physical fatigue. Postural responses, measured by using the "angle of bend," were positively related to the energy costs and other physiological responses. At a height which facilitated good posture, and was regarded as the most comfortable, other physiological factors such as metabolism rate, heart rate, respiration, and blood pressure were also most favorable.

Time and motion economy, which had a brief period of attention from home economists following the First World War, was given new impetus during the Second World War by the development of Job Methods Training. Its basic questions, "What is the job? Where should the job be done? What should it be done with? and How should it be done?" were applied to many homemaking tasks. The best performance of a task is possible only when an adequate work place and adequate tools are available. The principles of motion economy as applied to working arrangements in the kitchen, summarized by Wilson (1947), are also applicable to working arrangements in other work centers in the home:

> The kitchen installation should make it possible for the worker to maintain a healthful and comfortable posture and to work efficiently with the minimum of discomfort and fatigue. For the average woman this implies that:
>
> 1. Work surfaces should not be so low as to require stooping for more than brief periods, nor should they be so high as to require the arms to be held away from the body.
>
> 2. Heavy articles should be stored as nearly as possible on a level with the surface where they are

used, but not higher than this surface.

3. Articles in frequent use should be stored within reach of the worker as she stands on the floor.

4. There should be room for the toes under the edge of the cabinet used by the standing worker and for thighs and extended feet under that used by the seated worker.

5. Lateral spaces should be sufficient for arm movements required for the various kitchen tasks.

6. Facilities for doing work while seated should be part of every kitchen installation to make it possible to save energy while doing time-consuming jobs, and to make kitchen work easier when the homemaker finds it fatiguing to stand. This height should be as low as clearance over thighs will permit in order that the arms of the worker will need to be raised as little as possible.

7. Consideration should be given to the requirements of left-handed as well as right-handed workers.

Home economists continue to search for information concerning women's preferences for working arrangements and factors which produce fatigue. Fjare (1948) recorded the preferences of Iowa homemakers and Iowa State College women for heights for cabinet tops and lap tables. According to her data, the majority of homemakers preferred a 35-inch counter top for most of the tasks done standing, while the college women preferred a 36-inch counter. Their average preferences for the height of a lap table were 25 inches and 24.9 inches, respectively.

Bratton (1949) divided homemaking tasks into component activities and measured energy expenditures for reaching to various heights from the floor, for bending and for stooping, and for climbing. She found that the per cent of energy expenditures, above the requirement for standing, were:

Activity	Height of reach above floor (Inches)	Percentage of increase of oxygen consumed over standing
Arm reach	46	12
Arm reach	56	24
Arm reach and pivot body through 90 degree angle	36	40
Arm reach	72	50
Arm reach and trunk bend	22	57
Step up 7 inches	No reach	119
Arm reach and trunk bend	3	131
Arm reach and knee bend	3	224

Reaches did not involve maintaining a static position. It is probable that the trunk bend could be recommended for reaching a light object near the floor, but would not be well adapted for reaching a heavy object or for performing a task requiring a period of time. The significant difference between the energy requirements for reaching 46 inches and 72 or 22 inches is added proof of the need for planning correct working arrangements.

Each study of energy costs and working arrangements added evidence that the posture of the worker is an important element in energy requirements and resultant fatigue. Funk and Wagnall's New College Standard Dictionary defines posture as "the visible disposition, either natural or assumed, of the several parts of a material thing, especially of a living thing." Specialists in physical education emphasize that good posture offers many values. Williams (1934) classified the values as hygienic, economic, social, and spiritual. Frost includes these four values, saying, "When there is the best alignment and functioning of body parts, when movement is free, smooth and well controlled, then strain and fatigue are lessened, efficiency is increased, and the aesthe-

tic ideal is approached."

Body mechanics is a term gradually replacing posture because it includes the body in motion as well as in standing and sitting. The word 'mechanics' suggests a relationship to the functioning of the body. Lee and Wagner (1949) say, "As far as mechanics are concerned, the human body presents a problem of weights, levers, supports, and devices for producing motion." They summarize the basic principles of body mechanics as follows:

1. Correct body mechanics are those that produce the best results with the least effort.

    a. The least effort is required when those muscles selected to do the work are the strongest of those which can perform the task. (The leg muscles are stronger than the back muscles, and therefore they, instead of the back muscles, should do heavy lifting.)

    b. A muscle can exert its greatest force when it is fully extended and as it shortens, its force diminishes. (In other words, to get strong work out of a muscle, first put it on the stretch; the less the force required, the less the amount of stretch that is needed.)

    c. Low speeds of contraction of muscle require less energy than high speeds.

2. Opposing forces are constantly at work on the body so that there is ever present the task of holding these opposing forces in equilibrium.

    a. When opposing forces which act upon a body are equal, stability is maintained in that body.

    b. When opposing forces are not equal, stability is disturbed until additional force is available to supplement the lesser force. (If the requirements for additional force are too much, strain results.)

3. An object at rest tends to remain at rest and an object moving tends to continue moving in the same direction and at the same speed unless some external force intervenes.

a. In moving, the body must overcome inertia.

b. Once a movement is started it takes less effort to maintain a given speed than to change the speed (because of momentum).

c. The more the use of momentum, the less the effort required.

4. Gravity acts upon the body in a vertical downward pull.

a. The stability of the body is most efficiently maintained when the body segments are centered over each other and the base of support, and along the line of the pull of gravity.

b. The greater the angle of inclination of the body or any segment from the vertical position, the greater the muscular effort required to maintain balance.

(1) When body balance is disturbed, a broader base of support makes the maintenance of balance easier.

5. When the body is to be put in motion, force should be applied through the center of gravity in the direction of the desired movement.

a. The circumstances are the most favorable for correct mechanics in movement if the body segments are maintained in correct alignment in relation to each other.

b. When the body is moved vertically upward or lowered vertically downward, less effort is required if the center of gravity is kept directly above the base of support.

6. When lifting, supporting, or carrying an object that object becomes a part of the body weight in so far as forces that maintain balance are concerned.

a. The closer the load is kept to the center of body gravity and the more directly over the base of support, the less the expenditure of energy.

b. Moderate weights are more economical of energy than extremely light or extremely heavy ones. (A moderate weight is one which is about half what the muscle can lift.)

c. The work of handling a load is performed with the least expenditure of energy if the muscles that are to do the work get set before contacting the load. (In other words, prepare for the load.)

d. The greator the distance of the lift of either body or object or both, the greater the amount of work.

(1) When stooping to a load, the body should be lowered only so far as necessary to reach the desired object and at the same time to put the leg muscles on sufficient stretch for the work to be done.

7. In moving a load less enorgy is exponded if the force is applied through the center of gravity of the load in the direction of the desired movement.

8. It requires many repetitions of a desired action before the reflex arcs of the nervous system are effectively "conditioned" and tho action is done without oonscious control. (If habits of efficient body mechanics are to be formed, each repetition of the action must be done in a correct manner.)

Added emphasis to these principles of body mechanics are suggested by Nye (1949), when she states, "In correct posturo, whether standing, sitting, or using a tool, muscles constructed to do certain things do thom. In incorrect posture, muscles not so constructed must do the job."

Authorities are agreed that correct body alignment means that the body weights should be balanced above tho base of support. They also agree that the same principles of balanced weights apply in postures assumed in sitting and in activity because the body functions more efficiently when principles of good body mechanics are observed.

The public seems ready to accept the idea which it rejected for years. Popular magazines for homemakers are now featuring

articles by home economists and by physical education specialists, emphasizing the relation between working arrangements, energy requirements, and correct postural habits. It is a role of home economists to aid homemakers in applying the knowledge which has been gained through the years of study.

DISCUSSION AND COMPARISON OF FINDINGS OF THE KANSAS STATE COLLEGE AND OREGON-WASHINGTON STUDIES

General Information

One hundred thirty-five young women enrolled in the 'House' course at Kansas State College during the fall and spring semesters, 1949-1950, participated in this study. With few exceptions, they were junior or senior students majoring in home economics. The Oregon-Washington study was made by Wilson, Roberts, and Thayer in 1937 and included data for 562 homemakers in those states.

Physical Measurements

No marked differences were found between the physical measurements of the Kansas State College women and the women in the Oregon-Washington study. Average measurements were similar, although there was a smaller range of measurements in the Kansas study than in the Oregon-Washington study. Standing heights averaged 65.6 inches for the young women, with a range of 61 to 70 inches. The average for the Oregon-Washington cooperators was 65.2 inches, with a range of 57.6 to 74 inches.

Table 1. Heights and eye levels of Kansas State College and Oregon-Washington women.

Distance to floor	Average heights		Range of heights	
	Kansas	Oregon-Washington	Kansas	Oregon-Washington
	Inches			
Subject standing				
Top of head	65.6	65.2	61-70	57.6-74
Eye level	61.4	61.0	56-65	54 -69
Subject seated				
Top of head	51.5	50.5*	48-58	46 -57*
Eye level	47.2	46.1*	44-53	42 -52*

* Cooperators were measured from top of head to seat, using a chair which measured 17 inches from the floor.

Eye levels varied in exactly the same relationship as the average heights. For Kansas State College women, the average eye level when standing was 61.4 inches and the range, 56 to 65 inches. Corresponding measurements for the Oregon-Washington women were: average, 61 inches; and range, 54 to 69 inches.

Sitting heights of the Kansas State College women were measured from the floor, using a chair selected by the subject as the most comfortable height for her. Heights for chair seats selected were 15, 16, and 17 inches. Sitting heights of the Oregon-Washington women were measured from the seat of the chair. To obtain comparable measurements, the average height-under-the-knee measurement (17 inches) was added to the reported sitting height in the Oregon-Washington study. Average sitting heights were 51.5 inches for the Kansas State College women and 50.5 for the Oregon-Washington women. Heights when seated ranged from 48 to 58 inches and from 46 to 57 inches, respectively.

Eye levels are important in determining the placement of storage arrangements for such materials as are identified by small labels, and for placement of such tasks as require reading. It appeared that the eye levels for Kansas State College women were higher than those reported for Oregon-Washington women. The distance of the eyes from the floor when sitting showed a range of 44 to 53 inches for the Kansas State College group, and 42 to 52 inches for the Oregon-Washington group. The averages were 47.2 and 46.1 inches, respectively.

Eye levels of 76.4 per cent of the Kansas State College women were included in the range of 59 to 63.9 inches, and for 84.6 per cent, the eye level measured 60 inches or more. The corresponding measurements of Oregon-Washington women were 72 per cent between 59 and 63.9 inches, and 70 per cent above 60 inches.

Plate I shows the heights and eye levels of Kansas State College and Oregon-Washington women, with per cent of women having each measurement. Tables 4, 5, and 6 (Appendix) show the measurements of heights and eye levels by number and per cent of women.

Heights of Reach

In the Kansas State College study, heights of reaches were interpreted to be comfortable reaches which did not necessitate raising the shoulder, while the Oregon-Washington study reported an extended reach. Plate II, Fig. 1, shows that, because of the two methods of determining reaches, both the average and the range of reaches of Kansas State College women were approximately five inches lower than for Oregon-Washington women. Average

EXPLANATION OF PLATE I

Fig. 1. Graph showing distribution of standing heights of Kansas and Oregon-Washington women.

Fig. 2. Graph showing distribution of sitting heights of Kansas women.

Fig. 3. Graph showing distribution of standing eye levels of Kansas and Oregon-Washington women.

Fig. 4. Graph showing distribution of sitting eye levels of Kansas and Oregon-Washington women.

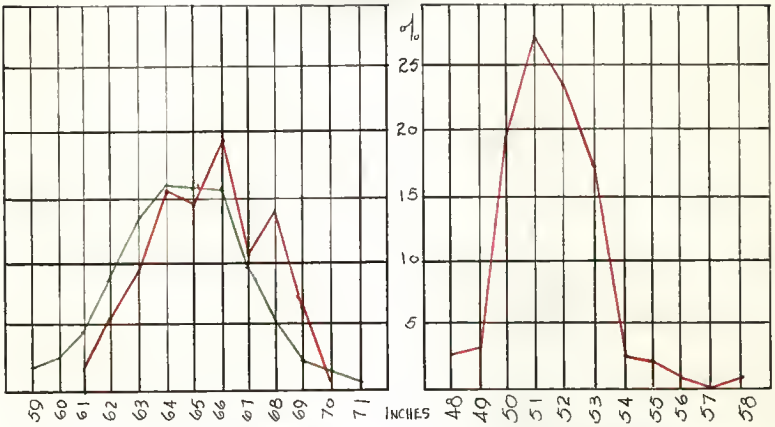


FIG. 1 · STANDING

FIG. 2 · SITTING

PLATE I · DISTRIBUTION OF HEIGHTS

KANSAS ——— OREGON-WASHINGTON ———

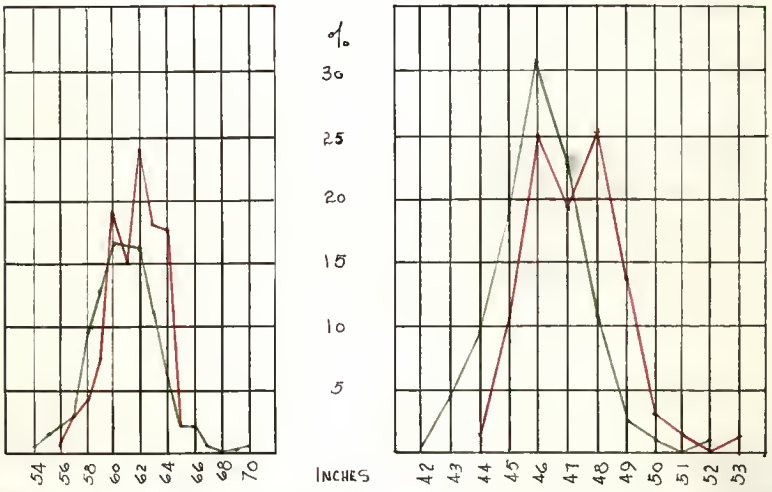


FIG. 3 · STANDING EYE LEVELS

FIG. 4 · SITTING EYE LEVELS

EXPLANATION OF PLATE II

Fig. 1. Graph showing distribution of heights of reaches of Kansas and Oregon-Washington women, standing position. (Kansas women - comfortable reach. Oregon-Washington women - maximum reach.)

Fig. 2. Graph of distribution of heights of comfortable reach upward of Kansas women. One hand and two hand reaches without an obstruction.

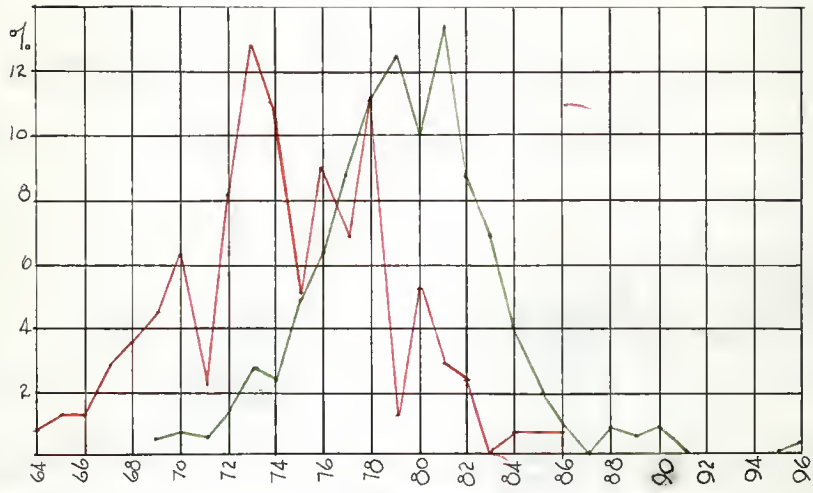


FIG. 1. STANDING

KANSAS — COMFORTABLE

OREGON-WASHINGTON — MAXIMUM

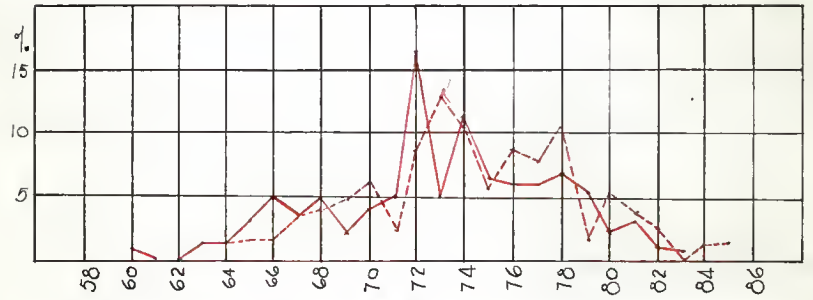


FIG. 2. STANDING. ONE & TWO HAND. NO OBSTRUCTION

PLATE II. DISTRIBUTION OF REACH HEIGHTS

ONE-HAND

TWO-HAND

height of reach for the Kansas State College women was 74.2 inches, for the Oregon-Washington women, 79.4 inches. The ranges were 63 to 85 inches for the Kansas State College study, and 69 to 96 inches for the previous study. Supplies which may be secured with one hand are readily available if stored at the height of this reach when there is no obstruction.

Although recommendations were made in the Oregon-Washington study that articles requiring two hands for reaching should be placed lower than those requiring one hand, measurements of two hand reaches are available only from the Kansas State College study. Reaches with both hands, without obstruction, averaged 73.2 inches, only one inch lower than with one hand (74.2 inches). The range of reaches with two hands was 60 to 83 inches. The decrease of one inch was not uniform for all subjects, however. One subject found that her reach with both hands was four inches lower than with one hand, and several subjects found no decrease in reach when both hands were required. Storage arrangements for heavier articles and height of the clothes line are working arrangements based on this measurement.

An obstruction, such as a base cupboard in the kitchen, decreases the height of reach by approximately three inches. Plate III, Fig. 1, shows that the average reach of Kansas State College women, over a base cabinet, was 71.1 inches with one hand, and that the average reach was lowered 1.6 inches or to 69.5 inches when both hands were used. The range of measurements was 59 to 80 inches for one hand reach and 56 to 78 inches for both hands.

In addition to the fact that a seated worker must reach from

EXPLANATION OF PLATE III

Fig. 1. Graph of distribution of heights of comfortable reach upward of Kansas women. One hand and two hand reaches with a one foot base cabinet obstructing.

Fig. 2. Graph showing distribution of heights of comfortable reach upward of Kansas women. One hand and two hand reaches, sitting position. No obstruction.

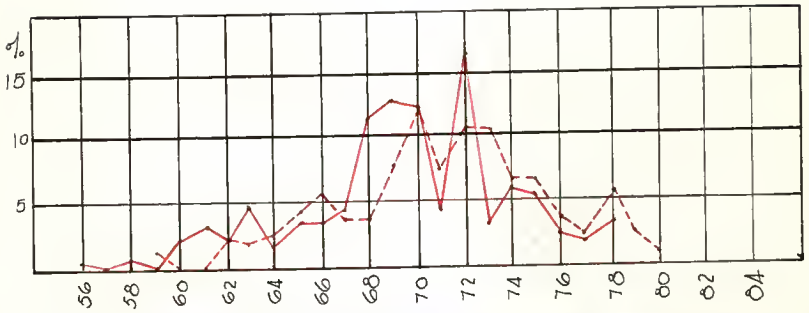


FIG. 1. STANDING · ONE FOOT BASE CABINET OBSTRUCTION

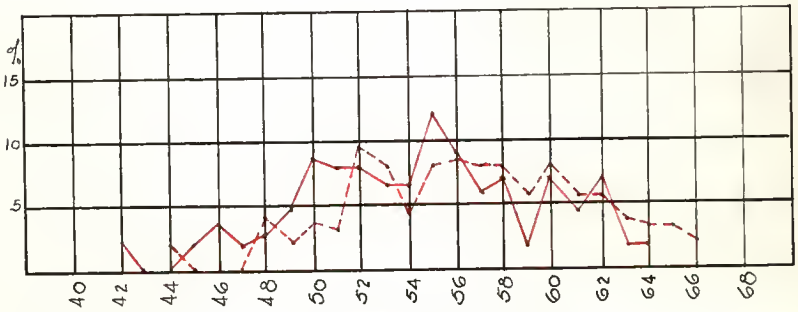


FIG. 2. SITTING · NO OBSTRUCTION

PLATE III · COMFORTABLE ONE & TWO HAND UPWARD REACHING HEIGHTS

ONE · HAND ——— TWO · HAND — — —

a lower position, the height of her reach is further diminished because of the necessity for reaching forward to secure supplies. The average height of reach with one hand for Kansas State College women was 56.5 inches, and the range, 44 to 66 inches. The decrease in height of reach with two hands was two inches, as compared to the decrease of 1 inch and 1.6 inches when the standing measurements were recorded. The average reach with both hands was 54.5 inches, and the range, 42 to 64 inches. Storage units, such as in study, ironing, or sewing centers, or lap tables for various tasks, such as making sandwiches, should be designed with respect to these measurements.

Plate III, Fig. 2, shows the reaches upward with one hand and with two hands, when sitting, of Kansas State College women.

A complete tabulation of data for the heights of reach for Kansas State College and Oregon-Washington women will be found in Tables 7, 8, and 9 in the Appendix.

Preferred Heights for Working Surfaces

Different homemaking tasks require different heights of working surfaces to facilitate ease of performance and maintenance of good posture. The height which the cooperators preferred for each task was determined in both the Kansas and Oregon-Washington studies by performing the task at different levels and selecting the most comfortable height. Average heights preferred for standing to perform various tasks are summarized in Table 2.

Table 2. Average preferred heights for working surfaces for various activities.

Activity	Kansas study	Oregon-Washington study
	Inches	
Rolling	33.9	33.7
Beating	32.8	31.6
Dishwashing	32.5	32.3
Ironing	34.3	32.6
Cutting	36.7	35.4

Although the preferences of the Kansas State College women for heights for rolling dough and dishwashing were slightly higher (0.2 inch) than the heights preferred by Oregon-Washington women, these differences were not marked. More than 65 per cent of the Kansas State College women chose dishwashing heights between 32 and 33.9 inches, a range which included 56.5 por cent of the Oregon-Washington women. The average preferred heights were 32.5 inches and 32.3 inches for the two studies. It is likely that a greater amount of time at the sink is given to dishwashing than to any other task, thus it is desirable that the bottom of the sink be placed at the height preferred for dishwashing.

Variations in the amount of pressure used in rolling dough may account for the wider range of preferences for tho work surface for this task. For the Kansas State College women, the range was 31 to 39 inches, and for the Oregon-Washington women, 29 to 41 inches. Average preferred heights were 33.9 inches and 33.7 inches, respectively.

Kansas State College women preferred noticeably higher work

surfaces for beating, ironing, and cutting. The average height preferred for beating, 32.8 inches, in the Kansas State College study, was 1.2 inch higher than the 31.6 inches preferred by the Oregon-Washington women for this task. The ranges were 30 to 35 inches, and 26 to 38 inches, respectively. In homes where electric mixers are available, this height may be unimportant.

Kansas State College women preferred an ironing height almost two inches higher than did the Oregon-Washington women. The average heights preferred for this task were 34.3 inches and 32.6 inches, respectively. Recent studies of ironing heights and availability of improved equipment may have conditioned the Kansas State College responses to this test. Fewer than 10 per cent of the Kansas State College women chose a height as low as 32.9 inches, which was higher than the average selected in the Oregon-Washington study.

Cutting out a garment using a paper pattern is a homemaking task which combines the physical activities of reaching and seeing. This task required the highest work surface of any of the tasks reported. The average height preferred by the Kansas State College women was 36.7 inches, 1.3 inches higher than the height preferred by Oregon-Washington women. The ranges were 32 to 41 inches and 31 to 43 inches, respectively.

Plate IV shows the preferred heights for rolling, dishwashing, ironing, and cutting out a pattern. Tables 10 and 11 (Appendix) show the preferences of Kansas State College and Oregon-Washington women for heights of working surfaces for various tasks by number and per cent of women preferring each height.

EXPLANATION OF PLATE IV

Fig. 1. Graph showing distribution of heights preferred for working surface for rolling dough for Kansas and Oregon-Washington women.

Fig. 2. Graph showing distribution of heights preferred for working surface for dishwashing for Kansas and Oregon-Washington women.

Fig. 3. Graph showing distribution of heights preferred for working surface for ironing for Kansas and Oregon-Washington women.

Fig. 4. Graph showing distribution of heights preferred for working surface for cutting a garment for Kansas and Oregon-Washington women.

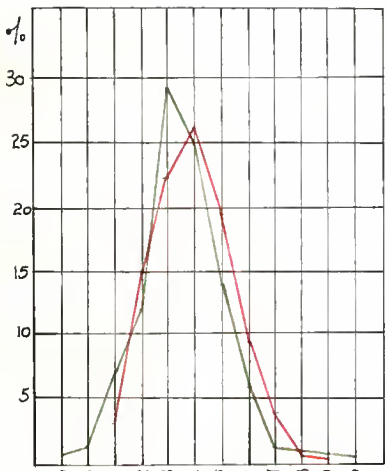


FIG. 1 · DOUGH ROLLING

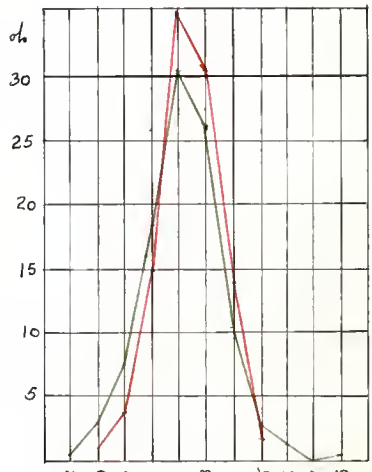


FIG. 2 · DISHWASHING

PLATE IV · DISTRIBUTION OF PREFERRED WORKING HEIGHTS

KANSAS

OREGON-WASHINGTON

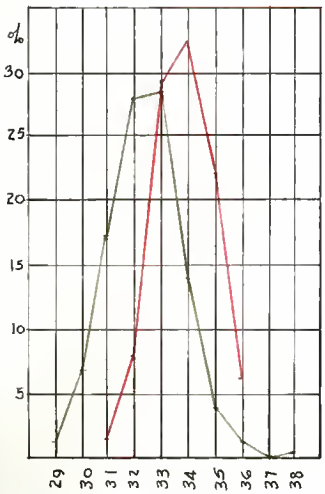


FIG. 3 · IRONING

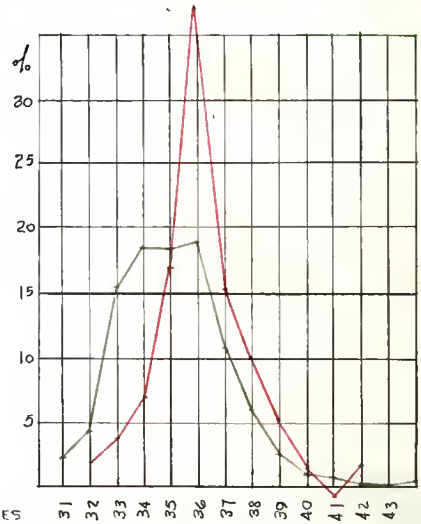


FIG. 4 · GARMENT CUTTING

Height of Working Surfaces for Seated Workers

Homemakers may conserve energy in performing tasks which require a considerable period of time by providing working arrangements which enable them to sit for the task. Preparing a quantity of fruits or vegetables, ironing, and writing are representative of tasks that are adapted to sitting to work.

In determining the height for a table for mixing, ironing, or sewing, the Oregon-Washington study used body measurements. The distance from the floor to the top of the thigh, plus two inches for table construction, was regarded as the minimum height possible, although too high for the most comfortable arm movement. As a result of the Oregon-Washington study, recommendations for tables for mixing, ironing, and sewing ranged from 21 to 25 inches.

The heights for a lap table, for an ironing board, and for a desk were determined separately in the Kansas State College study by experiments in using the table for these activities. Kansas State College women preferred a height of 25.7 inches for a lap table and for an ironing board. The ranges of preferences were 23 to 30 inches and 22 to 31 inches.

From the results of these studies, it would seem that about 25 inches is a suitable height for a lap table.

Data in regard to the height of a writing surface were recorded in the Kansas study. The average preferred height for a desk was 28.9 inches, and the range, 25 to 32 inches. Almost 70 per cent of the Kansas State College women preferred a desk lower

than the standard 30 inches.

Plate V, Fig. 1, shows the range of preferences for height of a lap table for Kansas and Oregon-Washington studies. Table 12 (Appendix) gives the preferences of Kansas State College and Oregon-Washington women for height of working surfaces for sitting to work.

Preferred Height of Stool for Sitting to Work

Sufficient time is frequently required for washing dishes or for preparing vegetables at the sink to make the stool an important piece of equipment in the kitchen to enable the homemaker to sit for these tasks. There was a wide variation of preferences for heights of a stool, both by the same subject for different tasks, and by different subjects for the same task. The average height preferred by Kansas State College students was 27.6 inches, and the range 21 to 32 inches. The average height of stool preferred for dishwashing at the sink was 30 inches, and the range 24 to 36 inches for the Oregon-Washington women. No more than 25.4 per cent of the cooperators in either the Kansas State College study or the Oregon-Washington study agreed on one single height. For the Kansas State College women, 91.6 per cent of the choices were between 25 and 30 inches. For the Oregon-Washington women, 91.5 per cent of the choices were between 28 and 33 inches. On no other point was there such a significant difference between the findings of the two studies.

When the additional preferences of Kansas State College women for heights of stools for beating with a rotary beater, for

paring potatoes, for rolling dough, and for ironing at a board (fixed at the preferred height for standing to perform these tasks) are considered, it is evident that a stool, adjustable in height, is the only practical solution for the homemaker.

For sitting to iron, the average preferred height was 27.2 inches, and the range 24 to 35 inches. The preferred heights for other tasks were: for beating with a rotary beater, 27.6 inches; for rolling dough, 28.4 inches; and for paring potatoes, 28.2 inches. The near uniformity of average preferred heights for a stool for these tasks gives no indication of the variation in preferences. The preference ranges were: for beating with a rotary beater, 21 to 32 inches; for paring potatoes, 23 to 34 inches; for rolling dough, 24 to 34 inches; and for ironing, from 25 to 35 inches.

Plate V, Fig. 2, and Table 13 (Appendix) show the preferences of Kansas State College and Oregon-Washington women for height of a kitchen stool for washing dishes in the sink.

Summary of Findings and Conclusions

A comparison of the findings of the Kansas State College study with the Oregon-Washington study indicated that measurements and preferences for working arrangements were similar in most respects. Exceptions were heights preferred for an ironing board and for cutting a garment, and for a stool for various activities. A summary of the average measurements is shown in Table 3.

EXPLANATION OF PLATE V

Fig. 1. Graph showing heights preferred for a lap table by Kansas State College women and Oregon-Washington women.

Fig. 2. Graph showing heights of stool preferred for washing dishes in the kitchen sink by Kansas State College and Oregon-Washington women.

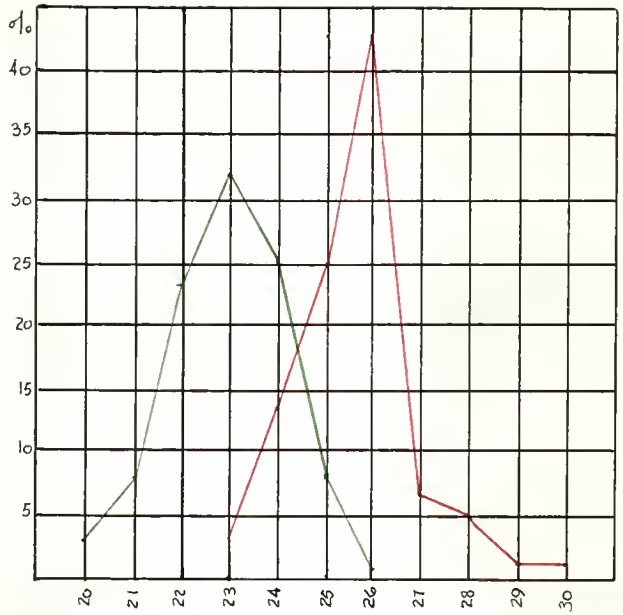


FIG. 1 · LAP TABLE

PLATE V · PREFERRED HEIGHTS

KANSAS OREGON·WASHINGTON

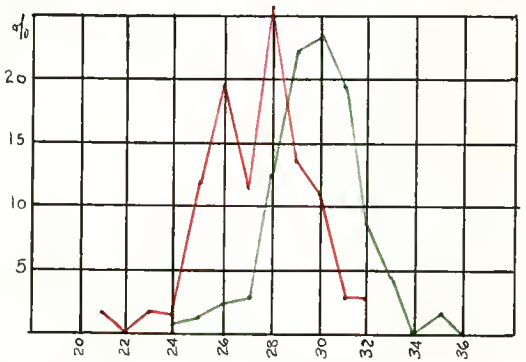


FIG. 2. DISH WASHING AT KITCHEN SINK
STOOL HEIGHT

Table 3. Summary of average measurements.

Measurement	Kansas study	Oregon-Washington study
	Inches	
Physical measurements		
Standing height	65.6	65.2
Standing eye level	61.4	61.0
Sitting height	51.5	50.5
Sitting eye level	47.2	46.1
Reaches upward		
One hand, no obstruction, standing	74.2	79.4
Two hands, no obstruction, standing	73.2	
One hand, one foot obstruction, standing	71.1	
Two hands, one foot obstruction, standing	69.5	
One hand, no obstruction, sitting	56.5	
Two hands, no obstruction, sitting	54.5	
Preferred heights for working surfaces, standing		
Rolling dough	33.9	33.7
Beating	32.8	31.6
Dishwashing	32.5	32.3
Ironing	34.3	32.6
Cutting	36.7	35.4
Preferred heights for working surfaces, sitting		
Lap table	25.7	21 to 25
Ironing board	25.7	
Desk	28.9	
Preferred height for a kitchen stool for working at a surface		
Dishwashing	27.6	30.0
Rolling dough	28.4	
Beating	27.6	
Paring	28.2	
Ironing	27.2	

Kansas State College women averaged slightly taller and had slightly higher eye levels than did the Oregon-Washington women. This difference, however, is not sufficient to warrant a conclusion that young women are taller or to warrant a change in recommendations for working arrangements based on average measurements.

Storage facilities should be designed with regard to the height of reach of the individual homemaker if it is possible to do so. Correct placement of shelves for various supplies and equipment is dependent upon these factors: the necessity for using one or both hands to secure them, the presence or absence of an obstructing base cabinet, and the position of the worker, whether standing or sitting.

Different homemaking tasks require different heights of working surfaces. Personal experimentation is the only adequate method for determining optimum heights for the various tasks. Working surfaces at two or more heights should be available for each homemaker to facilitate the performance of the different tasks.

Provision should be made for sitting to perform time-consuming tasks. It would seem that about 25 inches is a suitable height for a lap table and for an ironing board.

It is evident that a stool, adjustable in height, is the only practical solution for the homemaker.

Working arrangements designed to fit the physical requirements of the homemaker may do much to help her save energy in the daily performance of her tasks. Habitual good posture and the correct use of her body will make a further contribution to saving energy and lessening fatigue.

CORRECT POSTURAL PRACTICES AND BODY MECHANICS IN HOMEMAKING ACTIVITIES

General Information

Good posture alone does not assure good health, but it does have a profound effect upon it. Maintaining the correct alignment of body segments affects the functioning of all the body organs. The heart and lungs may be crowded and only partially effective when the chest sags because of a bowed back. A tilted pelvis may be the cause of back strain and improper functioning of abdominal organs. Unbalanced weight distribution may produce painful reactions in the feet, legs, and back.

When the body weights are not well balanced, the muscles must work against the pull of gravity to maintain an upright position. This results in wasted energy and muscle strain.

Habitually poor posture and weak muscular conditions associated with poor posture are definite liabilities. It is in the younger habit-forming years that poor posture should be prevented, but continuous, conscious practice of good posture can be helpful at any age.

Correct Standing Posture

Basic to correct posture is the principle of balanced alignment. When body alignment is achieved, the center of the hips, of the trunk at the shoulders, and of the head are in a direct line over the center of the arches, the weight-bearing parts of the feet. Viewed laterally, a vertical line should pass just in

front of the malleleous (ankle bone), just back of the patella (knee-cap), through the greater trochanter (projection on the femur at the hip), through the acromium process (tip of the shoulder), and through the lobe of the ear. A feeling of "upness" or "tallness" is invaluable in the practice of good posture.

Static postures are not easy to maintain for long periods of time. When basic good standing posture is habitual, there is far less muscular strain and tension than when the muscles must work to hold up the body. Adequate toe space is essential for those tasks that require static postures, such as in standing, if correct body balance is to be maintained.

When working arrangements require bending to reach the task, as in using a sink that is too low, the bend should come in the hips and not in the upper back. To facilitate bending at the hips, stand with one foot slightly in advance of the other, but with weight balanced on both feet. This will maintain balance, and will minimize the pushing backward of the buttocks.

Correct Sitting Posture

The basic principle of alignment of the body segments applies in sitting as it does in standing. Essentially, the only difference is that the base of support has been transferred from the floor to the chair seat.

The body's base of support is, properly, the tuberosities of the "ischia"--two prominences that can be identified by sitting on the hands. Slumping and fatigue result from tensions which

exist when correct body balance is not maintained. It is less fatiguing to sit "tall," just as it is to stand "tall." Whether the feet are placed directly in front of the chair or to one side of the center, they should be kept close together.

A chair which facilitates good posture is essential in the performance of tasks and in recreational activities. If the chair fits, the chair back will support rather than hinder good posture. The seated person should sit with the hips well back in the chair, or, if the chair is deep, with a cushion at the back of the hips.

When sitting to work, it should be possible to work with the elbows near the waist level. The height of the chair and of the working surface should be so adjusted that the worker need not raise her shoulders.

Forward movement to reach the task should be accomplished by a rocking motion originating in the hip joint, with the trunk and head in correct alignment. Adequate knee space for the seated worker enables her to perform her task with a minimum of forward motion or bending.

Correct Body Mechanics in Reaching

Many homemaking activities require reaching. Whether reaching upward, downward, or forward, the principle of body balance should guide the correct action. Most tasks requiring reaching are also associated with lifting, stooping, or other activities.

When reaching upward for any object, correct body alignment should be maintained, with the base of support as nearly as pos-

sible under the object to be reached. It is important to keep the center of the weight of the object as nearly as possible through the center of the body. To avoid twisting, the body should face the object. A wider base is needed for a heavy object. The feet may be placed parallel, with one in advance of the other, or a stride position may be used.

Reaching beyond comfortable reach may be avoided by moving nearer the object. If the reach is upward, a stepladder or other firm base is essential. If the reach is downward, move nearer the object by stooping, kneeling, or sitting.

Out-reaching movements, such as are involved in sweeping or using a paint brush, should be kept near the body. Instead of using an extended reach, move the body as the work progresses, keeping the task within the area of comfortable reach.

In reaching forward for a heavy object, some part of the body must shift backward to balance the additional load. The shift is extremely slight for a light object. A device, such as tongs, may be used to extend the reach for light articles.

Correct Body Mechanics in Stretching

A stretch is an extended reach, and it is important that working arrangements make it unnecessary to use an extended reach for heavy utensils or supplies. As in reaching, stretch toward the object from a base as nearly as possible under the object, and face it to avoid unnecessary twist.

Stretching is an excellent exercise for relieving tensions built up by static positions. It is wise to make opportunities

to stretch for exercise or for lightweight objects, particularly if the task is a time-consuming one. Bulky, lightweight supplies, as prepared cereals, and small utensils, as pie tins in a vertical file, are well adapted to placement on shelves a little beyond comfortable reach.

Correct Body Mechanics in Stooping

It is likely that there are no activities of the body in which correct body mechanics are more frequently violated than in the associated activities of stooping, lifting, and carrying. Lee and Wagner (1949) say, "There are probably no body movements which, if performed continuously incorrectly, will do so much damage to the body." More often than not, the homemaker will bend her back in the attempt to reach a task that is too low.

Correct body mechanics in stooping require that the body be lowered to the task by bending at the hips, knees, and ankles, while maintaining an erect posture of the trunk and head. The principle of balanced body weights indicates that the erect posture of the trunk is essential.

If stooping is in preparation for lifting, the worker should stoop as near the object to be lifted as possible because the weight to be lifted becomes a part of the body weight. Stooping from a position with one foot in advance of the other is much easier than a squat with the feet parallel. If a heavy object is to be lifted, a wider base is needed and the feet are placed farther apart.

Homemaking tasks that require stooping for long periods,

such as washing baseboards or working in the garden, may be fatiguing, especially if a stoop or squat position is long maintained. For such tasks, however, it is essential to lower the body to a base of support which enables the worker to maintain an extended trunk posture. Kneeling on one knee facilitates moving as the work progresses. Kneeling on both knees, keeping the back straight, and using one hand for balance may be easier for some. Sitting on a low stool may also lower the body sufficiently for other tasks.

Correct Body Mechanics in Lifting

A cardinal principle of body mechanics is that the muscles best adapted for a task should be the muscles which perform the task. Leg muscles are stronger than back muscles, and should bear the weight of the body and the additional load when objects are to be lifted.

Prepare for a lift by anticipating the load. A wider base of support and a deeper hip and knee bend are required if the load is heavy. To make the load a part of the body weight, lift it as near the center line of the body as the load will permit. Grasp the object as near its center of gravity as possible, then lift in a straight upward line by using the leg muscles to return to a standing position.

Muscles work most efficiently if they are not forced to exert to the limit. Where it is possible to divide the load, lift two or more lesser loads instead of one heavy load. If required to lift a very heavy object, it is wise to secure help, thus dividing

the weight of the load between two or more persons.

Lifting is the body activity that is involved in raising a window sash. Stand near the window and face it so that the lift is in a vertical line.

Correct Body Mechanics in Carrying

Carrying is closely related to the body activity of lifting. Body balance may be more easily maintained if the object to be carried is held near the body, thus becoming an integral part of the body weight. In all carrying tasks, keep the head and trunk as erect as is possible. Avoid letting the weight of the load pull the shoulders forward.

Divided loads are conducive to balanced loads because part of the weight is carried on each side of the body in a symmetrical pattern. If it is not possible to divide a load, it should be balanced between the two arms or shifted frequently from side to side.

Asymmetrical loads should also be kept near the body. The instability of the body because of the uneven weight should be counterbalanced. Move some part of the body (arm or trunk) to the opposite side to bring the center of gravity directly over the base of support. Homemakers who have small children may find that it is less fatiguing to carry them on the hips.

Devices which save one from carrying, such as a wheelbarrow, a shopping cart, a baby carriage, or a table on casters, are of inestimable value to the homemaker in saving energy.

Correct Body Mechanics in Pushing

Pushing a weight is less fatiguing than pulling or carrying the same weight. Pushing is involved in such homemaking tasks as using those devices which save carrying and devices having their own purpose, including an upright vacuum cleaner or a mop, a lawn mower, as well as in moving furniture. The amount of weight that is moved by pushing varies from light to heavy.

Several principles of body mechanics in pushing are illustrated in the operation of a vacuum cleaner. If good posture is to be maintained, the handle should be adjusted to the height of the worker. Momentum of a moving object will be used to advantage if the push is in a straight, forward line rather than an alternate push and pull. Moving the body as the work progresses will keep the task near the body and reduce reaching. The leg muscles will do the pushing as the worker walks forward.

A heavy object should be pushed at its center of weight. The worker should anticipate the weight by stooping correctly to bring the body in line with the center of the object to be pushed. The leg muscles should be contracted in preparation for the load. The worker then walks forward slowly in the crouched position to gain the advantage of the momentum of the object after it has been set in motion. The head and trunk should be held in correct alignment and the shoulders down and relaxed.

Correct Body Mechanics in Seeing

Seeing is an activity that involves not only the eyes, but

the entire body. Correct working arrangements facilitate seeing. Seeing is dependent upon adequate light for the task and on correct placement of materials. Supplies requiring close inspection need to be stored near eye level. Recipes or directions for a task should be located at eye level.

It is possible to see objects above or below the eye level only if there is no obstruction. Stooping to see requires energy, just as does stooping to perform a task. Cut-back or step shelves facilitate seeing at these levels. Full width shelves obscure vision both above and below eye level.

Correct Body Mechanics in Relaxing

Relaxation and recreation are not synonymous terms, but both are needed to offset the strains of work. Complete relaxation is essential for the conservation of energy and for recuperation of the body following activity. Frequent times should be planned in the homemaker's schedule to permit her to relax completely, if only for a short period at a time.

Relaxation of the parts of the body that are not needed for the immediate task is of primary importance, both to increase skill and as a means of lessening fatigue. Tensions are built up by keeping muscles "on the alert" when they are not involved in the task. Both physiological and subjective fatigue are closely related to failure to relax.

An excellent "exercise" in relaxing is lying flat on the back, without a pillow, with the knees flexed and the feet elevated or flat on the floor near the buttocks. In this position,

muscles may be relaxed, consciously if necessary, while the floor supports all the body weight.

POPULAR APPLICATION OF STUDY

Homemakers frequently are not aware that their working arrangements and habitual postures are important factors in fatigue. A bulletin or a set of slides using the information concerning the method of determining correct working arrangements and correct body mechanics will be a valuable teaching device for extension and other workers. Illustrations and brief explanations demonstrate these practices more clearly than do longer descriptions.

The title, "How to use your body effectively in homemaking tasks," is applicable to the illustrations and explanations which follow.

EXPLANATION OF PLATE VI

Balanced weights illustrate the principle of body balance. Stability results when weights are correctly aligned, each centered over the base of support.

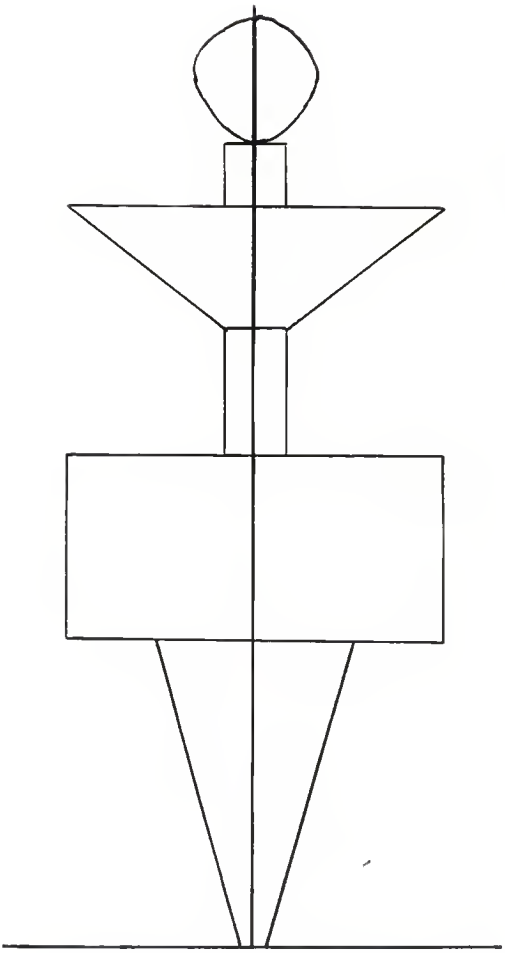
Legend: THIS PICTURE CONCERNS YOU.

Your body is made up of weights.

When weights are aligned, each centered above the base, they are stable.

When your weights - your pelvis or hip girdle - your shoulder girdle - your head - are aligned, you are poised, ready to

stand easily,
move easily,
work easily.



EXPLANATION OF PLATE VII

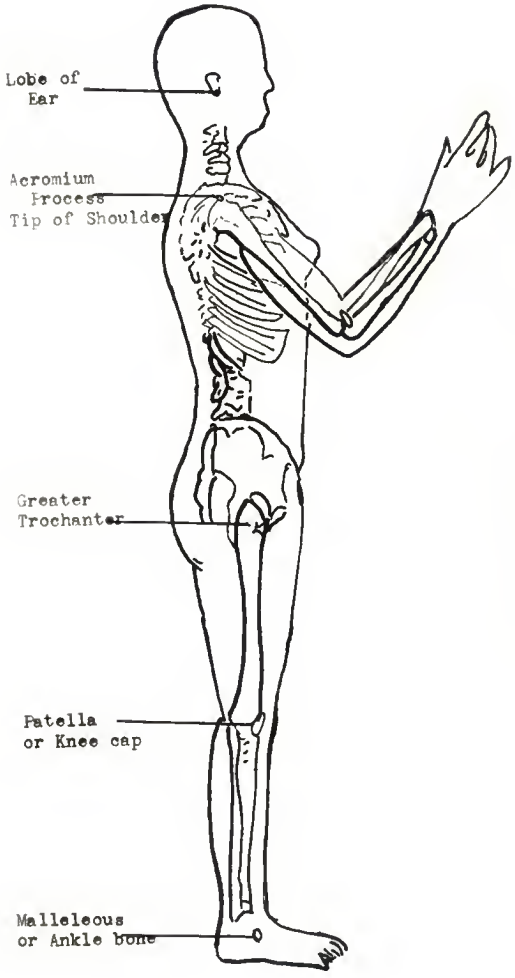
Drawing of body, lateral view, illustrating landmarks for body alignment.

Legend: HOW CAN YOU KNOW

When you are correctly aligned?

A straight line, perpendicular to the floor will pass through these points:

1. In front of the malleleous (ankle bone).
2. Back of the patella (knee cap).
3. Through the greater trochanter (projection on the top of the femur where your hip bends).
4. Through the tip of the acromium process (the tip of your shoulder).
5. Through the lobe of the ear.


Lobe of
Ear
Acromium
Process
Tip of Shoulder
Greater
Trochanter
Patella
or Knee cap
Malleleous
or Ankle bone

EXPLANATION OF PLATE VIII

Picture of model, lateral view, illustrating correct standing posture.

Legend: ALICE DEMONSTRATES GOOD POSTURE.

Let's check those landmarks!

The vertical line from the floor passes through these points:

1. In front of her ankle bone.
2. Back of her patella (knee cap).
3. Through her greater trochanter.
   (That's the projection you can feel when you bend your hip.)
4. Through the tip of her shoulder.
5. Through the lobe of her ear.

EXPLANATION OF PLATE IX

Picture of model, posterior view, illustrating correct standing posture.

Legend: ALICE HAS GOOD POSTURE.

Her body weights are balanced exactly above the base of support.

Her spine is straight.

Her head is eroct.

Her hips and shoulders are level.

EXPLANATION OF PLATE X

Picture of model, anterior view, illustrating correct standing posture.

Legend: ALICE STANDS TALL.

Her posture is erect, with the body weights exactly balanced.

Her weight is on both feet.

Her toes are pointed straight forward.

Her abdomen is "up and in."

Her chest is "up" but not "out."

Her shoulders are relaxed and wide.

Her head is high.

EXPLANATION OF PLATE XI

Picture of model at ironing board, testing the height of the board for ironing. (Low ironing surface.)

Legend: ALICE TESTS THE HEIGHT OF AN IRONING BOARD.

She knows that women do not come in standard sizes, so she tries out several heights to find the best height for her.

This board is too low, because Alice must bend to see and to reach her task.

PLATE XI

EXPLANATION OF PLATE XII

Picture of model at ironing board, testing the height of the board for ironing. (High ironing surface.)

Legend: ALICE TRIES A HIGH BOARD.

She finds that too high an ironing board forces her to raise her shoulder.

Alice knows that will add to muscle tension in her shoulder and back muscles, and will lead to fatigue.

EXPLANATION OF PLATE XIII

Picture of model at ironing board, testing the height of the board for ironing. (Comfortable height.)

Legend: ALICE FINDS THE HEIGHT THAT IS MOST COMFORTABLE FOR IRONING.

She can see and reach her task with little bending.

She does not need to raise her shoulders.

She can maintain good posture, with her weight balanced.

EXPLANATION OF PLATE XIV

Picture of model, illustrating three heights of the ironing board and the postures required for ironing at each of the three heights.

Legend: ALICE SHOWS YOU THAT GOOD POSTURE DEPENDS ON THE HEIGHT OF THE IRONING BOARD.

The too-low board requires a large "angle of bend."

The too-high board requires her to raise her shoulder.

Both high and low boards cause strain and fatigue.

The right-height board helps her maintain good posture and save energy.


IA7470

EXPLANATION OF PLATE XV

Picture of model, working at the sink placed at her comfortable height.

Legend: ALICE PREPARES LETTUCE AT THE SINK.

The bottom of this sink is 32 inches above the floor. This height is right for Alice.

She stands with one foot a little in front of the other to help her maintain good posture as she reaches the back of the sink.

She bends at her hips and not in her back and shoulders.

She keeps her trunk and head in good alignment.


M7436

EXPLANATION OF PLATE XVI

Picture of model using a lap table to enable her to sit to work at time-consuming task.

Legend: ALICE SITS TO PREPARE SANDWICHES.

She keeps her trunk and head in alignment and sits "tall."

She uses a pull-out lap table that fits just over her thighs.

She sits "all the way" under the table to keep close to her task.

She keeps her shoulders down and relaxed.

She holds her knees and feet close together.

She pushes her hips all the way back in the chair.

She rocks forward from her hips to reach the far edge of the table.

EXPLANATION OF PLATE XVII

Picture of model using ironing board for sewing tasks, at height for sitting to iron.

Legend: ALICE SEWS AT THE IRONING BOARD.

She adjusts the board to fit her height when she sits to sew.

She maintains good sitting posture.

She has her sewing equipment within an easy reach.

She has the iron ready to press as she sews.


IA7478

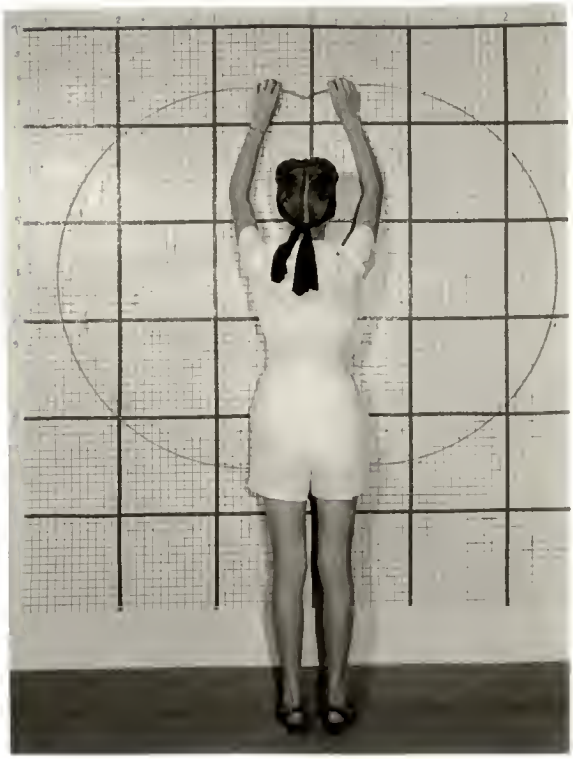
EXPLANATION OF PLATE XVIII

Picture of model using wall measurement chart to determine comfortable upward reach.

Legend: ALICE MEASURES HER COMFORTABLE REACH UPWARD.

She is finding out how high to place shelves in the closet or to put up the clothes line.

She reaches easily, without stretching, without raising her shoulders.

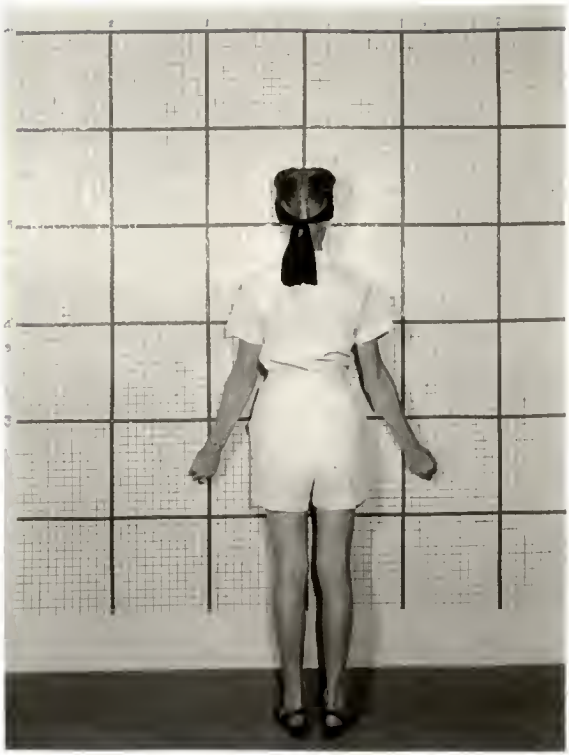


EXPLANATION OF PLATE XIX

Picture of model using wall dimension chart to determine her comfortable downward reach.

Legend: ALICE MEASURES HER REACH DOWNWARD.

She will store heavy articles above this level and avoid bending or stooping to reach them.



EXPLANATION OF PLATE XX

Picture of model hanging a sheet at the clothes line placed within comfortable reach upward. Basket of clothes is placed within area of comfortable reach downward.

Legend: ALICE HANGS OUT THE LAUNDRY.

Her clothes line is within her comfortable reach.

She uses a cart for her clothes basket to avoid bending and carrying.

EXPLANATION OF PLATE XXI

Picture of model measuring her comfortable reach upward and laterally over a base cabinet.

Legend: ALICE MEASURES HER REACH AT THE CUPBOARD.

She knows that she can reach supplies easily if they are within this circle.

EXPLANATION OF PLATE XXII

Picture of model standing at open cupboard with circle of comfortable reach indicated.

Legend: ALICE SHOWS SUPPLIES PLACED IN CUPBOARD.
She can reach supplies easily within the circle.
She reads small labels at eye level.

EXPLANATION OF PLATE XXIII

Picture of model reaching for lightweight article on a shelf above her area of comfortable reach.

Legend: ALICE STRETCHES TO REACH HER RESERVE SUPPLY OF CEREAL.

She knows that stretching relieves muscle tension,

but

She stretches only to reach lightweight supplies

or

She stretches just for the exercise.

EXPLANATION OF PLATE XXIV

Picture of model using step ladder to reach articles above the area of comfortable reach.

Legend: ALICE USES A STEP LADDER
to avoid stretching when she reaches heavy articles above her comfortable reach.

She stores those "seldom used" utensils and supplies high to save space for "often used" equipment where she can reach it easily.

She moves near her task by using a firm base of support.

She stands directly under the object she is reaching.

EXPLANATION OF PLATE XXV

Picture of model on step ladder handing object to assistant.

Legend: ALICE HAS A PLACE READY
to receive the article when she uses a step ladder.

She avoids climbing down with her load.

She may have an assistant, as she does in this picture

or

She may have a cloared space on a lower shelf.

EXPLANATION OF PLATE XXVI

Picture of model stooping to perform a task at a low level, using one-knee kneel to wash a baseboard.

Legend: ALICE WASHES THE BASEBOARD.

She moves near the task by kneeling on one knee.

She keeps her back and head in correct alignment.

She keeps the task close to her by working in small areas and moving as the work progresses.

EXPLANATION OF PLATE XXVII

Picture of model kneeling to perform task at a low level; kneeling on both knees to clean spot on rug.

Legend: ALICE CLEANS A SPOT ON THE RUG.

She moves near the task by kneeling on both knees.

She keeps her back and head in correct alignment.

She uses both hands for the task, changing from one to the other frequently.

She may use one hand for balance, but does not need it to hold her up.

EXPLANATION OF PLATE XXVIII

Picture of model stooping correctly to lift a child.

Legend: ALICE LIFTS DANNY.

She stoops correctly, with one foot in advance of the other.

She bends at her hips, knees, and ankles.

She keeps her trunk and head in correct alignment and her weight balanced.

She stoops near Danny to keep his weight close to her body's gravity line.

Her leg muscles do the lifting as she rises to standing position.

EXPLANATION OF PLATE XXIX

Picture of model opening window by lifting the window sash correctly.

Legend: ALICE OPENS THE WINDOW.

She stands as near the window as possible to lift it in a straight, vertical direction.

She stoops correctly, and just far enough to reach the window sash.

Her leg muscles lift the heavy window sash as she rises to standing position.


A7-89

EXPLANATION OF PLATE XXX

Picture of model and assistant lifting a davenport.

Legend: ALICE HAS HELP TO LIFT HEAVY FURNITURE OR EQUIPMENT.

Alice stoops correctly as near the davenport as possible.

Alice stoops just enough to prepare her leg muscles for the lift.

Alice "prepared" for the load by placing her feet apart to give her a wider base.

Alice's leg muscles do the lifting as she rises to standing position.

HAZEL BENDS HER BACK TO LIFT.

Hazel lifts partly with her shouldor and back muscles as she stands away from the task and reaches with her back.

Hazel's leg muscles will do only a part of the lifting.


IA7443

EXPLANATION OF PLATE XXXI

Picture of model carrying shopping bags with balanced, divided load.

Legend: ALICE COMES HOME FROM SHOPPING.

She divides her purchases to make two lesser loads.

She balances her loads on each side of her body.

She is careful not to "hunch" her shoulders.

She does not let the loads pull her shoulders forward.

She carries her loads near her body.

EXPLANATION OF PLATE XXXII

Picture of model carrying a tray of dishes correctly.

Legend: ALICE CARRIES DISHES ON A TRAY.

She makes one trip with the dishes to set her table.

She carries the tray correctly, balanced between both hands.

She carries the tray near her body, as part of her body weight.

She keeps her shoulders relaxed.

She maintains correct posture as she carries the load.

PLATE XXXII

EXPLANATION OF PLATE XXXIII

Picture of model pushing a baby carriage.

Legend: ALICE PUSHES THE BABY CARRIAGE.

She adjusts the handle to her height to avoid bending.

She holds the handle near her body to avoid reaching.

She pushes the baby carriage in a straight forward line, without any downward push.

PLATE XXXIII

EXPLANATION OF PLATE XXXIV

Picture of model pushing a chest of drawers.

Legend: ALICE PUSHES A CHEST OF DRAWERS.

She knows that pushing is easier than lifting.

She pushes directly in the direction she wants it to move, with no downward push or lift.

She prepares for the load by contracting her leg muscles.

She stoops just enough to push it at its center of weight.

She lets momentum help by pushing steadily as she walks forward in the crouched position.

PLATE XXXIV

EXPLANATION OF PLATE XXXV

Picture of model cutting out a garment at a low table.

Legend: ALICE CUTS OUT A GARMENT.

She uses a pattern that she must follow accurately.

She finds that she must bend to see the pattern markings, as well as to reach her task at this level.

She knows that bending will cause muscle tension and fatigue.

PLATE XXXV

EXPLANATION OF PLATE XXXVI

Picture of model cutting out a garment at a comfortable level.

Legend: ALICE CUTS OUT A GARMENT

She uses a surface 38 inches from the floor.

She can see the pattern markings without bending.

She can maintain correct posture and reach her task easily.

PLATE XXXVI

EXPLANATION OF PLATE XXXVII

Picture of base cabinet illustrating cut-back shelves to facilitate seeing equipment.

Legend: ALICE LETS YOU LOOK INTO THE BASE CABINET.

The camera is at her eye level.

She can see her utensils easily.

She can select one without stooping to search for it.

PLATE XXXVII

EXPLANATION OF PLATE XXXVIII

Picture of model illustrating relaxing position.

Legend: ALICE RELAXES FREQUENTLY.

She knows that relaxation is necessary to avoid and to relieve fatigue.

She relaxes often during tasks that take considerable time.

She suggests that you try relaxing as she does by lying flat on your back, without a pillow, with your knees flexed and let the floor support all your weight.

PLATE XXXVIII

SUMMARY

1. Research effort has been progressing slowly for almost forty years in the study of working arrangements to enable the worker to reduce fatigue by lessening the energy costs of his tasks. The application of this effort to working arrangements in the home, however, has been a comparatively recent development.

2. Home economists and specialists in physical education have demonstrated that there is a relation between correct working arrangements and correct body mechanics, and that both are factors which contribute to the lessening of fatigue in homemaking tasks.

3. Physical measurements are not an adequate guide to the homemaker in her selection of working arrangements. Personal experiments with various arrangements are the successful guides to correct choices of working arrangements.

4. Physical measurements and preferences for working arrangements of Kansas State College women and Oregon-Washington women were similar in most respects. The exceptions were: height preferred for an ironing board and for cutting a garment, and height preferred for a stool for various activities, in which Kansas State College women preferred a slightly higher height.

5. Correct postural practices and correct body mechanics require that the various segments of the body be maintained in correct alignment, and that muscles best adapted to perform the task should be the muscles which do the task. Incorrect postures and incorrect body mechanics are factors in producing strain and tension, resulting in fatigue.

6. Illustrations with brief descriptions are valuable teaching devices for demonstrating the methods of determining correct working arrangements and the effective use of the body in homemaking tasks.

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APPENDIX

PERSONAL MEASUREMENTS FOR WORK CENTERS*

Name _____ Date _____

When designing work centers, it is important to arrange the work surfaces, shelves, hooks, drawers, and other features in comfortable relation to the reach and vision of the persons using them. Efficient use of the body and of the center is improved when correct relationships are observed. The following measurements will help you decide how to determine heights for any work center.

I. Personal measurements important for planning the location of shelves, drawers, and hooks in relation to the human figure.

Measurements	Standing	Sitting on chair
1. Height		
2. Eye level		
3. Comfortable reach upward, no obstruction--one hand		
4. Comfortable reach upward, no obstruction--two hands		
5. Comfortable reach upward, one foot obstruction--one hand		xxxxxxxxxxxxx
6. Comfortable reach upward, one foot obstruction--two hands		xxxxxxxxxxxxx

What is the highest shelf you can:	Standing	Sitting
See for its full width?		
Reach with one hand?		
Reach with two hands?		

II. Heights required for some of the activities done around the house.

	Most Comfortable Height	
Activities	Standing (Surface)	Sitting (Stool)
1. Dishwashing**		
2. Beating (eggs)		
3. Paring (potatoes)		
4. Rolling dough (noodles)		
5. Ironing (board for standing)		
6. Ironing (when sitting on chair)	xxxxxxxxxx	(Surface)
7. Cutting (pattern)		xxxxxxxxxxxx
8. Writing (desk)	xxxxxxxxxx	(Surface)
9. Using lap table	xxxxxxxxxx	(Surface)

* Portion of form used in "The House" class.

** Interpreted to be preferred height for floor of sink. Measurement is made by using dishpan of same depth as standard sink and testing it at various heights.

Table 4. Heights of Kansas State College women.

Standing height			Sitting height		
Inches	Number	Per cent	Inches	Number	Per cent
61	3	2.2	48	3	2.3
62	7	5.2	49	5	3.8
63	11	8.2	50	26	19.4
64	21	15.5	51	36	26.8
65	20	14.8	52	32	23.8
66	27	20.0	53	23	17.0
67	16	11.9	54	4	3.0
68	19	14.1	55	3	2.3
69	10	7.4	56	1	.8
70	1	.7	57		
			58	1	.8
	135	100		134	100

Table 5. Eye levels of Kansas and Oregon-Washington women, standing position.

	Kansas study		Oregon-Washington study	
Inches	Number	Per cent	Number	Per cent
54			1	.2
55			6	1.1
56	1	.7	12	2.1
57	5	3.7	22	3.9
58	6	4.3	53	9.4
59	9	6.7	72	12.8
60	25	18.5	92	16.4
61	20	14.8	90	16.0
62	31	23.0	86	15.3
63	18	13.4	64	11.4
64	17	12.7	34	6.1
65	3	2.2	15	2.6
66			11	2.0
67			3	.5
68				
69			1	.2
	135	100	562	100

Table 6. Eye levels of Kansas and Oregon-Washington women, sitting position.

Inches	Kansas study*		Oregon-Washington study**	
	Number	Per cent	Number	Per cent
42			1	.5
43			8	4.0
44	2	1.5	18	9.0
45	14	10.4	37	18.5
46	34	25.2	62	31.0
47	25	19.2	45	22.5
48	34	25.2	22	11.0
49	19	14.2	5	2.5
50	4	2.9	1	.5
51	1	.7		
52			1	.5
53	1	.7		
	135	100	200	100

* Heights were measured from floor, using chair selected by subject as comfortable height. 15, 16, and 17 inches were chosen.

** Heights were measured from seat of chair, using 17-inch chair.

Table 7. Heights of reach of Kansas and Oregon-Washington women, standing position.

Inches	Kansas study*		Oregon-Washington study**	
	Number	Per cent	Number	Per cent
64	1	0.75		
65	2	1.51		
66	2	1.51		
67	4	3.02		
68	5	3.76		
69	6	4.53	1	0.2
70	8	6.04	3	0.5
71	3	2.27	1	.2
72	11	8.25	8	1.4
73	17	12.78	16	2.9
74	14	10.52	13	2.3
75	7	5.26	28	5.0
76	12	9.02	37	6.6
77	9	6.80	51	9.1
78	14	10.52	61	10.9
79	2	1.51	70	12.4
80	7	5.26	56	10.0
81	4	3.02	74	13.2
82	3	2.27	49	8.7
83			39	6.9
84	1	.75	22	3.9
85	1	.75	11	2.0
86			8	1.4
87			6	1.1
88			2	.3
89			1	.2
90			4	.7
91				
92				
93				
94				
95				
96			1	.2
	133	100	562	100

* Comfortable reach which did not necessitate raising the shoulder.

** Maximum reach.

Table 8. Comfortable upward reach of Kansas State College women, standing position.

Inches	No obstruction: 1 hand: Number	No obstruction: 1 hand: Per cent	No obstruction: 2 hands: Number	No obstruction: 2 hands: Per cent	1-foot obstruction: 1 hand: Number	1-foot obstruction: 1 hand: Per cent	1-foot obstruction: 2 hands: Number	1-foot obstruction: 2 hands: Per cent
56							1	0.7
57								
58							1	0.7
59					1	0.7		
60			1	0.7			2	1.5
61							4	3.0
62					3	2.2	3	2.2
63			1	0.7	2	1.5	6	4.4
64	1	0.7	1	0.7	3	2.2	2	1.5
65	2	1.5	4	3.0	6	4.5	5	3.7
66	2	1.5	7	5.2	7	5.2	5	3.7
67	4	3.1	4	3.0	5	3.7	6	4.4
68	5	3.8	7	5.2	5	3.7	15	11.2
69	6	4.5	3	2.2	13	8.9	17	12.6
70	8	6.0	6	4.4	16	12.0	9	6.7
71	3	2.3	7	5.2	10	7.4	6	4.4
72	11	8.3	21	15.8	14	10.3	22	16.3
73	17	12.8	7	5.2	14	10.3	5	3.7
74	14	10.5	15	11.3	9	6.7	8	5.9
75	7	5.2	9	6.7	9	6.7	7	5.2
76	12	9.0	8	5.9	5	3.7	4	3.0
77	9	6.8	8	5.9	3	2.2	3	2.2
78	14	10.5	9	6.7	7	5.2	4	3.0
79	2	1.5	7	5.2	3	2.2		
80	7	5.2	3	2.2	1	0.7		
81	4	3.8	4	3.0				
82	3	2.3	2	1.5				
83			1	0.7				
84	1	0.7						
85	1	0.7						
	133	100	135	100	135	100	135	100

Table 9. Comfortable upward reach of Kansas State College women, sitting position.

Inches	One hand		Both hands	
	Number	Per cent	Number	Per cent
42			2	1.5
43				
44	2	1.5		
45				
46			4	3.0
47			2	1.5
48	5	3.7	3	2.2
49	2	1.5	6	4.5
50	5	3.7	11	8.2
51	4	3.0	10	7.5
52	13	9.6	10	7.5
53	10	7.4	8	6.2
54	6	4.4	8	6.2
55	10	7.4	15	11.2
56	11	8.1	11	8.3
57	10	7.4	7	5.2
58	10	7.4	8	6.0
59	8	6.0	2	1.5
60	10	7.4	8	6.0
61	7	5.2	6	4.5
62	7	5.2	8	6.0
63	5	3.7	2	1.5
64	4	3.0	2	1.5
65	4	3.0		
66	2	1.5		
	135	100	135	100

Table 10. Heights for working surfaces for various tasks preferred by Kansas and Oregon-Washington women. (Number of women.)

Inches	Rolling		Beating		Dishwashing		Ironing		Cutting	
	Kansas study	Oregon-Wash. study	Kansas study	Oregon-Wash. study	Kansas study	Oregon-Wash. study	Kansas study	Oregon-Wash. study	Kansas study	Oregon-Wash. study
26				1						
27				5						
28				11		2				
29		1		18	1	18		6		
30		7	10	86	5	43		33		
31	4	38	22	133	20	102	2	81		6
32	20	80	42	104	47	170	11	133	1	17
33	32	167	35	70	41	148	39	135	5	57
34	34	140	23	33	18	59	44	57	16	65
35	26	76	3	9	3	13	30	20	23	66
36	12	34		3		6	9	9	49	68
37	5	9		1					20	40
38	1	7		1		1		1	7	25
39	1	1							7	11
40		1							2	4
41		1								2
42									2	
43										1
44										
	135	562	135	475	135	562	135	475	132	362

Table 11. Heights for working surfaces for various tasks preferred by Kansas and Oregon-Washington women. (Per cent of women.)

Inches	Rolling		Beating		Dishwashing		Ironing		Cutting	
	Kansas study	Oregon-Wash. study	Kansas study	Oregon-Wash. study	Kansas study	Oregon-Wash. study	Kansas study	Oregon-Wash. study	Kansas study	Oregon-Wash. study
26				.2						
27				1.1						
28				2.3		.4				
29		.2		3.8	.7	3.2		1.3		
30		1.2	7.4	18.1	3.7	7.6		6.9		
31	3.0	6.8	16.3	28.0	14.8	18.2	1.4	17.1		1.7
32	14.9	14.2	31.1	21.9	34.8	30.2	8.2	28.0	.7	4.7
33	23.7	29.7	26.9	14.7	30.4	26.3	28.9	28.4	3.8	15.7
34	25.2	24.9	17.0	7.0	13.4	10.5	32.6	12.0	12.1	18.0
35	19.2	13.5	2.2	1.9	2.2	2.3	22.2	4.2	17.4	18.2
36	8.9	6.1		.6		1.1	6.7	6.7	37.1	18.8
37	3.7	1.6		.2					15.2	11.1
38	.7	1.2		.2		.2		.2	5.3	6.9
39	.7	.2							5.3	3.0
40		.2							1.6	1.1
41		.2								.5
42									1.6	
43										.3
44										
	100	100	100	100	100	100	100	100	100	100

Table 12. Heights for working surfaces preferred by Kansas and Oregon-Washington women for sitting to work.

Height	Kansas study						Oregon-Wash. study	
	Lap table		Ironing board		Desk		Mixing table	
	No.	%	No.	%	No.	%	No.	%
20 in.							6	3.0
21							16	8.0
22			1	0.8			47	23.5
23	4	3.5	3	2.3			63	31.5
24	16	13.8	12	9.3			50	25.0
25	29	25.0	24	18.5	2	1.6	16	8.0
26	49	42.2	74	57.5	5	4.0	2	1.0
27	8	7.0	13	10.0	12	9.5		
28	6	5.1	1	0.8	24	19.1		
29	2	1.7			43	34.1		
30	2	1.7			27	21.4		
31			1	0.8	11	8.7		
32					2	1.6		
	116	100	129	100	126	100	200	100

Table 13. Heights of kitchen stools preferred for various tasks by Kansas and Oregon-Washington women.

Height of stool	Washing dishes at sink				Beating		Paring		Rolling dough		Ironing	
	Kansas study		Oregon-Wash. study		Kansas study							
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
21 in.	1	0.8			1	0.8						
22												
23	1	0.8			3	2.3	3	2.3				
24	1	0.8	1	0.5	6	4.7	2	1.5	5	3.9	3	6.1
25	15	11.5	2	1.0	10	7.7	6	4.7	10	7.9	6	12.3
26	25	19.2	4	2.0	25	19.3	28	21.8	22	17.3	20	41.0
27	14	10.8	5	2.5	19	14.7	18	14.0	14	11.0	7	14.3
28	33	25.4	24	12.0	17	13.2	13	10.0	14	11.0	3	6.1
29	18	13.9	44	22.0	10	7.8	10	7.7	13	10.2		
30	14	10.8	48	24.0	27	20.9	26	20.2	21	16.6	3	6.1
31	4	3.0	39	19.5	9	7.0	15	11.6	18	14.2	1	2.0
32	4	3.0	18	9.0	2	1.6	7	5.4	6	4.7	3	6.1
33			10	5.0			1	0.8	4	3.2	1	2.0
34			1	0.5							1	2.0
35			3	1.5							1	2.0
36			1	0.5								
	130	100	200	100	129	100	129	100	127	100	49	100