

# LIFTING AND CARRYING WEIGHTS BY WOMEN IN INDUSTRY



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## LIFTING AND CARRYING WEIGHTS BY WOMEN IN INDUSTRY

- I. Guard against injury to physique in the lifting of heavy weights.
- II. Analyze the elements in weight lifting to develop methods of saving energy.
- III. Overcome the dangers involved in lifting heavy weights by using certain methods.
  1. Introduce lifting and conveying devices.
  2. Provide efficient conditions for work.
  3. Inform workers as to proper methods of lifting.
- IV. Train workers to use the most economical methods of carrying weights.
- V. Protect the health of workers in heavy industries by physical examinations.
- VI. State regulation of weight lifting is more effective through the general authority granted regulatory bodies than through specific laws fixing maximum weights.

The selection of a woman for a job requiring constant lifting, carrying, pushing, or pulling should depend not only on her weight and height but on the amount of strength she has. An apparently sturdy woman may find such work on heavy materials far beyond her capacity, whereas a slight woman may have the strength to do it without injury to herself if she does it properly. The plant physician should decide on a woman's physical ability in each heavy job.

The distances that loads are to be carried also should be considered in determining their size; and not only how far they are to be carried, but how constantly, and whether up or down stairs, through crowded aisles, or over uneven floors or ground.

As with lifting and carrying, the safe load to be pushed in a wheelbarrow or a cart will vary with the conditions of work. For short periods at a stretch, over a smooth floor and on the level, a woman can push more than she can if the work is constant over a period of hours, if the ground is rough, or if she pushes up and down ramps or other elevations. It is important also that whoever loads the wheelbarrow or cart should pile the material carefully, so as to balance the load, to relieve the woman of the weight as much as possible, and to avert the danger of spills.

Many occupations in which women are employed involve

the lifting and carrying of loads. The work of women in service and trade industries (such as waitresses), and in factory production, frequently brings exposure to the strain of heavy lifting. Even light manufacturing involves the lifting and carrying of materials during processes of manufacturing or packaging; and the heavier industries bring additional problems. A list of jobs on which women were found by the Women's Bureau to be working during World War I,<sup>1</sup> and which has been duplicated during the past few years, includes, for example:

Lathe operation on heavy work. Heaviest in munitions plants, where they cut shells weighing 19 to 100 pounds. (On heavy shells mechanical lifting aids were available.)

Operating automatic gear cutting or shaping machines to cut spur and bevel gears. Blanks from which gears were cut by women were very heavy.

Turning metal into rods, bars, wire, or sheets. Feeding and receiving strips through rolls. Much of the work entailed lifting of heavy ingots.

Core making. Heaviest core made successfully by hand by women in 26 firms studied weighed 45 pounds.

Loading shells. Lifting shell (weighing from approximately 20 pounds up), holding plug against revolving shaft, which grasped plug and unscrewed it.

Labor in petroleum refining. (369 women were found in 6 firms employed as laborers in various types of heavy work.)

Tire-making processes. These involved lifting tires weighing 14 pounds or more on and off spools. In some cases men were hired to do the lifting.

Unskilled manual labor. Much of this work involved lifting and pushing heavy materials. The maximum weight pushed by a woman was 750 pounds.

Loading and unloading.

Transporting material.

Shoveling sand and coal.

Piling boards in lumber mills.

In Great Britain still further types of heavy work were done by women during World War I. In a study of the physique

<sup>1</sup> See Women's Bureau Bull. No. 12, 1920, especially pp. 100, 106-107, 108, 124, 128, 129-130, 133. (Out of print but available in libraries.)

of over 3,000 industrial women, they were found doing severe muscular work in the following occupations: <sup>2</sup>

Chemical works—Navy work: One woman shoveled 20 to 25 tons of crude borite a day, lifting it to a height of about 2½ feet.

Brick setting and drawing—Filling and emptying ovens: Each girl carried three or four bricks, weighing 26¾ pounds each, a distance of 70 to 80 yards.

Brick molding: Slammed clay into wooden molds, then placed molded brick to dry on steam-heated stone floor. Women wheeled barrows containing 4 to 4½ hundredweight of bricks.

Tin-plate industry—Opening, cold rolling, reckoning, pickling: Lifting was an essential part of each process. The average proportion of load to body weight was found to be 58 percent for young girls.

Sanitary-pipe manufacture: Carrying pipes of 24 to 50 pounds about 40 yards to be dried. Average weight lifted, 6.6 tons a day. Also, feeding pipe-making machines with wedges of clay. (The physique of girls in this industry was poor.)

Nuts and bolts: Press operators carried pans of nuts and bolts to their benches, the size of the load being left entirely to the worker. One woman carried as much as 93 percent of her body weight.

Pottery: Carrying of tiles, and baskets and bungs of biscuit ware. Ordinarily two women carried basket between them.

Paper: Carrying bundles of paper for sorting. Average load 57 percent of worker's body weight.

Aerated waters and beer bottling: Stacking crates to heights sometimes exceeding height of worker.

Woolen and worsted: Load of 180 to 190 pounds carried by two women.

### *I. Guard Against Injury to Physique in the Lifting of Heavy Weights*

Much that may be said as to the proper methods of saving human energy in weight lifting applies to men as well as to women. Moreover, new applications of energy-saving lifting devices in industry are appearing constantly. However,

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<sup>2</sup> Great Britain. Industrial Fatigue Research Board, Report No. 44, *The Physique of Women in Industry*, 1927, pp. 20, 21, 118, 120, 121, 122, 125.

there still are important physical factors that must be considered as applying particularly to women.

**1. Limited strength of average woman precludes her employment in work that is excessively heavy.**

It has been found that the strength of the average woman is a little more than half that of the average man. This has been substantiated again by recent reports, which continue to agree with quite early studies made in Great Britain and other European countries.

The International Labor Office accepts the results of Josephine Joteyko's researches in France. She found that tests gave the index of strength of women by the dynamometer as 570/1000 that of man; the index of resistance by the ergograph as 679/1000.<sup>3</sup> Research by the British Industrial Fatigue Research Board substantiates these findings.<sup>4</sup> Still earlier, in fact, more than 55 years ago, the Anthropological Institute of Great Britain and Ireland concluded that "the female differs from the male more conspicuously in strength than in any other particular." This conclusion was reached as a result of a study by a pioneer authority in this field, Sir Francis Galton, who made careful examination of almost 6,400 adults—4,726 men and 1,657 women.<sup>5</sup>

**2. Heavy lifting especially affects women's physical structure.**

Continual lifting of heavy loads results in deformities of bone structure that may have serious effects at childbirth. To quote from findings of the International Labor Office: <sup>6</sup>

When women have habitually to carry heavy loads (e.g. in the country or mountainous districts), skeletal deformities are noted (of the vertebral column, lower limbs), alterations in the thoracic capacity and abdominal walls. Thus, for example, a broadening in the lumbar region of the spine in women who carry loads with crushing together of the vertebrae, bringing about diminution in height, deformity of the pelvic basin with harmful effects on the development of pregnancy. Occupational cramp of the lateral muscles of the neck, pains of the

<sup>3</sup> Joteyko, Josephine, *La Fatigue et la Respiration Elementaire du Muscle*. Paris, 1896. Quoted in International Labor Office, *Occupation and Health*, Brochure No. 152, *Women's Work*, Geneva, 1929, p. 5.

<sup>4</sup> Great Britain. Industrial Fatigue Research Board, *op. cit.*

<sup>5</sup> Galton, Sir Francis. In *Journal of the Anthropological Institute of Great Britain and Ireland*, vol. XIV, February 1885, pp. 275, 278.

<sup>6</sup> International Labor Office, *Occupation and Health*, *op. cit.*, p. 18.

brachial plexus, suboccipital nerves, movable kidneys, cardiac and thyroid hypertrophy, and so forth have been reported.

During pregnancy marked variations in certain physical factors should be considered in connection with weight lifting. Respiration, pulse rate, composition of the blood, and so forth, which even in the normal woman differ from those of man, show more marked variations during pregnancy. Pregnancy affects the work of the heart, increases the volume of the blood, the venous blood pressure and the heart rate and displaces the heart upward. There is noticeable diminution of the amplitude of the respiratory movements, and a diminution of muscular power.

Similarly, some authorities have found that lifting aggravates menstrual troubles. A Russian investigation showed menstrual troubles prevalent among 69.5 to 78 percent of the women who did heavy lifting and carrying, as against 26.5 to 39.2 percent among those in the occupations not requiring weight lifting. These findings were based on a study of 1,450 women employed in the peat, coal, and metallurgical industries. As a control, women in textile work and tramway conductors in Moscow were selected. The troubles referred to were most frequent for the younger groups—19 to 25 years. Inquiry showed the difficulties to be in direct proportion to the amount of occupational work.<sup>7</sup>

## *II. Analyze the Elements in Weight Lifting to Develop Methods of Saving Energy*

The elements entering into weight lifting and carrying must be analyzed, and conditions and methods of work adapted to the worker, in order to promote efficiency in the employment of women in occupations of a heavy nature. To do this, scientific study should be given to the following factors, both separately and in combination:

1. Weights of units lifted.
2. Ratio of load to body weight.

<sup>7</sup> Okunjeva, Steinbach, and Schtscheglowa, Moscow, 1927, quoted in International Labor Office, Occupation and Health, Brochure No. 152, Women's Work, Geneva, 1929, pp. 19-20; Moore and Barker, American Journal of Physiology, 1923, p. 405; Lee, Frederic S. The Human Machine and Industrial Efficiency, London, 1918, pp. 58 and 59.

3. Quantity lifted in a day.
4. Levels of lifting.
5. Compactness of load.
6. Distance and changes of level traversed in carrying load.
7. Interference of loads:
  - With normal gait.
  - With normal respiration.
  - With normal center of gravity.
  - With local movement, i. e., pressure on joints or bones or chafing of skin, and so forth.
8. Temperature and ventilation of workplace.
9. Method of lifting:
  - a. Wide stance results in unnecessary strain on groin.
  - b. Lifting with shoulders lower than hips results in unnecessary strain on back muscles.

### *III. Overcome the Dangers Involved in Lifting Heavy Weights by Using Certain Methods*

The analysis in the preceding paragraphs points naturally to the means for the most efficient employment of women who must use heavy materials or carry loads in connection with their work.

#### **1. Introduce lifting and conveying devices.**

Mechanical devices for conveyance are now designed to meet almost every serious problem of weight lifting and carrying.

#### **2. Provide efficient conditions for work.**

The first step should be to plan the best possible arrangement of the work. Such arrangement should include <sup>8</sup> (1) Reorganization of work lay-out to eliminate unnecessary lifting from one level to another. Vertical lifting is most costly in energy. Much lifting women do in feeding machines can be eliminated by having material on a level with the machine; (2) where lifting is necessary, arranging the work so that the worker does not have to stack above her height; (3) reorganization of work lay-out to shorten distances where carrying is necessary; (4) temperature and ventilation standards are of particular importance, especially in heavy work where allow-

<sup>8</sup> Weight Lifting by Industrial Workers. Home Office Safety Pamphlet No. 16, London, 1937, pp. 16, 17, 18, 19.



Figure 1.—Stacking above the worker's height strains the abdominal muscles.

ance should be made for loss of excess heat without undue chilling of body.

### 3. Inform workers as to proper methods of lifting.

First instruction to the new employee is not sufficient. It must be repeated often.

(1) Women in particular should be informed as to methods that will prevent undue abdominal strain:

To keep the feet close to the object.

To use a narrow stance, the feet approximately 8 to 12 inches apart.

(2) Young girls need very special supervision and training in proper methods of lifting and carrying. Studies show that young girls may suffer seriously from lifting because of the possibility of malformation in bone development.

Young girls and boys lack the judgment to determine the unit of weight to be lifted. For example, investigation showed that a girl suffering from a strained back was carrying about two and a half times the normal load, though she had to walk only about 30 feet, because she was working on a bonus system and wished to save time. Other girls were doing the same thing.

(3) Some methods of lifting and of carrying loads are much more efficient and less tiring than others, and workers should have instruction in these methods. Back muscles are protected from strain and exert a minimum

of effort when the worker bends her knees, crouches by the object, then lifts by straightening the knees and standing erect.

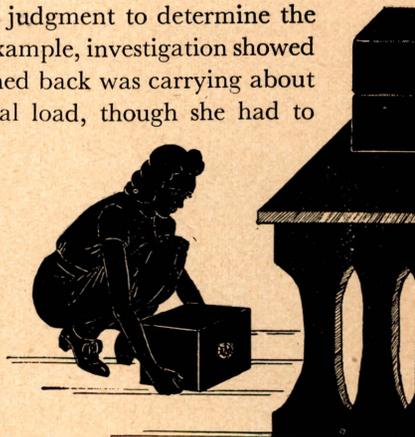


Figure 2.—With narrow stance and feet close to object worker bends her knees, putting brunt of strain on leg muscles rather than back. (By courtesy of National Safety Council, *Safety Fashions for Women in Industry*, p. 10.)

A frequent cause of back injury is improper lifting, that is, lifting with the back muscles rather than the leg muscles. A special survey by the New York Department of Labor found 72 cases of back injuries to women lifting heavy materials in industries of the State in 1930<sup>9</sup>.

#### *IV. Train Workers To Use the Most Economical Methods of Carrying Weights*

The major considerations in the carriage of weights are to secure the greatest economy of effort consistent with efficient work and to assure freedom from strain in carrying that must be continued for a considerable period.

1. Of the common methods of carrying by women in industry the most economical and comfortable is carriage on the shoulder. This method leaves free the lower limbs and does not result in fixation of the chest.

2. Tray carrying, a common job requirement for women in factories as well as in domestic work and other service occupations, is satisfactory only for short distances and irregular work. Local fatigue of arms and wrists is marked in continued transportation by this method. There may also be unpleasant pressure on abdomen or thighs. The tray may interfere seriously with normal gait and alter bodily posture to the point



of greatly increasing fatigue. Prolonged work with such loads may result in an habitual slouch. A load carried in front of a worker may interfere with vision of the floor surface and be a cause of falling. Heavy loads interfere with respiratory and circulatory functions. Where this type of carrying cannot be avoided, work periods should be appropriately short, or rest periods should be especially frequent.

3. Carrying bundles at the sides,

Figure 3.—Tray carrying is fatiguing to arms and may be a cause of falls.

<sup>9</sup>New York. Industrial Bulletin, April 1931, Compensated Back Injuries in New York State in 1930, pp. 222-224.

one in either hand, has the advantage of not disturbing body balance and not interfering with freedom of locomotion. However, marked local fatigue in hands and arms makes this an impractical method for *long continued* work. The drag on the shoulders interferes somewhat with respiration.

4. Carrying on the hip requires bending of the body to the side to compensate for the lateral load. It interferes with normal walking and to some extent with natural breathing. Workers find it particularly tiring because of fatigue to the arm and rubbing of the hip. For certain purposes it may be an advantage, since the load can be taken up from a table with ease and it leaves one arm free.



Figure 4.—Fatigue of hands and arms makes this an impractical method for continuous carrying.

#### Importance of rest periods in heavy occupations.

If awkward postures in lifting and

carrying are unavoidable, they should be maintained only for short periods.



Figure 5.—Interference with normal respiration and gait results from carrying weights on the hip.

Rest periods have been used with good results in heavy industries. They are essential because of the effect of lifting and carrying on respiration—the need for making up oxygen deficits. The length of such rests should be related to the duration of the periods of muscular work and its severity.

#### V. *Protect the Health of Workers in Heavy Industries by Physical Examinations*

During World War I good results in protecting the health of

women workers were obtained in some companies by pre-employment physical examinations. Where the employment rights of the worker are adequately protected, such examinations are advisable in heavy industries employing women.

In these examinations it is especially important that proper safeguards be assured for the worker. It is suggested that a plan similar to the Wisconsin one be put into effect for that purpose. This plan, adopted unanimously by representatives of organized labor, calls for examinations to be made by a physician selected by the employer. In the event of grievance the examined employee makes written complaint to the State Industrial Commission, an investigation is made, and if the grievance is justified the employer is required to have all further examinations made by another physician.<sup>10</sup>

The job should be fitted to the capacities of the individual. When a prospective worker gives a history suggesting disorders such as tumors or complications of pregnancy, examination should indicate whether carrying heavy materials may be suitable work. In every case the medical history should include a definite statement about the interval between a previous pregnancy and employment involving heavy lifting.

Of course, there are many disorders not peculiar to women that should preclude employment in heavy work and should be found in examination prior to employment. Such examination should weed out cases of heart disease, hypertension, obesity, neurocirculatory asthenia, tuberculosis, hernia, and other conditions.

## *VI. State Regulation of Weight Lifting Is More Effective Through the General Authority Granted Regulatory Bodies Than Through Specific Laws Fixing Maximum Weights*

Though it is frequently stated that the most economical load is about 35 percent of body weight, there are so many variations both above and below this figure in individual cases that scientific establishment of a maximum that would

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<sup>10</sup> Wisconsin Industrial Commission. *Physical Examination of Industrial Workers*. Madison, Wis., 1939.

apply to all women is impossible. All the elements in weight lifting, such as compactness of load, levels of lifting, and so forth, must be considered as well as the physical characteristics of the individual who is to do the work.

In line with the method of protection through individual physical examination, State administrative bodies engaged in factory inspection should have authority to inspect and to advise and fix rules concerning conditions under which women work where the jobs involve heavy lifting.

The present State regulations pertaining to weight lifting serve chiefly to show that a need for protection of women has been recognized in nine States. The following list summarizes these regulations:

CALIFORNIA.—

1. Object weighing *50 pounds or over* must be equipped with pulleys, casters, or other contrivances so that it can be moved easily. (Any establishment employing women.)

2. Prohibits the carrying of an object weighing *10 pounds or over*, up or down a stairway that rises more than 5 feet from its base. (Any occupation, trade, or industry.)

3. Limits to *25 pounds* weight to be lifted or carried. (Any occupation, trade, or industry.) [This 25-pound limitation in practice superseded the 50-pound maximum fixed by statute.]

Exceptions permitted during war period, upon investigation.

MASSACHUSETTS.—

1. Receptacle weighing with its contents *75 pounds or over* may not be moved unless provided with pulleys or casters. (Manufacturing and mechanical.)

2. Prohibits lifting of cores the total weight of which *exceeds 25 pounds*, unless assisted by mechanical appliances that limit physical effort to 25 pounds. (Core rooms.)

Exceptions permitted during war period, upon investigation.

MICHIGAN.—

Prohibits lifting of *more than 35 pounds* or carrying of *more than 20 pounds* when ascending stairs. Overhead lifting or stacking forbidden. (Any occupation.)

MINNESOTA.—

Prohibits handling of cores the total weight of which *exceeds 25 pounds*. (Core rooms.)

NEW YORK.—

Prohibits handling of cores when the combined weight of core, core-box and plate *exceeds 25 pounds*. (Core rooms.)

Exceptions permitted during war period, upon investigation.

OHIO.—

Prohibits employment requiring frequent or repeated lifting of weights *in excess of 25 pounds*. (Any occupation.)

During war period *35 pounds* permitted.

OREGON.—

Limits to *25 pounds* weight to be lifted and to *15 pounds* any article or receptacle carried for more than 10 feet. (Any occupation, trade, or industry.)

Order rescinded for duration of the war emergency.

UTAH.—

Prohibits lifting of "burdens" *in excess of 30 pounds* and carrying of "burdens" *in excess of 15 pounds*. (Any establishment.)

WASHINGTON.—

Prohibits lifting an excessive burden. (Canning; fruit and vegetable packing; manufacturing or other mercantile establishments. The order last-named adds "or carrying" to the prohibition.)

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