

Someone's in the kitchen

The Ergonomics of Cooking and Kitchen Design

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Believe it or not, ergonomics actually started in the kitchen. Lillian Moller Gilbreth was an inventor, author, industrial engineer, industrial psychologist, and mother of twelve children.¹ She patented many kitchen appliances including an electric food mixer, shelves inside refrigerator doors, and the trash can with foot-pedal lid-opener.¹ Gilbreth is best known for her work with her husband on time and motion studies. But after her husband's death, Lillian was an industrial engineer for General Electric, working on kitchen design improvements. She interviewed over 4,000 women to design the proper height for stoves, sinks, and other kitchen fixtures. Today much of the advice in kitchen design is derived from her ideas.

As with computer products, much of the kitchen gadgets and cookware products do not consider the user until the last phases of design. Architects and product designers often make functionality and aesthetics a higher priority than usability. But things are changing due to our aging population. The principles of ergonomics are rapidly emerging as a "must" for home design in the real estate market.² There is a current shift from treating the disabled and older people as special cases, to integrating their needs into the design of buildings, public spaces, products and services.^{3,4} Mainstream consumer markets are adapting to the shift in age groups who are less able-bodied, yet wish to enjoy an active and independent lifestyle for many years to come. The best designers are trained to consider the people who will use the products, systems, and environment they design.⁵ User-centered design engages the potential users directly rather than relying on assumptions of the designer. The whole process involves observation and analysis of the users, prototyping, evaluation and iteration of the design.⁶

A recent survey of professional kitchen staff in the United Kingdom found that 75% reported pain in the past year, over half sought medical treatment, and nearly as many noted that they had pain within the past week.⁷ Granted most of us are not professional cooks, but the culprits of injury were bending, twisting, and awkward postures. The problem lay in fixed-height countertops and a "one-size-fits-all" approach which does not accommodate the multiple types of users.⁷

When looking for hazards in the kitchen environment, ergonomic risks are pretty much the same as in any other environment. Specifically, identify and avoid:¹

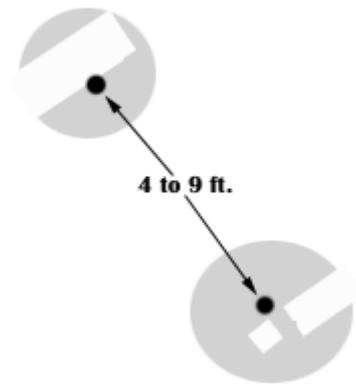
- Awkward postures
- Repetition
- High force
- Mechanical compression
- Extended duration of task
- Vibration
- Temperature extremes (especially cold)

Kitchen design

The kitchen is the single highest function room in the house.⁴ All residents use the space, so it needs to be accessible by the least able and the most able person as well as the smallest and tallest.⁴ If you are remodeling your kitchen or designing a kitchen from scratch, there are many things that can improve comfort.

A recent redesign of the Betty Crocker test kitchen featured big handles, easily manipulated controls and lots of drawers that can be easily opened even with floured or greasy hands.⁴ Railing systems located at the back of the countertops placed storage items like plate and knife racks within easy reach.⁴

Work Centers. In kitchen layout, the most basic concept is to minimize walking back and forth a lot, with clear pathways between work centers.^{8,9} In addition, when more than one person is in the kitchen, it's important that they don't step over each other when working. Consider each task and design work centers around them, taking into account the associated major appliance and its surrounding work area. Traditionally this was a triangle, but with added appliances, the current kitchen can have four or more centers. The distance between work centers should be more than 4 ft. but less than 9 ft. and an island or other obstacle should not intersect the path by more than 12 inches. No major traffic pattern through the kitchen should intersect the paths between work centers.¹⁰



To plan each work center, divide tasks and match them to appliance/tools/food location. If the kitchen has only one sink, locate it adjacent to or across from the cooking surface and refrigerator.¹⁰ Counter space is needed at each appliance and the width of each of these is described in detail in Reference 10 along with a host of other kitchen layout design principles. Pots and pans should not require burrowing in the back of bottom cabinets. Hang pots and pans on racks on walls or ceiling beams that are accessible with a step stool.^{8,14} Or use pullout shelves near the cooktop or range. Examples of storage near work centers:

Sink/Dishwasher Work Center	Oven/Baking Work Center	Stove/Cooking Work Center
<ul style="list-style-type: none"> ▪ Fruit and vegetable storage ▪ Cutting boards ▪ Collander ▪ Dishes and flatware 	<ul style="list-style-type: none"> ▪ Mixer ▪ Bake ware ▪ Flour, sugar, spices ▪ Measuring cups and spoons 	<ul style="list-style-type: none"> ▪ Spatulas and cooking utensils ▪ Herb and seasoning storage ▪ Pots and pans

Work surface height and design. To accommodate the different tasks to be done in the kitchen and the people of different heights doing them, counter surfaces should either be adjustable or set at various heights^{11,12}. Proper work surface height minimizes excessive forward bending and shoulder elevation.¹¹ For tasks requiring close visual inspection, position the surface height so that hands are slightly higher than elbow height and below shoulder level. For most tasks, the work surface should be slightly below elbow height. Work requiring force, such as kneading bread, rolling



dough, or cutting bones, should be done on a surface that is below elbow height unless close inspection is required.¹¹ Adjustable height cooktops, sinks, and cupboards are needed to accommodate wheelchairs or an extremely wide range of user heights.



Photos courtesy of AD•AS Furniture Solutions of Universal Design

Mechanisms are available to add to work surfaces to make them into sit/stand adjustable surfaces (See AD•AS Furniture Solutions in the Resources Section below). It is more comfortable to sit to perform some tasks than to spend hours on foot in the kitchen. By providing a height adjustable surface with leg clearance for sitting, it's possible to reduce pressure on the feet and back while performing many tasks.



A cutout design is very useful. It allows a person to get closer to the work at hand without reaching (see illustration at right). If a disposal hole is cut out so trimmings can be swept into an under-counter garbage container, the surface is even more effective in eliminating awkward postures.¹¹ Clipped or rounded edges on all counters are much safer than sharp edges.

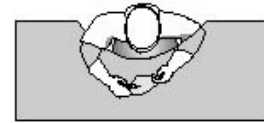


Illustration courtesy of OSHA¹¹

Floors. Prolonged standing on hard work surfaces can create contact trauma and pain in the feet. A cushioned floor surface such as cork or linoleum is best, and it minimizes breakage when things are dropped. If the floor is hard, such as tile, use anti-fatigue mats or cushioned rugs to increase blood flow to the feet and to reduce fatigue.¹¹

Lighting. In addition to general lighting, every work surface should be well illuminated by task lighting.^{2,10}

Appliances



Photo courtesy of Sub-Zero



Photo courtesy of Sub-Zero

Refrigerators and freezers are no longer limited to just one location. New designs incorporate drawers that are tucked under the counter and are readily accessible by cooks of all abilities, ages, and sizes.⁴ If you're buying a standard refrigerator, designs with the freezer on the bottom are best, with most commonly used foods on the top shelf for easy access.⁸ Dishwashers are available as drawer models to reduce bending.⁴

Rules for Tools

To reduce the risk of injury, follow these recommendations when buying and using tools.

1. Use proper tools for the job.⁸
2. Keep shears and knives sharp.^{8,9,13}
3. Use choppers, processors, and blenders to reduce repetitive motion and force.⁹
4. Try oversized molded and padded grips on knives and other tools to reduce hand fatigue. However, if these alternatives are not easy to grip and hold, use a tool that fits your hand.¹³

5. Angled and pistol grip handles on knives are advised for cuts made with a downward stroke. Such knives keep the wrist in neutral while allowing for sufficient downward force to make a smooth cut. Inline handles are best when the food is resting flat on a tabletop and the cut is to be made parallel to the surface.¹¹



Illustration courtesy of Life Solutions Plus

6. Handles should:

- a) be perpendicular to the line of action,
- b) be as long as the length of the palm,
- c) have a non-slip surface,
- d) be thick enough to allow a power grip (i.e., a grip that keeps the wrist straight),¹¹
- e) be textured to improve grip and hand force, and
- f) be washable in warm water to remove grease.¹¹



Illustration courtesy of Life Solutions Plus

7. Keep finger pinch to a minimum, especially for repetitive work.¹¹
8. Avoid tools with form-fitting ridges for fingers on the handle unless they fit your hand perfectly. People with larger hands find that their fingers overlap the ridges causing pain, soreness and calluses. People with smaller hands have to spread their fingers to match the grooves. Strength testing has shown that spreading the fingers significantly reduces grip strength, requiring more pressure to maintain control of the tool.¹³
9. Heavy tools and cookware should have two handles.¹¹

10. It is important to choose tools that minimize force and strain. Zyliss and OXO are two brands that have applied ergonomics principles in the design of their kitchen tools and gadgets. The pizza cutter (pictured on the right) from Zyliss concentrates pressure directly above the blade. Most pizza cutters (even OXO's) place the user's strength off-axis. OXO's jar opener is easy to grip, has a rubber mat for stabilizing the bottom of the jar, and greatly reduces the strain on wrists and hands.



Photo courtesy of IDEO



Photo courtesy of OXO

Other factors

Standing. Static postures cause blood to pool in the lower extremities, resulting in muscle fatigue and pain. Cooks often stand in one position while cooking or preparing food. Avoid static postures by continually changing your position. Use a foot rest or a stool to help alter your posture, resting one foot and then the other.¹²

Wear comfortable, cushioning shoes when you know you'll be standing in the kitchen for a long time.^{7,12}

Reaching. Minimize reaching by organizing your work environment so that most cooking processes can be completed within easy reach while keeping your elbows close to your body.¹² Place most commonly used tools within easy reach.⁸ Assemble all ingredients and utensils needed before cooking near the work center, similar to preparing a lab for an experiment.

Use a stepstool to avoid reaching above shoulder height.¹¹

CONCLUSION

Arranging your current kitchen or incorporating "inclusive design" principles into a new design is important to enable accessibility to the kitchen for all residents of the home. The kitchen is full of potential sources of strains, repetitive motion, force, and awkward posture, especially if you are a "non-standard" sized person or if you have already overworked certain body parts during the day at work. Making the kitchen fit you, using tools that fit you, reducing potential causes of strain, and following these suggestions to reduce awkward postures, stresses and fatigue will help you to cook comfortably.

RESOURCES:

Life Solutions Plus. Perpendicular handled knives, spatulas, and other tools for easier living. 877-785-8326. http://www.lifesolutionsplus.com/product_info~products_id~73.htm

AD•AS Furniture Solutions of Universal Design. Height adjustable cooktop, sink, and cabinet systems. 1-800-208-2020. <http://www.ad-as.com/kb/>

OXO (Good Grips Products). 800-545-4411. <http://www.oxo.com>

Sub-Zero. Undercounter refrigerator and freezer options. 800-222-7820. <http://www.subzero.com>

Functional Solutions. Cooking and eating tools, especially for people with special needs. North Coast Medical: 800-235-7054. <http://www.beabletodo.com>

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