

Ergonomically Design and Improvement on Hot Double Plate

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ABSTRACT

An integrated electrical heating tool used for baking, stewing, and cooking is the hot double plate/stove. A rotary switch can also be used to operate an electric stove. The majority of individuals use electric stoves, particularly those who reside in cities. There are several kinds of stoves since some are used for cooking and others for making stew. However, the focus of this research is on electric stoves used for stew, also known as hot double plate electric stoves. While there are certain ergonomic issues with that stove, the majority of Ethiopians who live in cities utilize this hot double plate to prepare stew. This stove is used by placing it straight on the ground; it lacks a foot. However, there isn't any room, height, or distance between the stove and the ground. Users always extend to the limit in order to complete their tasks, but since every person's body and age are different, it might be challenging to go beyond one's comfort zone. Not only that, but when using the stove, the user's rear body is curved downward. People who use hot double plates are affected by this issue since they use the stove at least three times a day. People started experiencing knee and back discomfort after a long time as a result of this issue. The goal of this research is to create ergonomics for the hot double plate in order to address current issues. This issue is resolved by the ergonomic system that creates a distance of a certain height between the ground and the stove so that it can be conveniently used in both directions. When designing the stove foot, Solid Work software is used to take the user's physique into account together with the stove foot height. Once the foot is on the stove in both directions, the problem is solved and the users are happy that they can use the stove to perform their jobs more easily and with less knee and back pain.

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1. INTRODUCTION

The development of technology for new product set it needs to find a solution and create wellbeing

condition for human on their life and also considering and performing on a job will result less fatigue and energy loss [1]. Hot plate/stove is used for cooking in daily life activities of the

peoples but, ergonomically principles are not frequently considered in design of the kitchen materials (stove) and other tools in developing countries [2]. Food preparation activities in the kitchen it may experience fatigue and discomfort when performing highly repetitive task for a long period of time and it continued work under these difficult conditions may result in chronic injuries to muscles with back and knee pain with injuries of these types are known as work related musculoskeletal disorder (WRMSDs) and it does occur when the physical capabilities of the workers do no match the physical requirements of the job and also musculoskeletal disorder like back and knee pain and other parts of the body pain can happen to anyone who perform activities in the kitchen [3,4]. One of the significant health problem faced by human while working in a kitchen is pain perceived extremely at lower and upper back region and work had an excessive influence on the evolution of the musculoskeletal disorder (MSD) among women involved in various kitchen activities [2,5]. If the workers/users continuously perform the activity during food preparation in the kitchen, they may experience prolonged it creates fatigue and others problems because of uncomfortable working conditions and improper designing kitchen materials like stove and it spent time by the users/workers is 6 to 8 hours per a day and there is a repetitive movement with task which causes of back and knee pain on the users of that materials like stove because of the physical capabilities of the workers do no match the physical requirements of the stove [6-8]. Improper designing of hot plate/stove in kitchen are causes of ergonomic problems and it can make uncomfortable working work generally involving tasks are pushing, pilling lifting and carrying materials those causes of injuries and it also often designed without considering the people who will be using them [9]. Ergonomics has a great role on product development process with improvement in order to reduce ergonomically problem [10]. Well-designed product has well acceptance and reduce fatigue of the workers [11,12].

Today ergonomics and occupational safety and health needs more consideration. In development of technology and specialized work requiring repetitive task needs ergonomics [12]. Repetitive work on improper working conditions impact on musculoskeletal health [5]. During

developing ergonomics on the existing products it considering the existence variability of the populations [13]. Embedding ergonomic consideration to productise it taking accounts in to both psychological and physiological needs for user helps to in hence user efficiency, productivity and satisfaction [14,15]. Then by using ergonomics principles possible to reduce ergonomics problems [16]. Before improving the exist hot pale/stove, it needs to consider on human body (Anthropometric) and posture of the users with the overall dimensions of the stove [17]. Using proper ergonomically designed stove in kitchen is used to reduce fatigue (back and knee pain) of users and increase satisfaction from work with safety [18].

2. STATEMENT PROBLEM

An integrated electrical heating appliance for baking and cooking is an electric range or stove. Solid-fuel stoves (wood or charcoal) that required more labor to run and maintain were gradually replaced with electric stoves, which gained popularity. A rotary switch with a limited or infinite number of locations that engages a different combination of electric resistances and, consequently, a different heating power is used to operate electric stoves, which can have one or several cook tops. Some might have a thermostat to regulate the elements' average heating effect and to turn the electricity on and off. In Ethiopia, electric stoves are often found in both residential and commercial kitchens. When using a heated double hot plate, there are certain ergonomic issues that arise, making it uncomfortable for the users. Vertebral bodies, or discs, comprise the lower back region and serve as "shock absorbers." Back pain strikes people who work repetitively and extend their reach downward with time. Hip weakness can lessen pelvic area support and result in back discomfort, in addition to other pains that arise from an unpleasant way of doing tasks. Knee discomfort may result from increased femur internal rotation. Knee and low back pain can definitely be brought on by hip dysfunction. In addition to causing discomfort on the outside of the knee, iliotibial band tightness can also induce hip issues and knee pain. Both hip and knee issues can result from tightness in the rectus femora muscles, which straighten the knee. Hip and low back discomfort can undoubtedly be brought on by knee dysfunction and pain. The ergonomic issues with the products

(hot double plate) are the cause of all of those pains. The goal of this research is to improve the ergonomics of the current hot double plate in order to overcome difficulties.

3. METHODOLOGY

Under this methodology it consider how the steps paper is processed, what types of data uses, how the data is analyzed and material is used is located. In this case it consider the average of the population dimensions used depend up on the age which used the stove. Data is considered according to averagely fit all the users of the hot plate/ stove, because all dimensions are taken with in the age of the users that material. This study only considering on the height of the knee of users, because the main target is to reduce the height between the stove and the knee during work by increasing the of the stove height from the ground.

3.1 Exist hot double plate/stove

- Have not foot or height from the ground and it attached to ground.
- It's difficult for cooking for user.
- Its causes of back and knee pain on the users.
- It require improvement or develop ergonomics.



Fig. 1. Exist hot double plate/stove.

3.2 Type of data uses

The instruments engaged in order to collect primary data is structured questionnaires, direct observation and personal interviews and use secondary data like relevant books, articles, reports and data from previously worked researches. Both primary and secondary used to identify existing of the ergonomically problem on hot plate.

3.3 Data Analysis Equipment and Tools

The tools will use for the data analysis to show both the existing & the propos methods, the

equipment includes, meter, record sheet and calculator.

3.4 Gathered and analysed data

During gathering data we consider the age of the users peoples and the user's age most probably included between 15–65 ages. Then for this article use ten user dimensions and recorded with knee height in order to identify the height which related with seating position (Table 1).

Table 1. Gathered and analysed data.

No.	Knee height (cm)
1	58
2	54
3	57
4	54
5	55
6	53
7	55
8	51
9	59
10	54
Average = 55cm	

3.5 Material selection criteria

During selection designing this stove, it consider type of materials which going to select, because, to identify the relationship between exists materials and electric property. It consider some terms during selection of materials for designing the foot and other materials of the stove. So it consider the :non-conductive electric material, good strength material, lightweight materials, heat resist materials, corrosion resist materials, non-magnetic, less cost and easily availably material.

Types of material selected:

- Machined Wood - Depend up on the above criteria it select wood for designing foot of the plate. Because it is available and easily get from local.
- Bolt and Nut - both are needs according to their requirement dimensions.

4. RESULT AND DISCUSSION

4.1 Existing problems of hot double plate/stove

It was already identified the existence of the problems on the hot plate/stove by using both questioners and direct observation. There are some ergonomically problems on that stove because stove hasn't foot, it is directly put on the land (ground) and use it. On the other hand there is no distance/height or space between the land (ground) and the stove. Users do their job always fully stretching to down ward, but the body and age of all peoples are not the same so it's difficult to stretch beyond of his ability during doing their jobs. Not only this but also, the back body of the user of the stove is concave to downward during uses. The duration of using that stove is at least three time per day, so this problem it affect the peoples those uses glory hot plate stove. After a long period of time the output of this problem is back pain and knee pain happened on the peoples.



Fig. 2. Outer and Inner part of hot plate.

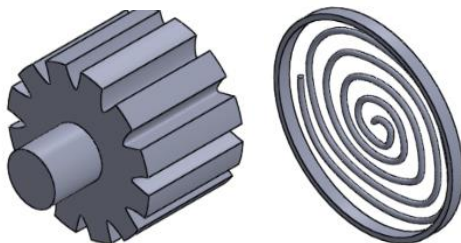


Fig. 3. Switch and coil of the existing plate.

4.2 Ergonomically Improvement

When it improve this plate it considering the existence of different peoples/ users, body size of the users also different. Depend up on the

gathered data it considering between 15 to 65 ages of the peoples height of the knee in average 55 cm and hand reach (length) in average 45cm. also the design considering seating working condition of the work with normal working area. By using solid work software design foot with height of 55cm and assemble by using bolt and nut.

4.3 Material specification

The material specification is shown in Tables 2 and 3.

Table 2. Specification for foot.

Types	Dimension
Length	48cm
Width	2cm
Upper bend rectangle	3cm

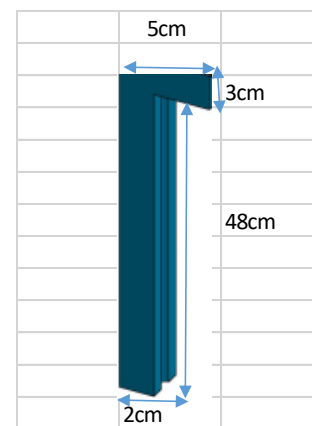


Fig. 4. Designed plate foot with dimension.

Table 3. Specifications for bolt and nut.

Types	Types of dimensions	Amount
	Length	11cm + 2cm (for nut) = 14cm
	Thickness (diameter)	0.5cm
	Diameter	0.65cm

4.4 Assemble place on existing plate

When it assemble without affecting the exist plate. Then 4cm away from electric wire and 4cm inter to beside of the body.

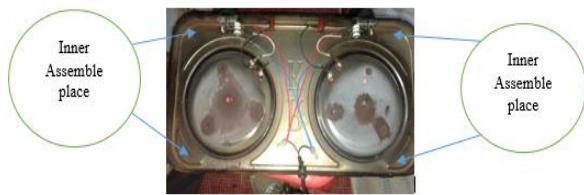


Fig. 5. Inner assemble place.

Total height of the plate from the ground is:
Length of plate foot + thickness bend foot of
subtained by nut + thickness of original plate:
 $48\text{cm} + 3\text{cm} + 4\text{cm} = 55\text{cm}$.

Then depend up on the gathered data get average
dimension wich reperesent the people age
located between 15 to 65 age. When it design and
assemble the over all of the plate by using solid
work 2017 software it as follows.



Fig. 6. Ergonomically improved electric hot double
plate/stove.

4.5 System of Packaging the plate after manufactured

After manufacturing the hot double plate it will
pack with foots, bolts and Nuts without
assembling, but show the way to assemble on bill
of the material for customers and others.

4.6 Outcome of the study

The improved (designed) hot double plate have:
Height from the ground is increased from 0 to
55cm, downward bending and stretching of the
users totally reduced, hot double plate is
comfortable for users seating on chair during use,
back and knee pain of the user is also reduces and
satisfaction of the users are increase.



Fig. 7. Matching both improved hot double plate with
user.

5. CONCLUSION

Hot double plate/ stove is an integrated electrical
heating device which used to cook, bake and
stew. Major number of the populations of
Ethiopia those living in urban (city) uses this
double coil hot stove for prepare stew. There are
some ergonomically problems on that stove. This
stove hasn't foot, it is directly put on the land
(ground) and use it. Users do their job always
fully stretching to down ward, but the body and
age of all peoples are not the same so it's difficult
to stretch beyond of his ability during doing their
jobs. After a long period of time the output of this
problem is back pain and knee pain happened on
the peoples. This paper (project) developed
ergonomics on the glory hot double plate stove in
order to solve exist of the problems. This
problems solved through ergonomic system
make/ design the foot in both direction for exist
stove, in order to make space in 55cm between
the ground to the stove for easily appropriate for
use.

Generally, the improved material decrease the
back and knee pain from the users and users
easily use after the foot is bind by using nut and
bolt and also the manufacturer easy to pack
without assembling and showing the way to
assemble on the bill of the materials.

The manufacturers of the hot double plate should
be consider the ergonomics before producing the
products. Not only this but also it consider
diversity of the people use the products, those
peoples has different body size and age.

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