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# Design Modification and Analysis of Head Load Sharing Apparatus for Farm Workers and Vegetable Vendors- Literature Review

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**Abstract:** Farm community across India, which includes the farm workers as well as the vegetable vendors, is lifting, carrying and moving objects on head since a long time. A load carrier so designed that it would distribute load from head to shoulders will solve the complex traumatic problems caused by work drudgery. Even though a few designs of load carrier are already available but still they are not efficient enough to be implemented. Workers carrying heavy loads like vegetable baskets on their head often bear medical injuries like neck pain, back pain, knee joint pain and fractures. Thus the aim is to design a load carrier that can ease the manual labour and exertion on the farm worker and vegetable vendor and thereby increase their efficiency.

**Keywords :** Head load, musculoskeletal disorders, ergonomics, occupational health, farmers

## I. INTRODUCTION

Throughout recorded history, mankind has transported loads from place to place using different carrying devices such as yokes, rucksacks and backpacks [5] while using different parts of his body like hands, back, head etc. Women and men of different age groups have carried goods, supplies, food, kids and arms for the purpose of survival, construction, migration, commerce and warfare [5]. Presently, India is termed as growing or developing country instead of a developed country. As per the studies of World Bank made during the year 2016, 67% [7] of total Indian population lives in rural areas and the reason for being called a developing nation is that we are still developing the basic requirements, necessities or facilities in the rural region. Thus we can say that the scope of material handling and management by any reasons is more in rural areas but it can't deny the material handling possibilities in urban region as well. As already stated, the maximum population is living in rural areas and many of them are dependent on farming or work related to farming which involves different material handling requirements. Since ancient times, we have witnessed several ways of transporting material from one place to another. Some of them like carrying the load on head, use of bullock carts and tractors, etc are in use even today. Unfortunately, some of the methods used for material handling are not much sound and they may cause severe disorders in human anatomy which leads to either partial or permanent disabilities. These injuries are often termed as musculoskeletal disorders [1]. Thus there is a need to study different material handling processes through the angle of musculoskeletal disorder investigation and we will try to provide a solution to solve the problem of musculoskeletal disorder among the farm workers and vegetable vendors.

## II. LITERATURE REVIEW

A. Kanal Chhajed, Rakesh Maheshwari, Raghunath Lohar, Khimji Kanadiya [12]

In this paper, they have studied various effects of carrying load on head by carrying out survey of different workers in Ahmadabad. They found that the excessive load carried on head caused pain and discomfort to the workers. Majority of the workers reported of having neck muscle strained and headache because of carrying heavy loads. Thus there was a need to design a load carrier which can reduce the stress on head. For this they studied the existing designs of load carrier and based on that they formulated their design considerations. Three prototypes were designed and they were given to the workers to obtain their feedback. Every prototype had its own pros and cons. So the conclusion is that the design should be made considering the social, gender and cultural issues of the workers.

B. Manjusha S. Revanwar, Jayshree P. Zend, Sandhya N. Admankar [15]

This paper shows the assessment of activities carried out by women in a cotton production system. For the study, 50 women from five villages of Parbhani district, Maharashtra were selected. As agriculture is the prime occupation in India, hence majority of the

rural population is involved in farming out of which women are more. These women perform different activities like cotton picking, gathering, heaping, spreading manure, seeds, weeding etc. All these activities caused discomforts according to the type of load in each activity. The author concluded that the cotton picking activity caused the maximum drudgery load because of maximum repetitive strain followed by physical and physiological load.

*C. MF Hoque, Z Hasan, ATMA Razzak and SU Helal [17]*

This paper presents the study which was carried among the people of Bangladesh. It studied the problem of fall due to carrying heavy load on head. The study showed that the most common effect was cervical spinal cord injury which was mostly caused because of head loading. The age of majority of the affected people was 40 and below that. The authors concluded that the neck, C5 and C6 were the most affected areas of spinal cord injury. Hence there is a need for building some preventive measures for them.

*D. Steven R. Kirkhorn MD MPH, Giulia Earle-Richardson PhD & R.J. Banks CIE [22]*

Ergonomic risks present in production agriculture and the resulting MSDs pose a physical and economic concern to both producers and workers. The authors' recommend ongoing efforts that will lead to effective field trials of ergonomic interventions combined with administrative practices to decrease MSDs and dissemination of results throughout the agricultural and academic communities. Although not as lethal as tractor roll-overs, MSDs can result in disability, lost work time, and increased production costs. MSDs increase production costs as a result of worker absence, medical and insurance costs, decreased work capacity, and loss of employees to turnover and competition from other less physically demanding industries. This paper provides an overview of what is currently known about MSDs in agriculture, including high-risk commodities, tasks and work practices, and the related regulatory factors and workers' compensation costs.

*E. Aoife Osborne, Catherine Blake, Brona M. Fullen, David Meredith, James Phelan, John McNamara, and Caitriona Cunningham [3]*

The authors have listed various risk factors that cause musculoskeletal disorders among the farmers. They are classified into three categories namely work characteristics, personal characteristics and psychosocial factors [3]. After performing a systematic review of the risk factors, they have found that the spinal region is the most researched body part having MSD. The causes for spinal MSD being postural load as a work factor, age as a personal factor and poor sleep quality, geographic location as the psychosocial factor and many such other factors.

*F. M.F. Haisman [16]*

In this paper different aspects of load carriage have been reviewed. It is concluded that there is no easy solution in the definition of a maximal load, because of widely varying circumstances, but for healthy young males there appears to be some consensus for the traditional rule of one third body weight [16]. But there is an exception to this conclusion as the weight carried by a physically fitter person like soldier will be different. Load carriage in industrial and other civilian areas will also involve a similar compromise between the person's capabilities and requirements of the task which may in some circumstances have important implications for health and safety. [16]

*G. Rohit Sharma and Ranjit Singh [20]*

In this paper, the authors have determined the safe limit for carrying load by women. They have performed a study on 20 subjects from different villages of Haryana who carry water. The subjects carried the load on head, shoulder or waist. Biomechanical stresses show that carrying water is safe only for head mode [20]. So the minimum weight that can be carried for maximum time duration is 10 kg in all modes and on head maximum 15 kg weight can be carried.

*H. Horst J. Jäger, Len Gordon-Harris, Ulrich-Martin Mehring, G. Friedrich Goetz, Klaus D. Mathias [6]*

In this paper the authors have evaluated the relationship between the load-carrying on the head and the development of degenerative change in the cervical spine [6]. A study was carried out on subjects under controlled conditions. The presence of ventral and dorsal osteophytes of the surrounding end plates of an intervertebral disc space and a decrease in the height of the disc space were recorded [6]. It was found that there was a degenerative change in the cervical spine for 88.6% [6] of the subjects carrying heavy load on their head. The authors have concluded that the axial strain of load-carrying on the head exacerbates degenerative change in the cervical spine [6].



### III. IDENTIFIED GAPS IN LITERATURE

Many researchers have presented their work on the causes and effects of head loading. Some of them have focused on the musculoskeletal disorders occurring due to head loading while some have focused on the ergonomic aspect. Work is going on to design a load carrier which can reduce the stresses on the head and distribute them evenly on head and shoulders. But it is found that the existing designs have not considered some of the aspects like spine analysis and ergonomically sound design while formulating the design considerations. Further there is also one problem of loading and unloading the load from head to the desired place which is commonly found from the papers.

### IV. PROBLEM FORMULATION

After carrying out the literature survey we have found out that improper material handling practices are being used by the farm workers and due to excessive head loading they have to suffer from musculoskeletal disorders. This results in economic loss and efficiency of the farm workers. So we are going to design a head load sharing apparatus based on the investigation carried out using questionnaire and structural analysis of spine under different loading conditions.

### V. RESEARCH METHODOLOGY

The design modification and analysis of head load sharing apparatus will involve the development of concept based on the existing designs. To modify the existing design is the main aim. The modifications will be done post the investigation using Nordic Musculoskeletal Questionnaire (NMQ) and direct observations. After that CAD model of the apparatus and spine will be prepared. FEA analysis of both the models will be done. The results will be discussed and they will be further used for validation of the design both analytically and experimentally.

### VI. CONCLUSION

This project involves design of head load sharing apparatus for the farm workers and vegetable vendors, who carry excessive load on their head due to socio-economic conditions, which causes discomfort and affects their health at large. Although there are many load carriers available in the market, but each one of them has its own pros and cons. We will try to provide a solution that will take into consideration all the aspects like social, economical, cultural, Ergonomical and physiological conditions of the workers.

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