

Status of Anthropometric and Biomechanical Studies on Agricultural Workers in Northeast India

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INTRODUCTION

Anthropometric and biomechanical characteristics of the users are essential for designing tools and equipment for enhancing their comfort, safety and productivity. On the other hand, the use of poorly designed tools and equipment fails to account for the anthropometric and biomechanical characteristics of its users and has a negative influence on human health. Across India, the anthropometric and biomechanical database of agricultural workers has been compiled and utilized by various researchers to design, development, design modification of various tools and equipment; while anthropometric database and muscular strength database are limited for Northeast India [1-4]. Moreover, tools/equipment designed specifically for the population of one region could not be used for the people in other regions without modification or redesign to consider differences in their characteristics. Furthermore, it has been observed that minimal work has been done for tools and equipment used in this region. Indeed, it has also been shown in different circumstances, that although farmers are rational and intelligent enough, technological stagnation or slow improvements may still withstand them. Application of practical knowledge from various disciplines of ergonomics like agricultural ergonomics, occupational health and safety, environmental ergonomics and design ergonomics may be useful for developing sustainable agricultural practices leading to a better productivity and uplifted farmers' well-being. Anthropometric and biomechanical database along with information regarding the cause and prevention of injury/accidents are essential requirements for the design and development of appropriate tools/equipment.

In contrast, need-based ergonomic designs in the region principally lack such database. Therefore, the introduction of improved technology in the present farming system demands the selective use of mechanization with ergonomic design criteria fitting the target users. The database for anthropometry, strength and physical work capacity must be standardized first to intervene comprehensive and realistic user-friendly solutions to ensure workers' strength, skills and abilities through improved design and application.

Anthropometric studies

Availability of user-friendly farm equipment is one of the crucial prerequisites for the growth of the agriculture sector in any region/state. Agriculture forms the backbone of the Northeast India economy. It provides livelihood to more than 70 per cent of the region's population. However, the overall agricultural yield is insufficient to fulfil the local need. The use of local artisans made primitive tools/equipment which is ineffective/not well suited to user's physical capacity and incapable of providing better performance for higher efficiency.

Further, heavy physical work, inadequate working methods, working techniques and tools not only cause unnecessary fatigue and occupational accidents but also leads to low productivity. Therefore, designers and engineers must consider physical dimensions and human capabilities while designing farm equipment for better productivity. A lack of such a relevant database of tools and equipment design may lead to low productivity and work-related injuries.

In India, efforts are being made to collect the anthropometric database of farmworkers by various researchers like and many more [1,5-8]. There is a lack of anthropometric data of agricultural workers of Northeast India. Available literature suggests that steps have been initiated only in the recent past by a few researchers [1-3]. Patel et al. reported significant variation in the anthropometric database among the different states of India, therefore emphasizing regional database for tools and equipment design [9].

Biomechanical studies

The ergonomic design of products adapted to the user population puts particular emphasis on an ergonomic approach that is anthropometric as well as the biomechanical database. It is true that the user-centered design of tools and equipment takes into account not only the physical human body dimensions but also strength capabilities of intended users. The efficiency of the man-machine system depends on the human operator, the tool, and the task. Therefore, understanding of the relationship between

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the capabilities of human worker and the force requirement for operating tools and equipment is of fundamental importance to ergonomic research and practice. A large amount of strength required to perform a task or failure to include variability in its range can produce degraded results which can affect the musculoskeletal system by physical overloading which causes discomfort, fatigue, pain, injury and illness to workers.

Isometric muscular strength is considered as one of the most crucial factors for the design and development of various tools and equipment in agricultural activities. Isometric muscular strength data of Indian farmworkers have been measured and utilized by Gite and Chatterjee (1999), Gite and Yadav (1989), Mehta et al. (2007) and Tiwari et al. [5,10-12]. However, muscular strength data of agricultural workers of this region are limited but also rarely in use [1,2,4,13]. Adjusted or normalized strength data from other countries or other regions of India could not be utilized for designing of tools and equipment for Northeast Indian people since the capability to exert maximum force to do the task depends on a person's race, body weight and lifestyle [14]. Effective ergonomic interventions must be developed and implemented to reduce musculoskeletal disorders among farmers.

Various researchers have pointed out the importance of using the relevant anthropometric and biomechanical database for the best possible match between the product and its users [11,15]. To that end, it is fundamental to know the up-to-date primary database, like anthropometric and biomechanical dimensions of the target population. It has been found that an underlying database of agricultural workers from Northeast India is minimal. The large number of farming operations are carried out manually by using locally made tools and equipment. Anthropometric and biomechanical data are hardly taken into considerations while making those hand tools by local artisans. Moreover, farm equipment developed and used in other parts of India cannot be introduced directly in Northeast Region of India (NER) as anthropometric and biomechanical characteristics of NER people are different from other population of India. Adopted implements need to be modified before introduction to suit agricultural workers of this region. This would surely help in reducing occupational injuries and musculoskeletal ailment, which occurs due to mismatch between the strength capability of the workers and operational demands of the job.

SCOPE FOR FUTURE RESEARCH

Strategic planning is necessary for the development of human-centric tools and equipment to develop agriculture and make region marginally, if not significantly, a surplus in food production by the implementation of the anthropometric and biomechanical database for design and development of need-based farm equipment. While designing various agricultural hand-tools and equipment in the region, little attention has been given to the users' competencies and limitations [1-4]. Cases of injuries and morbidity among agricultural workers may be reduced with relatively low-cost ergonomic interventions, remediating other risk factors inherent in tool design and working environment, thereby finally securing the task itself. Any improvement in the mechanical farming process, methods or working environment is considered under essential ergonomic interventions for an enhancement in comfort, safety and overall productivity. The importance of

developing the anthropometric and biomechanical database of Northeast India population is necessary for designing agricultural tools and equipment, as well as to opine design recommendations therein; because any improvement in agricultural mechanization has always been, and will ever remain the chauffeur of agricultural growth.

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