

## Ergonomic evaluation of tea farmers in north of Iran during plucking using body modeling

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### Introduction

People in different jobs may face skeletal problems in their body due to poor physical conditions as a result of poor working conditions and inappropriate equipment. Harvesting tea is one of those jobs that are known as a very vigorous process and it requires hard work and perseverance. Moreover, after water, tea is the most widely consumed beverage in the world. This fact highlights the great importance of jobs related to tea. The most prevailing method used for tea harvesting in Iran is manual harvesting, although this job in some regions is mechanized. Manual harvesting intensifies the hardness of this job.

### Materials and Methods

This study was launched and aimed to find harmful postures in tasks related to tea plucking in order to reduce the intensities in this job. To obtain this goal workers' postures were needed while working. Different postures should be attained by filming during a working day. Films were recorded from 30 workers in tea farms at the different parts of Lahijan region, Iran, and were analyzed by modeling tea harvesters' bodies by CATIA software. Then, the modeled postures were analyzed by three methods: OWAS, REBA and RULA.

### Results and Discussion

According to OWAS analysis, 30% of postures placed at the first level, that means the postures have not harmful effects on musculoskeletal system, and the corrective action is not required. 10% of the tea harvesters population was placed at level 2 so the posture has harmful effects on musculoskeletal system and the corrective action is necessary in the near future. This situation is not critical, only needs more attention. The corrective actions require soon in the third level. 33% of analyzed and modeled postures were in this level. In the fourth level which is absolutely critical and has biomechanical strain with very traumatic effect on musculoskeletal system and it is necessary to exert corrective action immediately, 27% of postures were observed.

The results of REBA analysis showed that 24% of workers' postures in tea farms and under this study were at level 1 where the risk level is low and the corrective action may be necessary to them. 53% of workers are at level 2 who are at the average risk and corrective action is necessary for them. 23% of tea harvesters are in level 3 with high level of risk, therefore the corrective action must be performed immediately. Finally, similar to results obtained from the analysis of OWAS, no posture placed at level 4. The results of RULA analysis show that there is no posture in positions 1 or 2 and all positions need to be investigated. According to this analysis, 2% of tea harvesters' postures are in position 3 and no posture in position 4. Therefore, in total, 2% were in second level. According to RULA analysis, 16% of workers' postures were in position 5. 44% of postures of tea harvesters working in different parts of Lahijan region were in position 6. Accordingly, 38% of the postures were in position 7.

### Conclusions

The findings from this study showed that the highest prevalence rate of musculoskeletal pain or discomfort was in the trunk region (92%), following by the neck and upper arm (38%), lower arm (23%) and wrist (15%). For men the most frequent disorders were trunk (89%), upper arm and neck (33%), lower arm and wrist (22%). The results from this study also revealed that all women in this occupation faced musculoskeletal problems in the trunk region (100%). After trunk, neck and upper arm (57%) and lower arm (25%). No disorder was seen in wrist region in this analysis, which is consistent with female labors' report. After this analysis finding uncomfortable postures in each duty and making changes in simulated bodies in CATIA software in order to

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reach a lower grand score can be helpful to improve working conditions. Reanalyzing new posture is the stage to obtain new grand score. Final step in this case is reporting harmful and improved postures to employees and employers. Notice that improved postures are not valid unless workers can have acceptable access to their work. Similarity between the results of OWAS and RULA methods and the difference from the results of REBA method could come to conclusion of not using REBA method for jobs similar to tea plucking.

**Keywords:** Body simulation, Musculoskeletal problems, Posture analysis, Tea harvesting