Effects of safety gloves used by gardeners on perceived discomfort and performance

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ABSTRACT

A shovel is a common tool in agricultural activities. It is very popular among Iranian gardeners and they used it for a variety of purposes. To avoid such damages, some gardeners wear safety gloves. Some other gardeners do not use safety gloves because they maintain that the gloves negatively affect their performance. Accordingly, the aim of the present study was to investigate and compare several safety gloves used by gardeners in terms of comfort and performance. Ten gardeners with at least two years of experience were invited to participate in this study. The participants were asked to plow the ground with two commonly-used gloves and also bare hands for 30 minutes. After completing the task, they were given a hand and fingers map to express their discomfort level in each region. The performance of the participants was determined by measuring the surface area plowed by them. Area P was the one with the highest level of perceived discomfort, followed by TP, MM, and IM. In all areas, the lowest level of discomfort was perceived when the participants used the cotton glove. The average area plowed by participants with bare hands, cotton gloves, and Latex gloves were 1266cm^2 (±112.7), 1230cm^2 (±80.4), and 1186cm^2 (±138.6), respectively. Therefore, wearing any type of safety gloves can negatively affect the performance of gardeners. Safety gloves used by gardeners were different in terms of the perceived discomfort and performance.

KEYWORDS

Glove, Comfort, Shovel

Introduction

According to the International Labor Organization (ILO), almost half of the world's workforce are employed in the agriculture sector. Agricultural activities have been known to be dangerous such that the risk of occupational injuries has been reported to be high in this sector (ILO, 2003). There have been introduced many reasons why the rate of occupational injuries and fatalities are high among agricultural workers. Forceful movements, awkward working posture, harsh environment, use of improper agricultural tools and equipment, misuse of agricultural tools and equipment, and lack of willingness in using protective equipment are some important causes in this respect (Fathallah, 2010; Frank et al., 2004; Kirkhorn et al., 2010).

Agriculture plays an important role in Iran's economy. A considerable proportion of Iranian workforce, particularly in rural areas, are farmers, tillers, and planters. Unfortunately, in most cases, agricultural activities are still carried out in its own traditional ways using a variety of basic tools, resulting in a high prevalence of occupational injuries (Amad, 2012; Dianat et al., 2020). Shovel, sickle, and farming claw are some hand tools extensively used in agricultural activities (Chang et al., 1999). The use of these tools increase the risk of occupational injuries among agricultural

workers because most of them have been designed and manufactured with the least attention to the human factor issues (Abdalla et al., 2017).

Shovel is an important agricultural basic tool used for various purposes such as preparing the ground, removing weeds, and harvesting (Bhardwaj et al., 2004). The handle of shovels is commonly rough and very damaging to the hands and hand skin. Therefore, agricultural workers use protective gloves to avoid hand injuries. Although protecting hands and fingers against a wide range of mechanical (cuttings, punctures, abrasions, and so on), chemical (hazardous materials), and physical hazards (extreme temperatures), protective gloves are known to downgrade hand performance and discomfort (Dianat et al., 2012a; Sorock et al., 2004).

There are several types of protective gloves used by agricultural workers. However, no study has investigated these gloves in terms of their effects on hand performance and perceived comfort. Therefore, the present study was conducted to assess the effects of these gloves on hand performance and perceived comfort.

Material and methods

Participants

Ten gardeners with at least two years of experience were participated in this study. All participants were right-handed and without any pain and discomfort in their musculoskeletal systems. The participation in this study was totally voluntary and they were free to leave the study at any stage. All participants read and signed an informed consent form before the study.

Protective gloves

Two types of protective gloves commonly used by gardeners were investigated. Presented in Table 1 are the characteristics of these gloves. The first type of gloves, Glove A, is made of cotton with a coating of latex and the second type of gloves, Glove B, is made of cotton. Both types of gloves have general applications in agriculture, construction, and warehouse activities.

Table 1, the characteristics of gloves investigated in this study

Gloves	Application	Main Materials	Thickness at Palm (mm)
Glove A	Public works (Construction, warehouse work, Agriculture, mechanic work, moving, landscaping)	Latex-coated glove	1.3
Glove B	Public works (Agriculture, Construction, Manual Handling)	cotton	1.1

Figure 1: gloves invetigated in this study

Study protocol

Participants were asked to plow the ground for 30 minutes. Each participant performed this activity three times: (1) with the bare hands, (2) with Glove A, (3) with Glove B. The order of experiments were random to minimize the learning effect. A 30-min rest time was given to the participants between two successive experiments.

Discomfort/Comfort assessment

After completing each experiment, a hand and fingers map (Figure 2) was given to the participants to express the level of pain and discomfort that they perceived during shoveling in each area. A 6-point Likert scale, ranging from 0=no pain and discomfort to 6=very high pain and discomfort, was used to express the level of perceived pain and discomfort. For assessing the overall perceived comfort experienced with each type of gloves, a nine-point comfort scale ranging from 1=extremely discomfort to 9=extremely comfort was a=applied at the end of each experiment.

Figure 2: The hand and fingers map used in this study

Performance assessment

The surface area shoveled by each participant was regarded as an indicator of performance. It should be noted that the ground shoveled by the participants was the same in terms of physical characteristics.

Statistical analyses

Descriptive statistics was used to describe the data. Repeated measures ANOVA test was applied to investigate the differences among three experiments in terms of shoveling performance.

Results

The level perceived discomfort in various areas of the hand and fingers are presented in Figure 3. It can be seen from this figure that area P was the one with the highest level of perceived discomfort, followed by TP, MM, and IM. Areas SD, SM, RD, ID, and TD were the ones with the lowest level of perceived discomfort. In all areas, the lowest level of discomfort was perceived when the participants used the cotton glove (Glove B). Interestingly, the level of perceived discomfort with the latex coated glove (Glove A) was higher than that of bare hands. This may be because the fact that the latex coating reduce the friction between the hand and handle of shovel, requiring the gardeners to exert extra force to grasp and control the shovel.

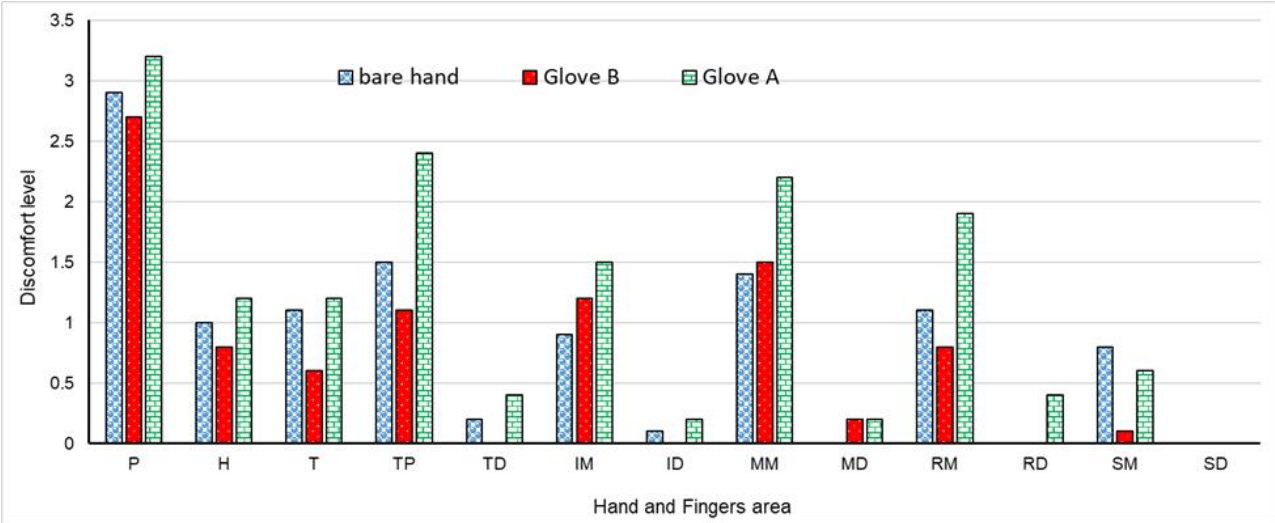

Figure 3: the level of discomfort perceived in various regions of the hands and fingers

The performance of participants while wearing various types of gloves is demonstrated in Figure 4. The average area plowed by participants with bare hands, the cotton glove (Glove B), and latex-coated glove (Glove A) were 1266cm^2 (±112.7), 1230cm^2 (±80.4), and 1186cm^2 (±138.6), respectively. Therefore, wearing any type of safety gloves can negatively affect the performance of gardeners. The results of repeated measures ANOVA analysis revealed that there was a significant difference among the bare hand, Glove A, and Glove B in terms of shoveling performance. The Bonferroni Post Hoc test revealed that there was no significant difference between the bare hand and Glove B (p=0.191), similarly the difference between the bare hand and Glove A was also no significant (p=0.071). Likewise, no significant difference was observed between Glove A and Glove B in this respect (p=0.920). Therefore, it can be inferred that wearing protective gloves could reduce shoveling performance but this reduction is not significant.

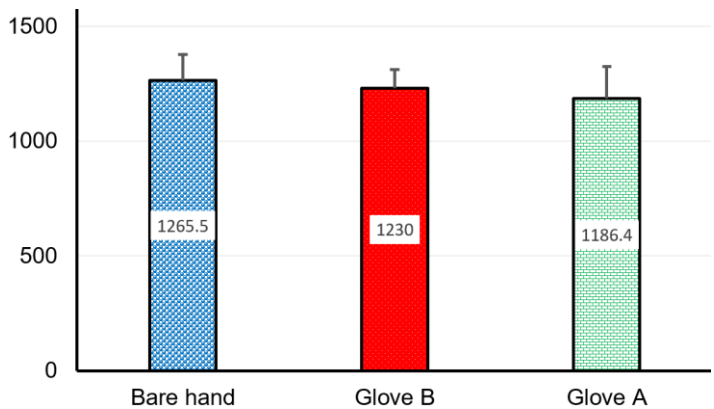

Figure 4: the shoveled area (cm^2) by participants while wearing various types of protective gloves

Discussion

In this study, the effects of two types of gloves used in agriculture activities on comfort and performance were investigated. The results revealed that wearing both cotton gloves (Glove B) or latex-coated gloves (Glove A) could reduce the level of perceived discomfort in various areas of

hands and fingers. Reducing the contact stress imposed by the shovel handle on the hand and fingers skin may be the most important reason why wearing any type of gloves could reduce the level of perceived discomfort. The reduction in the level of perceived discomfort was higher for the cotton gloves. This part of study was in line with the study carried out by Dianat et al. (2012b) in which it was demonstrated that wearing cotton gloves causes less discomfort than wearing nitrile and nylon gloves in a screw driving task. A reason for this observation can be the flow of air which is much easier in cotton gloves than gloves with a polymeric coating. The air flowing on the skin removes sweat and prevent sweat accumulation.

Moreover, areas M and TP were the regions with the highest level of perceived discomfort, this finding is also in line with (Dianat et al., 2010). These areas seem to be more subjected to contact stress than other areas. Therefore, it can be inferred that these areas need more attention in designing and manufacturing protective gloves. For example, they can be made with double or a thicker layer.

In this study, we found no significant difference among the performances of partcipants while wearing various types of gloves. A study carried out to assess the effect wearing gloves on muscles activity demonstrated no significant difference between the bare hands and hands with cotton gloves (Dianat et al., 2012b). Accordingly, wearing cotton gloves or cotton gloves with a latex coating has no effect on muscle activity and thereby fatigue, so it would be unlikely for performance to be altered.

Conclusion

Safety gloves used by gardeners were different in terms of the perceived discomfort and performance. The cotton gloves could reduce the perceived discomfort, while the Latex-coated glove did not have such an effect. According to the hand and fingers map, the perceived discomfort is not at the same level in all areas. In the other words, a few parts of the hand and fingers are under pressure when a shovel is used. Accordingly, these areas can be made using thicker materials while other parts can be made of thinner materials.

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