

Ergonomics in Beekeeping Activities

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Abstract: Most of the academic research that has been done on beekeeping focuses on bee health, ways to protect bees from diseases, and how to get more yield. However, there are also ergonomic risks during beekeeping activities that affect the health of beekeepers and indirectly affect productivity. In this study, ergonomic risks that threaten the health of beekeepers were investigated. The most important ergonomic risks for beekeepers are those that threaten the health of the musculoskeletal system. These risks arise from working with improper body posture for long periods, manual handling/lifting, and the use of non-ergonomic hand tools. Measures and solutions that can be applied to protect the health of beekeepers against ergonomic risks and to increase working efficiency are presented.

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Anahtar Kelimeler

Arıcılık,
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Kas-iskelet
sistemi sağlığı

Öz: Arıcılık üzerine yapılan akademik araştırmaların çoğu arı sağlığı, arıları hastalıklardan koruma yolları ve nasıl daha fazla verim alınabileceği üzerine odaklanmaktadır. Bununla birlikte, arıcılık faaliyetleri sırasında arıcıların sağlığını etkileyen ve dolaylı olarak verimi etkileyen ergonomik riskler de vardır. Bu çalışmada, arıcıların sağlığını tehdit eden ergonomik riskler araştırılmıştır. Arıcılar için en önemli ergonomik riskler kas-iskelet sistemi sağlığını tehdit eden risklerdir. Bu riskler, uzun süreler boyunca uygun olmayan vücut duruşu ile çalışma, elle taşıma/kaldırma ve ergonomik olmayan el aletlerinin kullanımından kaynaklanmaktadır. Ergonomik risklere karşı arıcıların sağlığını korumak ve çalışma verimini artırmak için uygulanabilecek önlemler ve çözümler sunulmuştur.

1. INTRODUCTION

Beekeeping activities, which date back to 4500 BC [1], turned into a large-scale individual and commercial practice with the development of hives with removable frames in the 1800s [2]. The beekeeping industry and the extraction of honey have always been important for the global economy [3] and are also of great importance for the economy of our country [4]. In the last 10 years, there have been a total of 180 thousand beekeepers in Turkey, 140 thousand of which are stationary and 40 thousand are itinerant [4]. Although beekeeping is an important sector, it has not reached its real potential. The main reasons for this are lack of experience and knowledge, accommodation, marketing and bee diseases [5]. Solutions to these problems in the beekeeping sector are possible through technological and engineering

interventions and innovations [2]. However, there are also risk factors that threaten the health of beekeepers such as environmental factors, especially climatic conditions, psychological difficulties and mechanical hazards [6]. A limited number of studies have been conducted on what these risk factors that threaten the health of beekeepers are and how they can be prevented [2]. One of these health problems is musculoskeletal disorders. The most common health problems of beekeepers are pain in the back and lumbar regions [7].

Ergonomics is an interdisciplinary science aimed at adapting the work environment and conditions to the physiological and psychological capabilities of individuals, thereby reducing stress and fatigue in employees and enhancing productivity [4]. Effective application of ergonomics in the workplace significantly

contributes to the prevention of musculoskeletal disorders and occupational diseases among employees. Ergonomic studies include training on risky situations, body mechanics and exercise. In addition to preventing occupational accidents and occupational diseases, mental and physical protection of employees is among the goals of ergonomics [8].

In this study, the ergonomic risks that beekeepers are exposed to were investigated and the measures and solutions that can be applied to protect the health of beekeepers and increase their working efficiency against these risks were discussed.

2. METHOD

In the present study, ergonomic risk factors that beekeepers are exposed to during bee care and honey harvesting processes were determined in Bingöl. The most significant ergonomic risk factors are those that threaten musculoskeletal health. The methods used to assess exposures leading to musculoskeletal diseases are divided into three classes; personal survey methods, methods based on systematic observations and direct measurement methods [9]. In the study, ergonomic risk factors identified using methods based on systematic observations were photographed and recorded.

Ergonomic risk factors such as manual lifting and carrying, working in improper body postures, prolonged standing, and the use of hand tools were identified. Suggestions for eliminating or mitigating these risk factors through regulations and techniques that do not endanger the musculoskeletal system are presented.

3. RESULTS AND DISCUSSION

The most common health problems among beekeepers are low back and back pain. These health problems are caused by the fact that the hives that beekeepers often have to carry have a weight of about 30-40 kg and beekeepers work in the wrong body posture for a long time [7]. Figure 1 shows pictures of manual lifting and carrying in beekeeping activities. When Figure 1 is examined, it is seen that the beekeeper grasps the load by leaning his body forward to lift a hive on the ground. During this type of lifting, the load is lifted using the lumbar and back muscles, which causes a great deal of force to be applied to the intervertebral discs. The weight of the hives usually ranges between 30-40 kg. It has been reported that if a load of 40 kg is lifted from the floor by bending the torso forward, a load of 450 kg can act on the discs between the vertebrae [10]. Such large loads acting on the disc structures between the vertebrae can cause serious damage to the spine. One of these damages is injuries such as hernias, which occur as a result of slipping of the discs between the vertebrae or ejection of the support fluid sacs in these discs. Industrial lifting principles have been developed to protect the health of the spine during the lifting of loads on the ground in industry. Leg muscles, which are biomechanically much more advantageous and stronger, should be used instead of anatomically weak lumbar muscles when lifting loads on the floor [10]. As

shown schematically in Figure 2, the principle should be to approach the load by bending the knees to keep the body as upright as possible and to perform the lifting process using the leg muscles. Beekeepers should be informed about this industrial lifting principle. Thus, it will be possible to prevent spinal disorders that may be caused by load lifting. Another measure that can be taken to prevent the torso from leaning forward during the lifting of the hives is the use of stands with a height suitable for the anthropometric characteristics of the beekeeper. What is meant by the appropriate height here is that the handles of the hive should be raised to a level between the beekeeper's fingertips and waist. In this way, the beekeeper will be able to grasp the hive by keeping his body upright and will be relieved of large loads that may affect the cartilage discs between the vertebrae during lifting from the ground.



Figure 1. Wrong lifting procedures that threaten spinal health

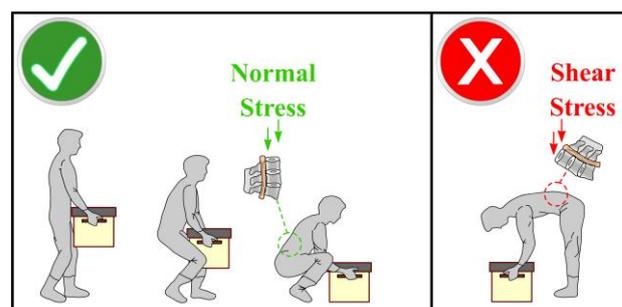


Figure 2. Industrial load lifting principle

Figure 3 depicts images related to the transportation of heavy loads in beekeeping work. Carrying or supporting heavy loads under inappropriate ergonomic conditions increases the risk of injury [11]. Two different groups of injuries can occur in handling operations using the hands. The first group includes cuts, bruises, and fractures resulting from accidents, while the second group comprises musculoskeletal injuries [12]. Musculoskeletal injuries can affect muscles, tendons, ligaments, joints, nerves, blood vessels or related soft tissues as a result of incorrect body posture, repetitive movements and vigorous exertion [13]. These injuries often lead to decreased work performance among employees, consequently reducing the quality and efficiency of their work. Most beekeepers complain of fatigue, back pain, upper body and neck pain, hand or arm pain due to manual material handling [7]. In addition, muscle fatigue and pain in the shoulders may occur as a result of weight bearing and increased duration of this carrying [14]. Local muscle fatigue is a result of increased intramuscular pressure and decreased blood flow in the muscles of the upper extremities as the arm is lifted. Restriction of muscle blood flow impairs muscle metabolism and increases metabolite accumulation, thus causing muscle fatigue [15].



Figure 3. Transportation of heavy loads in beekeeping

Lifting, holding, and carrying heavy loads can quickly lead to fatigue, strain, and health problems [10]. It is of paramount importance for beekeepers to adhere to the following recommendations while lifting and carrying loads, such as hives, to prevent musculoskeletal disorders.

- To prevent the torso from bending forward when lifting the hives, the position of the hive handles should be between the fingertips and waist level.
- Lifting the hives with mechanical lifts to waist height will reduce the risk of spinal or muscle damage.
- It is important that the handles that enable the gripping of the hives or loads have the appropriate geometry and dimensions. The geometry and dimensions of the handles are among the factors that determine the limit values in load lifting. The small size of the handles reduces the grip and the force that can be applied, making transportation difficult on the one hand, and on the other hand, it can cause accidents and injuries as a result of slipping. In addition, the handles should not have sharp corners [10].
- A hive or load being transported should be kept as close to the body as possible.
- If possible, it is easier and safer to transport hives or loads by mechanical means such as wheelbarrows.
- Transportation should not be performed on rough or uneven ground [15]. During transportation on uneven or uneven ground, it may be necessary to apply momentarily very large forces that can cause injuries to muscles and tendons in order to maintain balance. In order to prevent this, a place with a smooth ground should be selected as much as possible or corrections should be made on the ground.

Figure 4 shows images related to working in the wrong body posture. During the bee care and honey harvesting processes related to beekeeping, it is necessary to work for a long time in inappropriate wrong body postures as shown in the figure. The opposite of the wrong body posture is referred to as neutral posture. The term neutral posture is used for the torso as well as for different joints. For the torso, neutral posture is the posture in which the natural curvature of the spine is maintained during sitting or standing, and the body is aligned and balanced [10]. Incorrect body posture is a major problem that affects the balance and proper alignment of the body. Incorrect body posture leads to unbalanced use of muscle groups, resulting in pain, strain and muscle strains. In addition, long-term incorrect body posture can lead to serious health problems such as chronic back pain, neck problems and spinal curvature. Beekeepers' frequent movements such as squatting, bending, twisting, reaching, and working on the knees can cause posture disorders [7]. Especially during bee care and honey harvesting, arrangements must be made to ensure the maintenance of neutral body posture by preventing repetitive and prolonged movements that cause incorrect body postures such as squatting, bending, reaching and turning with waist and shoulder bending. One of these arrangements is to raise the hives to a height suitable for the anthropometric measures of the beekeeper. This can be achieved by using hive stands. Aiyeloja et al [3] conducted a study on the ergonomics of hive stands height and hive type in honey harvesting. In this study, it was

reported that hives usually have a height of 30 cm and for human height of 150-180 cm, placing stands with a height of 70 cm under the hives moderately improves ergonomic conditions. For the best working conditions, it was recommended to place stands with a height of 80-84 cm under the hives [3]. To avoid incorrect body postures, the body should be in neutral posture, facing and close to the work being done. It is also important for the health of the spine that rotational movements are made on the feet, not on the waist and shoulders. In order to avoid turning and bending movements in the back area, the employee should be careful not to go beyond the reach of their arms.

Beekeepers have to working in a standing posture for long periods of time during bee care and honey harvesting processes, which can adversely affect musculoskeletal health. Prolonged standing without adequate rest breaks may lead to joint disorders, back pain, swelling in the feet and legs and muscle fatigue, as well as heart and circulatory disorders [16]. Working in a sitting posture is not an alternative to working in a standing posture. It is useful to sit, walk and do stretching exercises intermittently to prevent the adverse effects of prolonged standing [7].



Figure 4. Working in the wrong body posture during bee care

Beekeeping is an occupational group in which hand and wrist areas are used intensively. During bee care and honey harvesting, repetitive movements are performed using some hand tools. Examples of these repetitive movements include the use of bee smoker and hive tool as shown in Figure 5. The uncapping fork, wire embedder

and bee brush are also frequently used hand tools in beekeeping. Continuous and repetitive hand movements can lead to carpal tunnel syndrome over time. Carpal tunnel syndrome causes numbness, tingling and pain in the hand as a result of compression of the nerves on the inside of the wrist [17]. Measures such as maintaining a neutral wrist posture during beekeeping activities and taking periodic rest breaks are important to reduce the risk of beekeepers encountering such health problems.



Figure 5. Wrist working in a non-neutral position during the use of hand tools.

4. CONCLUSIONS

In this study, ergonomic risks to which beekeepers are exposed were investigated. Measures that can be taken to protect the health of beekeepers against the identified risks and suggestions for improving working conditions in ergonomic terms are presented. Musculoskeletal system diseases are the leading ergonomic risks for beekeepers. To prevent these risks, the following recommendations should be taken into consideration:

- It is of great importance to comply with the industrial load lifting principle in manual lifting operations and to raise awareness of beekeepers in this regard.
- Manual handling of heavy loads should be avoided, and mechanical means should be used for such loads.
- Neutral body posture should be maintained during bee care and honey harvesting operations by placing stands under the hives. In order to maintain a neutral body posture, it is also important that the body is facing and close to the work being done. Bending, turning or over-reaching movements should be avoided, especially using the waist and shoulders.
- If prolonged standing work is necessary, intermittent sitting, walking or stretching exercises should be performed.
- The neutral position of the joints must be maintained during the use of hand tools.

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