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## Evaluation of Working Postures of Emergency Health Services Workers by REBA and RULA Method

### Acil Sağlık Hizmetleri Çalışanlarının Çalışma Duruşlarının REBA ve RULA Yöntemiyle Değerlendirilmesi

#### ABSTRACT

Following the industrial revolution there has been an increasing emphasis on occupational health and safety. Over the years, numerous regulations and laws have been enacted to ensure the health and safety of employees across all sectors. In our country, the Occupational Health and Safety (OHS) Law, implemented in 2012, clearly outlines the responsibilities of the state, employers, and employees across all sectors. The primary aim of the OHS Law is to reduce the incidence of occupational accidents and diseases. Diseases that arise due to the nature of a person's job and negatively impact their health are termed as occupational diseases. By identifying the causes of these diseases and taking necessary precautions, they can be effectively prevented. One prevalent occupational disease in our country is musculoskeletal (MSK) diseases. These diseases often result from poor posture, repetitive movements, and strains during work hours, particularly in occupations requiring physical labor. In our country, musculoskeletal complaints and MSI diseases are frequently observed among HÖASH workers. This is largely due to the rapid movements HÖASH workers must make during emergencies, improper patient handling techniques, and the physical strains in inadequate work environments. Treating these diseases can be lengthy, and full recovery rates are often low. Consequently, employees returning to work after treatment may struggle to perform their previous duties. Treating employees with MSI diseases not only results in lost working days but also incurs costs related to insurance compensation. Given the economic losses and health deterioration associated with MSI diseases, prevention should be prioritized over treatment. In this study, ergonomic risk analyses using REBA and RULA were conducted on ATTs, paramedics, and drivers employed in ASH, focusing on 7 different posture positions during patient interventions. The objective was to proactively address the posture positions posing a risk for MSI diseases. The analysis revealed that two posture positions were of low risk, one was of medium risk, one was of very high risk, and three were categorized as high risk. Recommendations were provided to mitigate the identified high-risk levels.

**Keywords:** Occupational health, ergonomics, health services, occupational disease, REBA, RULA.

#### ÖZET

Sanayi Devrimi'nden sonra iş sağlığı ve güvenliğine verilen önem giderek artmaktadır. Yıllarca her sektörde çalışanların sağlığı ve güvenliği için birçok düzenlemeler ve yasalar yürürlüğe girmiştir. Ülkemizde de son olarak 2012 yılında yürürlüğe giren İş Sağlığı ve Güvenliği (İSG) Kanun'unda her sektörü kapsayacak şekilde devlet, işveren ve çalışanın sorumlulukları açıkça yer almaktadır. İSG Kanun'un temel amacı yaşanabilecek iş kazası ve meslek hastalığı sayısını en aza indirmektir. Çalışanlarda yapılan işin niteliğine bağlı oluşan ve çalışan sağlığını olumsuz yönde etkileyen hastalıklara meslek hastalığı denir. Meslek hastalıklarına neden olan etkenler belirlenip bunlara karşı gerekli önlemler alındığı takdirde meslek hastalığı tamamen önlenebilmektedir. Ülkemizde en sık rastlanan meslek hastalıklarından biri de mesleki kas iskelet (MKİ) hastalıklarıdır. MKİ hastalıkları çalışanların çalışma saatlerindeki duruş pozisyonları, tekrarlayan hareket ve zorlamalar sonucu ortaya çıkmaktadır. Bedenen çalışmanın fazla olduğu iş kollarında MKİ hastalıkları da sık görülmektedir. Bu yüzden ülkemizde tehlikeli iş kolunda yer alan HÖASH çalışanlarının acil durum veya acil vakalar karşısında hızlı hareket etmeleri, uygun olmayan hareket pozisyonlarında hasta taşımaları ve uygun olmayan ortamlarda zorlayıcı hareket etmeleri sonucunda HÖASH çalışanlarında kas iskelet şikayetleri ve MKİ hastalıkları sıkça görülmektedir. Bu hastalıkların tedavisi çok uzun zaman sürebilmektedir. Tedavi sonrası tam iyileşme oranları da oldukça düşüktür. Bu yüzden tedavi sonrası işine geri dönen çalışanların büyük bir kısmı eski görevlerini yerine getirirken zorluk çekebilmektedir. MKİ hastalıklarında çalışanların işten uzaklaşarak tedavi olması hem iş günü kayıpları ve hem de sigorta tazminatlarına bağlı maliyetleri de ortaya çıkarmaktadır. Sağlığın bozulması yanında ekonomik kayıplarda göz önüne alındığında MKİ hastalıklarının tedavi etmekten çok önlemek için çalışmalar yapılmalıdır. Bu çalışmada da ASH görev yapan ATT, paramedik ve sürücülerin hastaya müdahale esansındaki 7 duruş pozisyonlarına bağlı REBA ve RULA ergonomik risk analizi yapıldı. Bu analizler ile oluşabilecek MKİ hastalıklarına neden olan risk duruş pozisyonları için önceden önlemler almak amaçlanmıştır. Analiz sonucunda iki duruş pozisyonunun düşük risk, bir duruş pozisyonunun orta risk, bir duruş pozisyonunun çok yüksek risk ve üç duruş pozisyonunun yüksek risk kategorisinde olduğu belirlenmiştir. Belirlenen yüksek risk seviyelerini azaltmak için alınması gereken önlemlerle ilgili önerilerde bulunmuştur.

**Anahtar Kelimeler:** İş sağlığı, ergonomi, sağlık hizmetleri, meslek hastalığı, REBA, RULA

## 1. INTRODUCTION

Pre-hospital health personnel are the first team to provide medical assistance before the hospital in cases of accidents or diseases requiring urgent intervention (Aşkın & Dinç, 2017; Salar, 2023). In our country, emergency health service (EHS) is provided by ambulance vehicles that are transferred to the relevant region by calling the command-and-control center with the telephone number “112”. Ambulances are equipped with the necessary equipment to provide medical intervention to the patient or injured individual until they are delivered to the hospital (Aşkın & Dinç, 2017).

In Turkey, business lines are divided into three classes (highly dangerous, dangerous, and less dangerous) in terms of hazard. Emergency health services are classified as "hazardous." NIOSH (National Institute for Occupational Safety and Health) has classified the risks in hospitals into five groups: physical, chemical, biological, ergonomic, and psychological. In addition to these risks, emergency healthcare workers face new risks (Arsal Yıldırım & Gerdan, 2017). The primary reason for the ergonomic risks that emergency healthcare services workers are exposed to is the lifting of patients without the necessary preparation and without complying with the appropriate technique. Lack of physical conditioning, stress, and other factors contribute to a second set of ergonomic risks. These risks may result in temporary or permanent disabilities (Arsal Yıldırım & Gerdan, 2017; Salar, 2022). Long and uninterrupted working hours in which healthcare services are provided, coupled with physical movement such as patient care and transportation, have been identified as a significant risk factor for musculoskeletal disorders among healthcare workers (Salar, 2022).

The primary objective of PHEASH (Pre-hospital Emergency Health Services), which serves as the foundation for the development of contemporary health services, is to reduce the incidence of morbidity and mortality resulting from traumatic, chronic, and acute health issues (Şimşek et al., 2019). While the daily working conditions of those who work in this role are already challenging, this situation is further exacerbated in the context of disasters and emergencies (Çakal & Özdemir, 2016; Arsal Yıldırım & Gerdan, 2017). The fact that most working hours are spent outside makes PHEASH workers more disadvantaged than other health workers (Aşkın & Dinç, 2017; Çakal & Özdemir, 2016; Arsal Yıldırım & Gerdan, 2017). The necessity to act quickly in initiating the first intervention in emergency situations, physical factors arising from environmental conditions and stressful environments, and the aforementioned factors further negatively affect the health of PHEASH (Aşkın & Dinç, 2017; Çakal & Özdemir, 2016). Studies in the field show that PHEASH workers have more health problems than other health workers (Çakal & Özdemir, 2016). While PHEASH, which is defined as stressful work abroad, is classified in the “high-risk” occupational group, in our country, ambulance transportation is included in the hazardous occupational group in the class group of other jobs related to human health (Arsal Yıldırım & Gerdan, 2017; Salar, 2022).

The combination of heavy working conditions, poor work habits, and incorrect posture positions can lead to a few occupational health problems. One of the occupational health problems is musculoskeletal disorders (MSDs) (Tükkan, 2009; Keçeci & Yıldız, 2020a; Gök Geçer, 2021; Keçeci & Yıldız, 2020b; Oğuzöncül & Kurt, 2020). Work-related musculoskeletal diseases are defined as damage to soft tissues, including muscles, nerves, tendons, and spinal discs, resulting from repetitive movements (Soylu & Altındış, 2018; Medeni & Medeni, 2021; Özcan et al., 2011). MSD diseases are disorders that affect the waist, back, shoulders, upper and lower extremities of the worker with long-term exposure. In general, the symptoms of these diseases include persistent pain, tingling, numbness, and limitations in movement, dexterity, and function (Keçeci and Yıldız, 2020; Oğuzöncül and Kurt, 2020; Medeni and Medeni, 2021; Özcan et al., 2011; Atasoy et al., 2010).

A study has revealed that musculoskeletal pain among healthcare workers is significantly influenced by inappropriate working conditions and inadequate rest periods throughout the day. These conditions tend to affect the load-bearing parts of the body, and the pain often persists after working hours (Atasoy et al., 2010). Given the difficulty in treating and healing musculoskeletal diseases due to their nature, the possibility of disability is high. Even if individuals with such disorders are treated, they may have trouble performing their duties upon their return to work and may even lose their jobs (Koltan, 2009). In Turkey, it is notable that occupational musculoskeletal diseases are not diagnosed as such, even though MSDs are more prevalent among occupational diseases (Keçeci & Yıldız, 2020; Keçeci & Yıldız, 2020b; Medeni & Medeni, 2021).

Risk assessment is of great importance in the evaluation, management, and prevention of risk factors that cause musculoskeletal injuries (MSI). In particular, a method consisting of three stages has been developed to measure exposure to postural loads. These stages are: employee information, observation-based method, and direct measurements. The observation technique is the most widely used in the industrial field. The four primary reasons for this are that there is no intervention in the applied work processes, there is no need for expensive questionnaires to measure angular deviations in the body, it is applicable and reproducible by the user, and it has higher subjective characteristics than self-reports (Kee, 2020; Kee, 2022). There are several standardized analyses, including NIOSH, RULA, OWAS, REBA, and WISHA, which focus on different parts of the body in ergonomic risk assessment (Kee, 2022; Kavus et al., 2023). Among these, RULA, REBA, and OWAS are the most widely used (Kee, 2022; Jara et al., 2022).

Emergency healthcare workers may experience musculoskeletal system strains during reaching the patient, intervening with the patient at the scene, and delivering the patient to the health institution. The number of studies in which posture position analyses have been conducted to determine these strains for healthcare workers is limited. Therefore, the aim of this study was to analyze the posture positions of healthcare workers providing emergency health services during their daily work and to categorize the results quantitatively.

## 2. MATERIALS and METHODS

The objective of this study was to identify the physical problems that may arise due to the postures assumed by emergency health service personnel, including ambulance attendants ATT (Emergency Medical Technicians), paramedics, and drivers, in the Çorum province. A sample of ambulance staff (four ATT, one paramedic, and one driver) fulfilling similar duties and responsibilities in Çorum province was selected. The tasks performed by the sample group were monitored for one week, and different observed basic postures were determined without intervention. The REBA and RULA analyses were conducted in accordance with the observed postures of the employees. The REBA method is employed to identify posture-related risks in a standing position, while the RULA method is utilized to identify posture-related risks in a seated position.

REBA analysis is employed to assess the posture of workers engaged in various tasks across a range of service industries, with a particular focus on healthcare (Kee, 2020; Ayvaz et al., 2023). The posture of the upper and lower arms, wrists, trunk, neck, and legs is evaluated through REBA analysis. Consequently, it reveals the effect of external loads and forces, muscle activities caused by static, dynamic, suddenly changing, or unstable situations, and the coupling effect (Kee, 2020). The angle degrees are graded according to the vertical axis. In REBA analysis, the body is divided into two sections: A (torso, neck, legs) and B (upper arm, lower arm, legs, and wrists). Once the scores for groups A and B have been calculated, the load/strength score is added. The scores obtained from groups A and B are then summed to form a C score, after which the REBA score is calculated by adding the activity score to this score (Kee, 2020; Kavus et al., 2023). RULA has been proposed for the rapid assessment of the load acting on the musculoskeletal system, considering the posture positions of the neck, trunk, upper limbs, muscle function, and external loads (Kee, 2020; Kee, 2022; Joshi and Deshpande, 2021; Ayvaz et al., 2023). The assessments are divided into two sections, A and B. In section A, scores are assigned based on the position of the arm and wrist, while in section B, scores are assigned based on the position of the neck and trunk. The scores from each section are then summed to obtain a single score (Kee, 2020; Joshi and Deshpande, 2021).

The risk categories and precautions based on the REBA and RULA scores obtained are presented in Table 1. The REBA ergonomic risk analysis was employed for outpatient drug or material preparation, venipuncture, and stretcher transportation of the patient in a lying and sitting position (six different posture positions). The RULA method was utilized for ergonomic risk analysis related to posture position (sitting position) during ambulance transportation to the patient. The Angle Meter software was employed to estimate the body position angles in the REBA and RULA methods.

**Table 1** REBA and RULA Scoring Results

Category	RULA score	Conclusion	Category	REBA score	Risk	Precaution
1	1-2	Acceptable	0	1	Negligible	Not required
2	3-4	Further review is required to determine whether any changes are necessary.	1	2-3	Low	May be required
3	5-6	A review is necessary to identify the necessary changes, which must be implemented without delay.	2	4-7	Center	Mandatory
4	6+	It is imperative that a review be conducted and that immediate changes be implemented.	3	8-10	High	Required soon
			4	11-15	Very high	Urgently needed

\* (Akar & Canbaz, 2020)

### 3. FINDINGS

The daily work of emergency health services workers was observed, and the seven posture positions (Figure 1-7) that they repeated the most during the day were identified and photographed. A risk analysis was then performed on these photographs using the REBA and RULA methods, with the posture positions' scores determined.

**Table 2** Posture Positions of Workers**Figure 1.** Material Preparation**Figure 2.** Opening an intravenous line**Figure 3.** Patient transportation 1**Figure 4.** Patient transportation 2**Figure 5.** Patient transportation 3**Figure 5.** Patient transportation 4**Figure 7.** Going to pick up patients

A risk analysis was conducted on the seven posture positions that employees working in ambulances repeated the most during a week. Among these posture positions, a REBA risk analysis was performed on six manual posture positions, while a RULA risk analysis was performed on one posture position. The scores obtained are presented in Table 3 and Table 4.

**Table 3** REBA score

Figure	Neck	Trunk	Leg	Strength load	REBA A	Upper arm	Lower arm	Wrist	REBA B	Activity Score	Total
Figure 1. Material Preparation	1	3	1	0	2	2	2	1	2	0	2
Figure 2 illustrates the process of establishing an intravenous line.	2	3	1	0	4	2	2	2	3	+1	5
Figure 3. Patient transportation 1	2	3	3	3	9	1	1	2	2	+2	11
Figure 4. Patient transportation 2	2	4	2	+2	8	2	1	2	2	+1	9
Figure 5. Patient transportation 3	2	4	2	+2	7	1	1	1	1	+1	8
Figure 6. Patient transportation 4	2	3	2	+2	7	1	2	1	1	+1	8

**Table 4** RULA score

	Upper arm	Lower arm	Wrist	Load/force Muscle utilization	RULA C	Trunk	Neck	Leg	Load/force Muscle utilization	RULA D	Total
Figure 7. Picking up a patient	1	1	1	0	1	1	1	1	0	1	1

Upon analysis of the REBA scores, it was determined that the material preparation position was "negligible," while the intravenous line opening position was identified as being at a medium risk level. The patient transport 2, patient transport 3, and patient transport 4 positions were found to be in the "high risk" group, while the patient transport 1 position was classified as being in the "very high risk" group. The RULA score was determined to be within the "acceptable" risk level for the position of going to patient transportation.

#### 4. CONCLUSION & DISCUSSION

A paucity of studies exists wherein musculoskeletal strains in the musculoskeletal system due to the posture positions of emergency healthcare workers have been determined. This study sought to identify potential occupational musculoskeletal disorders that may arise due to the continuous work of an emergency medical team operating in Çorum province during the day. The REBA and RULA risk analyses revealed that the posture positions associated with preparing medication for patients and transporting them in ambulances posed negligible and low risk levels, respectively. These posture positions did not appear to exert any significant physical strain on the workers, suggesting that they would not cause any harm to the musculoskeletal system. The absence of musculoskeletal damage in these workers indicated that they were unlikely to develop occupational musculoskeletal diseases. If the requisite precautions are not implemented expeditiously in the context of medium-risk posture positions, the repetitive movements undertaken over time may ultimately give rise to occupational musculoskeletal diseases among employees.

During the transportation of the patient on the stretcher, 4 different posture positions of the workers were evaluated. One of them was evaluated as very high risk and the other 3 posture positions were evaluated as high risk. It is thought that high and very high-risk positions are caused by the uncontrolled strain of all muscles and the presence of load/force effect during patient transportation. Measures need to be taken urgently for these posture positions. Otherwise, it is inevitable to see occupational musculoskeletal disease in employees after a very short time. The recommendations for what need to be done for this are as follows;

- A reduction in the number of working hours will result in a decrease in the number of repetitive positions.
- Resting during periods of lifting loads, and the efficient use of rest periods.
- Performing tasks that are challenging to accomplish independently with the assistance of at least two individuals.
- The design of new techniques or equipment for the transportation of patients on stretchers within the constraints of engineering principles.
- In occupational health and safety (OHS) training, it is crucial to provide detailed visual inventories of the specific situations that employees should pay close attention to, particularly in load lifting positions.

A few studies have been conducted with the objective of determining the posture positions that cause musculoskeletal problems in different health sector employees. Ratushnyi and Stakhaska (2024) evaluated the posture positions of dentists working in a dental polyclinic using REBA and RULA analyses. The results of this study demonstrated that the handedness of dentists and the positions of their patients are significant factors in the ergonomic risks faced by dentists. In 2021, Gök Çınar employed the REBA

method to assess the ergonomic risk of repeated postures performed by personnel in a laboratory setting. The obtained scores indicated that the evaluated employee postures were generally at a medium risk level. Kahya et al. (2018) conducted a REBA analysis of 11 posture positions of neurology intensive care nurses, yielding scores that ranged from 2 to 10. It was recommended that high-risk posture positions be avoided. Atasoy et al. (2010) conducted an ergonomic risk assessment of 77 jobs performed by laboratory workers using the REBA method. The results of the study indicated that 5.8% of the employees were at very high risk, 17.6% at high risk, 52.9% at medium risk, and 23.5% at low risk. Kahya and Sakarya (2020) conducted a REBA risk analysis of the posture positions of 112 emergency health service workers during patient treatment or care. Of the seven posture risk positions evaluated, one was determined to be of medium risk, four were identified as high risk, and two were classified as very risky. Özdemir and Örsal (2019) conducted an ergonomic risk analysis based on repetitive movements of intensive care nurses. The study, which utilized the REBA evaluation form, revealed that the average REBA score was between 7 and 10.4. Additionally, it was determined that 63.3% of the nurses worked in a high-risk posture position.

The posture positions of emergency health services workers were determined by the REBA and RULA methods, which identified those positions that may lead to occupational musculoskeletal diseases. The study also expressed the precautions to be taken for this. This study will be important in terms of preventing occupational musculoskeletal diseases that healthcare workers may face with a proactive method.

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