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ORIGINAL ARTICLE

Inter and intra observer reliability of the Ovako working posture analysis system: working posture analysis in senior physiotherapy and rehabilitation students

Ovako çalışma postürü analiz sisteminin gözlemciler arası ve içi güvenirliği: son sınıf fizyoterapi ve rehabilitasyon öğrencilerinde çalışma postürü analizi

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Abstract

Purpose: This study was planned to investigate the inter/intra observer reliability of the Ovako Working Posture Analysis System (OWAS) and to evaluate the body postures of senior physiotherapy students during intervention with the OWAS method in terms of ergonomic risk.

Method: To evaluate the postures during the study, digital photographs of 60 students were taken from three different perspectives: front, back, and side. The photographs were manually scored by three physiotherapists using the OWAS method. In the first stage, the inter/intra-observer reliability of the OWAS method was examined, and in the second stage, ergonomic risk analysis was performed on the OWAS total score.

Results: The study included 49 female and 11 male physiotherapy and rehabilitation senior students with a mean age of 22.45±1.09 (21-26). Inter/intra observer reliability was found to be good (ICC_{Ir0}=0.815; ICC_{Ia0}=0.872; p<0.05). Twenty-nine students (48.3%) were classified as "No action required", twenty-five students (41.7%) as "Corrective actions required in the near future", two students (3.3%) as "Corrective actions required as soon as possible" and four students (6.7%) as "Corrective actions are required immediately".

Conclusion: In the study; the OWAS method was found to be inter/intra observer reliable. It was determined that more than half of physiotherapy and rehabilitation students were at risk of developing work-related musculoskeletal problems. It is predicted that work-related musculoskeletal problems in physiotherapists can be reduced by early detection of these risks.

Keywords: Ergonomics, Musculoskeletal pain, Physical therapy, Posture.

Öz

Amaç: *Bu çalışma, Ovako Çalışma Postürü Analiz Sistemi'nin (OWAS) gözlemciler arası/içi güvenilirliğini araştırmak ve son sınıf fizyoterapi ve rehabilitasyon öğrencilerinin müdahale sırasındaki vücut duruşlarını OWAS yöntemi ile ergonomik risk açısından değerlendirmek amacıyla planlandı.*

Yöntem: *Çalışma sırasında ki duruşlarını değerlendirmek için 60 öğrencinin dijital fotoğrafları önden, arkadan ve yandan olmak üzere üç farklı düzlemden çekildi. Fotoğraflar üç fizyoterapist tarafından OWAS yöntemi kullanılarak manuel olarak puanlandı. İlk aşamada OWAS yönteminin gözlemciler arası/içi güvenilirliği incelendi, ikinci aşamada ise OWAS toplam puanı üzerinden ergonomik risk analizi yapıldı.*

Bulgular: *Çalışmaya, yaş ortalaması 22,45±1,09 (21-26) olan 49 kız ve 11 erkek fizyoterapi ve rehabilitasyon son sınıf öğrencisi katıldı. Gözlemciler arası/içi güvenirlik iyi bulundu (ICC_{GA}=0,815; $ICC_{Gİ}$=0,872; p<0,05). Yirmi dokuz öğrenci (%48,3) "İyileştirme gerekli değil", yirmi beş öğrenci (%41,7) "Yakın gelecekte iyileştirme gerekli", iki öğrenci (%3,3) "İyileştirmeler mümkün olan en kısa sürede gerekli" ve dört öğrenci (%6,7) "İyileştirmeleri şimdi uygula" olarak sınıflandırıldı.*

Sonuç: *Çalışmada; OWAS yönteminin gözlemciler arası/içi geçerli olduğu bulundu. Fizyoterapi ve rehabilitasyon öğrencilerinin yarısından fazlasının işle ilgili kas-iskelet sistemi sorunları geliştirme riski altında olduğu belirlendi. Bu risklerin erken tespit edilmesi ile fizyoterapistlerde işle ilgili kas-iskelet sorunlarının azaltılabileceği öngörülmektedir.*

Anahtar kelimeler: *Ergonomi, Kas-iskelet ağrısı, Fizik tedavi, Postür.*

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INTRODUCTION

Musculoskeletal system problems are defined as injuries or muscle pain in support structures such as bones, muscles, and ligaments, which can negatively affect daily activities, and occur after a single event or trauma caused by repetitive movements.[1] Musculoskeletal system problems may occur in the form of tendinitis, neuropathy, and stress fracture, especially low back and neck pain.[2]

The incidence of musculoskeletal problems in healthcare workers is high. Factors such as working posture, working in the same position for a long time, a high number of patients per day, and difficulties related to the functional status of patients, especially being exposed to heavy physical loads and performing manual therapy, form the basis of musculoskeletal system problems in physiotherapists.[3]

Most musculoskeletal problems occur in physiotherapists in the first five years of the profession.[4] Musculoskeletal system problems in physiotherapy students result in an inability to engage in education, and problems with physiotherapists result in loss of productivity and early retirement, disruption of patient care, and economic loss of labor.[5] Physiotherapy and rehabilitation undergraduate education in Turkey is four years. In the last two semesters of their undergraduate education, students intervene with the patients in the company of supervisor physiotherapists. This period can also be defined as the time when students generally meet the patient for the first time (some students benefit from voluntary internship opportunities), experience the practices within the scope of the profession for the first time, and apply them. In addition to determining the methods to be applied to the patient during the interventions, the correct use of their body mechanics is of great importance for the prevention of musculoskeletal problems that may occur in the future.

In the literature, there are studies examining the musculoskeletal system problems of physiotherapists[6-8], and studies on the musculoskeletal system problems of students studying in the field of health.[9-11] Postures that interact with the patient are not included. Risk analysis was carried out in line with subjective information by using self-report questionnaires in the studies. One of the observational methods developed for the evaluation of working posture is the OWAS. OWAS is a preferred, valid, and reliable method for determining the risk of musculoskeletal diseases in areas such as the industrial sector, entertainment, healthcare, etc. due to its low cost, easy use, and the fact that it can be applied without interfering with the work of the person being evaluated. In the method, risk is calculated based on back, arm, and leg postures and postural loading.[12] Studies are using the OWAS method to analyze ergonomic risk in health workers and students in health fields such as dentistry and nursing.[8,13,14] Widyanti et al. demonstrated intra-observer reliability in engineering students in industrial workplaces[15] and Lins et al. demonstrated inter-observer reliability in physiotherapy students in laboratory settings.[16] In the study, the evaluation of physiotherapy students by physiotherapists offers a different perspective on the field of health. In industrial environments, while the person tries to adjust himself/herself according to the machine, the posture preferred by physiotherapy students during manual applications is unique to the person.

To the best of our knowledge, no observational study for senior physiotherapy and rehabilitation students has been undertaken in Turkey. This study aimed to investigate the inter/intra rater reliability of the OWAS and analyze the body positions of senior physiotherapy and rehabilitation students during intervention using the OWAS method from an ergonomic perspective.

METHODS

Study design

The study was designed as a prospective observational study. The study was conducted in two stages. In the first stage, inter/intra observer reliability was examined. All scoring was completed on the same day. Scoring of a single photograph took approximately 5-10 min. Three observers (OC, ANA, AD) scored the digital photographs with the OWAS method for inter-observer reliability. Before the evaluation, the evaluators evaluated and discussed different photographs that were not included in the study.

Three of the evaluators had previously applied the method in an undergraduate course. For intra-observer agreement, one of the observers (OC) rescored the photos 10 days later. In the second stage, the working postures of the senior physiotherapy and rehabilitation students were analyzed for ergonomic risk.

Participants

Senior physiotherapy and rehabilitation students who progressed to the Professional Practice course at Kütahya Health Sciences University, Physiotherapy and Rehabilitation Department in the 2022-2023 term participated in the study.

A link was sent to the senior representative of the Department of Physiotherapy and Rehabilitation at Kütahya Health Sciences University via Google Forms. This link contained detailed information about the purpose, importance, and objectives of the study. The representative was asked to share this link in the class WhatsApp group to ensure that all students had the opportunity to engage with the study and contribute if they were interested.

The inclusion criteria for the study were as follows: 1) senior students in the physiotherapy and rehabilitation department, 2) taking the clinical practice course for the first time, and 3) volunteer to participate in the study.

Students were excluded from the study if they met any of the following conditions: 1) healthcare workers, such as nurses or physiotherapy technicians, who were pursuing further training in physiotherapy and rehabilitation through graduate programs, as their professional experience could influence the study outcomes; 2) a chronic illness that causes pain and deformity, as this could impact their posture and confound the results; or 3) experienced a condition in the past six months that could lead to postural disorders, such as trauma or surgery since these factors could significantly affect their posture at the time of the study.

Data collection

Sociodemographic information of the volunteers such as age, gender, height, weight, and presence of chronic disease were recorded.

OWAS: It is a method developed to evaluate working posture and loading in many different work areas, including healthcare. OWAS identifies the most common postures in employees; back postures (4 postures), arms (3 postures), legs (7 postures), and weight of the load (3 categories). The score obtained from the combination of these categories determines the risk of working posture in terms of musculoskeletal problems; 1) No action required, 2) Corrective actions required in the near future", 3) Corrective actions required as soon as possible 4) Immediate corrective actions required.[17,18] A higher total score means a worse working posture. Using a digital camera, the students were photographed from different planes (anteriorly, posteriorly, and laterally) during the intervention. During the clinical practice, students were distributed to 5 different practice centers. Each center had different patient groups, mainly neurology and orthopedics. Each student was photographed with a single patient for whom he/she was responsible at that moment. Photographing was completed within 2 weeks. No verbal intervention was made to the students to change their postures.

There was no connection between the researchers and the students that could potentially induce grade-related anxiety or bias in the study. Specifically, two of the investigators were employed at different universities, while the third investigator did not hold the position of clinical practice course supervisor. This separation ensured that the students' evaluations and participation were not influenced by their academic relationships with the researchers.

Risk scoring was done on the photographs according to the OWAS method (Figure 1). Scoring was done manually on paper and the total score was digitized.[19] The OWAS total score was used to perform ergonomic risk analysis. The scoring system was detailed in Appendix.

Statistical analysis

The Statistical Package for the Social Sciences (SPSS) 23.0 (SPSS Inc., Chicago, IL, USA) was used to perform statistical analysis. Kolmogorov-Smirnov test was used to analyze whether the data had normal distribution ($p<0.05$). Descriptive statistics were performed.

Intraclass Correlation Coefficient (ICC) was used for determining the intra/interobserver reliability (≥ 0.90 as excellent, $0.80 \leq ICC < 0.90$ as good, $0.70 \leq ICC < 0.80$ as acceptable).[20] Also, the inter-observer agreement was shown with

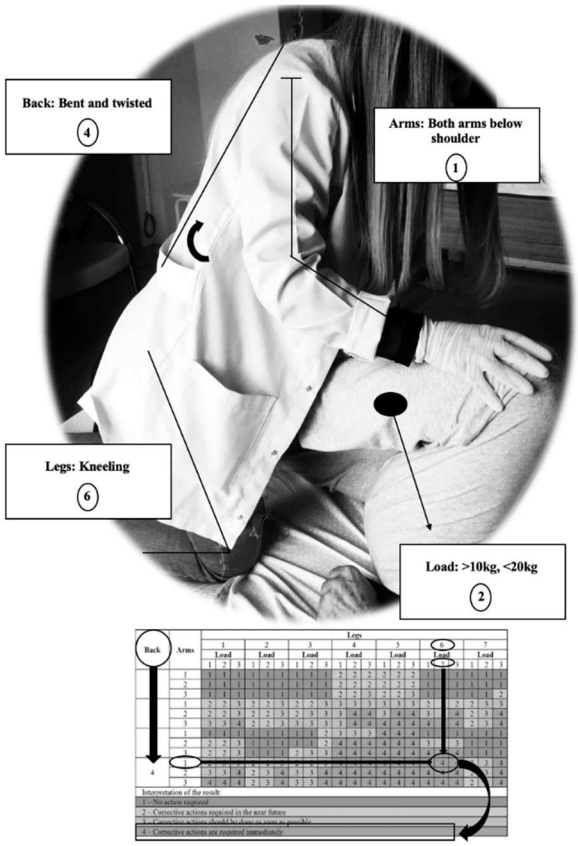

Figure 1. Scoring scheme.

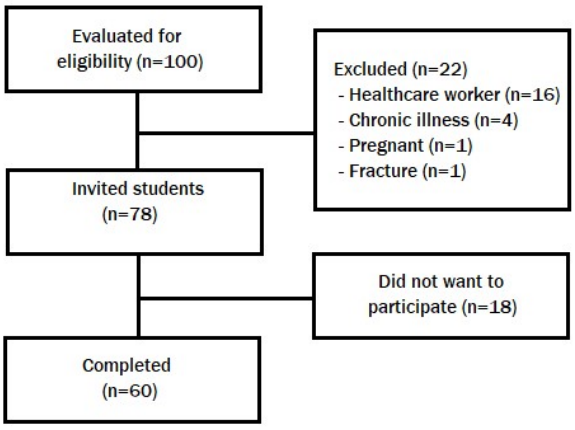

Figure 2. Flow diagram of the study.

Spearman correlation analysis. The r values obtained were interpreted as follows; 0.00–0.30 as negligible, 0.30–0.50 as low, 0.50–0.69 as moderate, 0.70– 0.89 as high, and 0.90–1.00 as very high.[20]

The prevalence of the risk of musculoskeletal disorders according to the OWAS method was estimated as a percentage. The level of significance was determined as $p<0.05$.

Post hoc power analysis was conducted using G*Power Version 3.1.9.7. The study revealed a ρ value of 0.749, based on a sample size of 60 and a significance level (α) of 0.05.

RESULTS

Sixty (49 Female, 11 Male) students with a mean age of 22.45±1.09 (21-26) years participated in the study. There were 100 senior physiotherapy and rehabilitation students in the evaluation period. However, the study was completed with 60 senior physiotherapy and rehabilitation students due to varied reasons (Figure 2).

ICC was 0.815 for inter-observer reliability and ICC was 0.872 for intra-observer reliability ($p<0.001$) (Table 1). There was a moderate correlation among the three raters (r=0.556-0.633; $p<0.001$) (Table 2).

Table 3 presents the interpretation of the OWAS scores derived from the observed data.

DISCUSSION

The study examined intra/inter observer reliability of the OWAS method as well as the working posture of senior physiotherapy and rehabilitation students in terms of ergonomic risk according to the OWAS method. The inter/intra observer reliability were good (Cronbach alpha=0.815 and 0.872, respectively) and more than half of the students had working experiences that needed ergonomic attention and management after performing an ergonomic evaluation was observed. This study is one of the rare studies that performed ergonomic risk analysis on senior physiotherapy and rehabilitation students. Also, some postures considered risky in terms of musculoskeletal system problems and modifications to prevent them are shown as examples.

Table 1. Intraclass Correlation Coefficient (ICC) values for intra/inter-observer reliability.

		95% CI	
	ICC	Lower bound	Upper bound
Intra-observer	0.872	0.786	0.924
Inter-observer	0.815	0.715	0.883

ICC: Intraclass Correlation Coefficient. CI: Confidence Interval.

Table 2. Correlation between raters according to risk score of The Ovako Working Posture Assessment System (OWAS).

		OWAS score				
Raters		Back	Forearm	Legs	Load	Total
PT1-PT2	rho	0.527**	1.000**	0.767**	0.520**	0.633**
PT1-PT3	rho	0.310*	1.000**	0.924**	0.483**	0.574**
PT2-PT3	rho	0.453**	1.000**	0.774**	0.465**	0.556**

* p<0.05. ** p<0.001. rho: Spearman correlation analysis. PT: Physiotherapist.

Table3. Distribution of risk categories.

No action required	48%
Corrective actions required in the near future	42%
Corrective actions required as soon as possible	3%
Corrective actions are required immediately	7%

Inter-observer and intra-observer reliability (0.815 and 0.872) were found to be good. In a previous study conducted with second and third-year physiotherapy students, the intra-observer reliability of OWAS was reported as 94%.[21] Widyanti stated that OWAS has good reliability among the new raters and that using the OWAS method was advantageous due to its simple table and cost-effectiveness.[15] Lins et al. examined the inter-observer agreement of the OWAS method. Twenty volunteers were analyzed with OWAS by assessors with and without physiotherapy training. As a result, the inter-observer reliability of the postures of the arms showed a high degree of agreement, while the postures of the legs and upper body showed lower levels of agreement. It was stated that there may be perception differences between the observers in the scoring of the lower extremity and trunk posture, but the method was simple, usable, and safe.[16] In the present study, the postures according to the table assessed simply. There was a moderate correlation between the three raters (r_{Total}:0.556-0.663). Similar to the study of Lins et al.[16], forearm posture agreement was found to be high, while back agreement was found to be low-medium. In contrast to the study of Lins et al.[16], lower extremity agreement was found to be high. Although inter-observer agreement for the lower extremities was found to be high, researchers would like to point out that the assessment was confusing in some positions in terms of leg posture and loading.

It was observed that 52% of the students had an ergonomically risky posture. Tišlar et al. studied musculoskeletal problems and related factors in 100 physiotherapy students. As a result, it has been reported that 46.5% of physiotherapy students have musculoskeletal problems (mostly in the waist, neck, and back regions). A relationship was found between the low physical fitness of students and musculoskeletal problems.[7] Falavigna et al. investigated the prevalence of low back pain in physiotherapy students and reported that physiotherapy students have a higher prevalence of low back pain when compared with other medical students.[22] In addition, it was suggested that preventative actions be carried out during the undergraduate

physiotherapy program to safeguard students from pain and musculoskeletal problems. Bid et al. stated that physiotherapy students experience musculoskeletal pain in various body parts, the most common being low back pain.[3] Physiotherapy students should learn to protect themselves before starting their profession so that the musculoskeletal problems that started during the student period do not cause unjust treatment for the physiotherapist, employer, and patient in the future. In the present study, when the postures that pose ergonomic risk were examined, it was found that the patient had a high score in terms of applications (passive exercise, stretching, strengthening) for the lower extremities of the patient while standing at the bedside, and applications performed by leaning forward and turning in a sitting position (manual applications). It has been reported that applications such as patient transfer, lifting and turning, which put abnormal stress on the spine, cause musculoskeletal problems, especially low back and neck pain.[5] Ngan et al. stated that poor body mechanics in activities such as patient positioning, carrying, and in-bed practice may cause musculoskeletal problems.[23] Other studies have emphasized that loose posture and biomechanically disadvantaged positions, low physical activity levels, gender, and years of work pave the way for musculoskeletal problems.[8,24,25]

Eighty-two percent of the participants in the study were female students. A systematic study examining musculoskeletal system problems in physiotherapists; reported that musculoskeletal problems were more common in women than men.[5] Jackson et al. evaluated the postures of 65 (56 Female, 8 Male) physiotherapy students in the second and third grades, with mean age of 21.5, during the clinical study according to the OWAS method.[21] It was stated that the students exhibited many dangerous postures in terms of musculoskeletal problems during the clinical study, and the working postures of the students in the two years were similar. As in the rest of the world, the majority of physiotherapy students in Turkey are female. Women, who have a higher risk of musculoskeletal system problems than men, should use body mechanics and equipment in ergonomic conditions to continue their physiotherapy profession and be efficient during patient treatment.

In the present study, only a postural examination of the students was made. However, it is thought that the sedentary lifestyle in the young population will create a risk in terms of musculoskeletal system problems together with incorrect postural loading. After the evaluation, when the students were asked the question "*Why don't you work ergonomically*?", it was found that they gave answers such as *"I work more comfortably in this posture", "I don't know how I should be in this posture", "I forget which posture I am in when receiving patients".* The injury rate is also high in the first five years of the profession, as the experience and knowledge of young physiotherapists are not sufficient to choose alternative techniques.[4] It is think that students should be made aware of postural alignment and stability and should be warned and informed about wrong positions during and after practical applications.

The strength of the present study is the evaluation of posture during the application with the OWAS method and risk determination, which is different from other studies involving physiotherapy and rehabilitation students in the literature.

Limitations

The OWAS method is a simple, cost-effective, and short-term analysis for analyzing the risks of musculoskeletal problems. However, the lack of examination for the neck in the posture category and the elbow and wrist in the upper extremity category is considered to be the shortcomings of the method. Because physiotherapists make frequent changes in neck and hand positions with the trunk during manual treatments, similar movements are repeated. Another limitation may be the choice of clothing. Although students mostly prefer to wear sports shoes, shoes, and crop clothes can be counted among the factors affecting posture. The fact that the majority of the students are female and the possibility of adjusting their posture according to their clothes should be taken into consideration in future studies.

Conclusion

OWAS was shown to have good inter/intra observer reliability as a result of the present study, and the majority of physiotherapy

students were found to be at risk of acquiring work-related musculoskeletal problems.

During undergraduate education, theoretical information is given about "*the physiotherapist's protection of his health first of all*" and what should be considered during the interventions. However, the use of theoretical knowledge may not be immediately available during practical applications. In time, experience will be gained in practical applications. This prepares the ground for musculoskeletal injuries. Reducing the risk of musculoskeletal problems requires a holistic approach. It is thought that ergonomic arrangements should be made at the working environment stage, the theoretical knowledge should be adapted to practice at the education level, and more importance should be given to safe working postures at the clinical practice level.

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Appendix. Ovako Working Posture Analysing System (OWAS) (This figure was used with permission from Lucas Wulff).

Back	Arms	Legs 1 Load			2 Load			3 Load			4 Load			5 Load			6 Load			7 Load		
		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	1	1	1	1	1	1
	2	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	1	1	1	1	1	1
	3	1	1	1	1	1	1	1	1	1	2	2	3	2	2	3	1	1	1	1	1	2
2	1	2	2	3	2	2	3	2	2	3	3	3	3	3	3	3	2	2	2	2	3	3
	2	2	2	3	2	2	3	2	3	3	3	4	4	3	4	4	3	3	4	2	3	4
	3	3	3	4	2	2	3	3	3	3	3	4	4	4	4	4	4	4	4	2	3	4
3	1	1	1	1	1	1	1	1	1	2	3	3	3	4	4	4	1	1	1	1	1	1
	2	2	2	3	1	1	1	1	1	2	4	4	4	4	4	4	3	3	3	1	1	1
	3	2	2	3	1	1	1	2	3	3	4	4	4	4	4	4	4	4	4	1	1	1
4	1	2	3	3	2	2	3	2	2	3	4	4	4	4	4	4	4	4	4	2	3	4
	2	3	3	4	2	3	4	3	3	4	4	4	4	4	4	4	4	4	4	2	3	4
	3	4	4	4	2	3	4	3	3	4	4	4	4	4	4	4	4	4	4	2	3	4

Interpretation of the result:
1 – No action required
2 – Corrective actions required in the near future
3 – Corrective actions should be done as soon as possible
4 – Corrective actions are required immediately

	Action	Digit
Back	Straight	1
	Bent	2
	Twisted	3
	Bent and twisted	4
Arms	Both arms below shoulder	1
	One arm at or above shoulder	2
	Both arms at or above shoulder	3
Legs	Sitting	1
	Standing on two straight legs	2
	Standing on one straight leg	3
	Standing or squatting on two bent legs	4
	Standing on one bent leg	5
	Kneeling	6
	Walking	7
Load	<= 10 kg	1
	10 kg <= 20 kg	2
	> 20 kg	3