Int. J. Morphol.,
41(5):1357-1363, 2023.

Evaluation of the Association Between Carrying Angle, Hand Grip Strength, Lateral Pinch Strength, and Hand Functional Index in Nursing Students

Evaluación de la Asociación entre el Ángulo de Carga, la Fuerza de Agarre de la Mano, la Fuerza de Pellizco Lateral y el Índice Funcional de la Mano en Estudiantes de Enfermería

Sema Polat[1]; Emir Ibrahim Isık[2]; Bayram Kelle[3] & Pinar Göker[1]

POLAT, S.; ISIK, E. I.; KELLE, B. & GÖKER; P. Evaluation of the association between carrying angle, hand grip strength, lateral pinch strength, and hand functional index in nursing students. *Int. J. Morphol., 41(5)*:1357-1363, 2023.

SUMMARY: Health professionals especially nurses have ongoing contact with patients and they may have a high incidence of musculoskeletal problems. For this reason, grip strength and carrying angle are important parameters for all health professionals to succeed in their job and avoid injuries. It was aimed to determine the effects of the hand grip, and pinch strength, carrying angle of dominant, and non-dominant hands as well as the association of the hand functional index with morphometric measurements in 193 nursing students. The means of the carrying angle of dominant and non-dominant sides were 169.11±4.21° and 168.16±4.30°, respectively. The means of the dominant and, non-dominant sides of hand grip strength were 45.99±11.24 kg and 45.89±11.34 kg, respectively. The lateral pinch strength means were measured as 19.55±3.75 kg and 19.31±3.45 kg, respectively. This paper's findings may be important for some experts such as anatomists, clinicians, surgeons, forensic scientists, anthropologists, and nurses- healthcare professionals keep in touch with patients. Also, we believe that appropriate and effective knowledge of carrying angle, hand grip and lateral pinch strength has created an opportunity to research in terms of reducing work-related risk factors.

KEY WORDS: Carrying angle; Bi-trochanteric distance; Hand grip strength; Lateral pinch strength; Nursing studies.

INTRODUCTION

Healthcare professionals especially nurses have ongoing contact with patients. They expend physical effort and perform daily routine activities during work; moving, repositioning, or transferring patients. Thus, they may have a high incidence of stress and pain. Additionally, they complain about a number of musculoskeletal problems. One of these are complaints about wrists or shoulders (Alperovitch-Najenson *et al*., 2015; Nodooshan *et al*., 2016; Andrade *et al*., 2017). Moreover, the work-related musculoskeletal problems affect the nurses' quality of life (Naoum *et al*., 2022). The incidence of musculoskeletal disorders increases with age, body mass index, prolonged work in standing positions, or inappropriate working postures and movements such as bending, stretching, and twisting of body. Many factors including, grip and pinch strength, and carrying angle is important to provide against work-related injury, or trauma.

The Carrying angle (CA) known as the acute angle (AA), which is between the arm and forearm, plays an important role in helping the arms to swing without hitting the hips for daily life activities (Zampagni *et al*., 2008; Lim *et al*., 2014; Chakrabarti *et al*., 2021). CA allows the forearms to clear the hips in swinging movements during walking and is important when carrying objects (Chakrabati *et al*., 2021; Sriwastava & Solanki., 2015). The angle is accepted as normal when 170° in males and 167° in females. Additionally, anatomically, the carrying angle is measured at 10° (180°-10°,170°) and 13° (180°-13°,167°) for males and females, respectively (Sriwastava & Solanki., 2015). An increase in this angle brings with it many risks such as elbow instability-dislocation, elbow fracture risk, pain during exercise, in throwing activities of sports, and probably secondarily, ulnar nerve entrapment neuropathy and distal humeral epiphysis fracture may develop (Sriwastava & Solanki., 2015.). The

[1] Cukurova University, Faculty of Medicine, Department of Anatomy, Adana, Turkey.
[2] Cukurova University, Abdi Sütcü Vocational School of Health Sciences, Department of Therapy and Rehabilitation, Adana, Turkey.
[3] Cukurova University, Faculty of Medicine, Department of Phisical Medicine and Rehabilitation, Adana, Turkey.

Received: 2023-05-08 Accepted: 2023-07-04

significant differences in this angle compared with the contralateral elbow may be a result of previous trauma or developmental abnormality. To know and assess the carrying angle reference values and pathological variations comes into prominence in etiopathogenesis or surgical treatment or reconstruction of fractures around the elbow or lateral and medial epicondylitis diagnosis (Zampagni *et al*., 2008).

Grip and pinch strength are commonly employed indices used in hand evaluations. Both methods are used in hand therapy. Also, grip strength is an important parameter for all health professionals to be successful in their job. This has been used to assess to determine work capacity, for the extent of injury, and disease processes and the potential for progress in rehabilitation. The nursing profession needs grip strength in many tasks such as transferring of patients, lifting, and injecting the patient (Shah *et al*., 2016). Hand functions consist of several tasks: Subjects possess, allowing manipulative abilities to pinch items, operate tools, pick up small objects, and eat with one hand. Pinch plays a significant role in several hand functions and the pinch strength is one of the methods evaluating the upper extremity, and may determine the success of a surgical approach, or therapeutic intervention. This method can be also used in the evaluation of predicting subjects activities performed in daily living, work tasks, forpersonal hygiene, performing surgery, or doing sports. Additionally, pinch strength is used to evaluate of quantification of loss of hand strength with distal median and ulnar nerve pathology, distal radius fractures, and neurologic pathology. Briefly, pinch strength's importance comes from also, the evaluation of orthosis used to develop functional pinch (Hock & Lindstrom, 2021; Shah *et al*., 2016). Lateral pinch or key pinch is defined as lateral prehension or pulp-to-side pinch that contacts the lateral side of the index finger. Lateral pinch strength is used to turn a key, screw, close a zip lock bag or open a bag of chips (Hock & Lindstrom, 2021).

Most of the studies related to the carrying angle are performed. Some of them are related to age and carrying angle, or sex and carrying angle, or race variations or anthropometric dimensions and carrying angle. Some of them performed with pediatric groups or adults (Zampagni *et al*., 2008; Lim *et al*., 2014; Sriwastava & Solanki., 2015; Shah & Naqvi, 2020; Chakrabarti *et al*., 2021; Kushwaka *et al*., 2022; Manandhar *et al*., 2022). Also, one study about pinch and hand strength was present about health care professionals (Shah *et al*., 216). Conversely, this is the first study considering the association between hand functional test, grip-pinch strength, morphometric measurements, and carrying angle in detail to investigate changes in dominant and non-dominant sides, and body mass index in nursing students. Therefore, it was aimed to determine the effects of occupation on hand grip-pinch strength, carrying angle of dominant, and non-dominant hand as well as the association of the hand functional index with morphometric measurements like strength, the carrying angle, bi-trochanteric diameter in healthy nursing students.

MATERIAL AND METHOD

Design and Participants. This descriptive and cross-sectional study was conducted with Nursing Department students of Cukurova University in Turkey between October of 2022 and February 2023 with 193 nursing students who agreed to participate in the study and which originated from five different cities of Southern Turkey.

Instruments. The data of the study was collected using the Dreiser Functional Index, and demographic characteristics (age, weight, height, and body mass index) were performed. Moreover, nursing students were asked about their dominant and non-dominant sides.

The Dreiser Functional Index for Hand Arthropathies developed by Dreiser *et al*. (1995), aims to measure subjects' hand functions and quantify manual function. The scale is a 10-item self-reported questionnaire using a semi-quantitative four point scale scoring, suitable to be self or physician-administered. This scale was feasible, precise, reliable, and sensitive to change this scale was validated in Dutch, Norwegian, Italian, Persian, Korean, Portuguese (Dreiser *et al*., 1995; Wittoek *et al*., 2009; Moe *et al*., 2010; Gandini *et al*., 2012; Cruz *et al*., 2022). The scoring ranges from 0 to 3. "0" refers to the possible without difficulty, "1 point" refers to possible with slight difficulty, "2 points" shows the possible with important difficulty, and "3 points" states the impossibility of doing the task. An increase in index score shows the disability for the task. The Dreiser FIHOA consists of 10 questions. The questions were as follows:

Are you able to turn a key in a lock, cut meat with a knife, cut cloth or paper with a pair of scissors, lift a full bottle with the hand, clench your fist, tie a knot, to sew, to fasten buttons, to write for a long period time (10 minutes) and the final question is would you accept a handshake without reluctance?.

Data collection. Students agreeing to participate in to study were informed about the study's aim both written and verbal consent. The one questionnaire-Dreiser Functional Index for Hand Arthropothies was completed in the classrooms and lasted approximately 5 min. After the questionnaire form was filled out, the students were taken to the room prepared

by the researcher, one by one, to be measured. Measurements were carried out by the same researcher. The Hand functional Index was evaluated by researchers lasting 20 min. The anthropometric measurements and demographic data were performed on nursing students, and the measurements lasted 30 min. Additionally, anthropometric dimensions were measured and recorded. These measures were as follows:

The body height was measured using a stadiometer to the nearest 0.1 cm in bare feet with the participants standing upright against the stadiometer.

Body weight was measured with a digital scale of 0.1 kg calibrate with precision (Amgain *et al*., 2022).

Body mass index (BMI) was calculated as weight in kilograms divided by the square of the height of the students in meters (kg/m^2) value. The hip breadth was measured in centimeters with a pelvimeter.

The carrying angle was determined using a digital goniometer (Baseline digital absolute with axis goniometer). Additionally, hand grip strength and lateral grip strength were measured.

Hand grip strength: A hydraulic hand dynamometer (Lafayette Hydraulic Hand Dynamometer, Model J00105, Lafayette Instrument Company, USA) was used in the measurement of hand grip strength. The measurement was made in the standard position recommended by the American Hand Therapists Association with the patient seated and the hand in a neutral position, shoulders in adduction and neutral rotation, the elbow in 90° flexion, and the forearm supported in mid-rotation (Fess, 1982; Isik *et al*., 2022).

Lateral grip or pinch strength: A pinch meter (baseline mechanical pinch gauge) was used for the measurement of lateral grip strength. The measurement was taken with the patient seated and the arms supported, shoulders in adduction, and neutral position, the elbow in 90° flexion, the forearm in a neutral position, and the wrist in 0–30° extension and 0–15°ulnar deviation. Three measurements were taken and the mean value was recorded as kilogram-force. Rest breaks of 30 s were given between measurements (Ziv *et al*., 2008; Isik *et al*., 2022).

Ethical considerations. The study was conducted in conformity with the Helsinki Declaration principles. Necessary ethical board approvals and institution authorizations were obtained for conducting the study. Approval from the Çukurova University Faculty of Medicine Non-Invasive Clinical Research Ethics Committee was obtained (Number: 2023/132-31). All participants were informed about the aim of the study, the voluntary nature of participation and that they can withdraw from the study at any time.

Analysis of Data. The data was analyzed using SPSS 22.0 program. The data was determined using mean, standard deviation, minimum, and maximum values. For comparing means of dominant, and non-dominant sides of the carrying angle, grip-lateral pinch strengths, and bi-trochanteric measurements, the Paired Simple T-test was used. The correlation coefficients were used to assess two continuous variables. The statistical significance level was considered as $p<0.05$.

RESULTS

The mean age, height, and weight of the nursing students were 19.92± 1.38 years, 163.75±4.65 cm, and 57.29±9.14 kg, respectively. The average body mass index was 21.39±3.49 kg/m2 (Table I). Also, the bi-trochanteric distance of nursing students was measured as 49.50±4.94 cm. The means of the carrying angle of dominant and non-dominant sides were 169.11±4.21° and 168.16±4.30°, respectively. The mean values of dominant and non-dominant sides of hand grip strength were 45.99±11.24kg, and 45.89±11.34kg, respectively. The lateral pinch strength means were measured as 19.55±3.75kg and 19.31±3.45kg, respectively (Table II). According to Paired Simple T-test results, there were both a very strong correlation and a significance ($r=0.839$; $p<0.001$) and significant difference between the dominant side and non-dominant side in carrying angle measurement ($p<0.001$). Moreover, a strong, and significant correlation between dominant and non-dominant sides in hand grip strength measurements (0.765;$p<0.001$), and a moderate and significant correlation between dominant, and non-dominant sides in lateral pinch strength measurements (0.576; $p<0.001$) were recorded. Conversely, a significant difference was no found in hand grip strength and pinch strength measurements between dominant and non-dominant sides ($p>0.05$) (Table III). The Dreiser functional index for hand arthropathies score was found as 0.0526±0.022 in the parameter about lifting a full bottle with the hand. Only 10 nursing subjects perform this job with slight difficulty. The parameter including writing for a long period time was evaluated as 0.5105±0.050 in nursing subjects who can perform this job with slight difficulty. The Dreiser functional index for hand arthropathies (FIHOA) was evaluated and the score was calculated. There was a weak, positive, and significant correlation between Dreiser FIHOA and dominant ($r=0.398$; $p<0.001$) and non-dominant carrying angle ($r=0.355$; $p<0.001$).

Table I. The demographic data and demographic data of 193 nursing students.

Measuments (193 subjects)	Minimum (Min.)	Maximum (Max.)	Mean	Standard Deviation (SD)
Age	18.00	23.00	19.92	1.38
Height	153.00	174.00	163.75	4.65
Weight	40.00	80.00	57.29	9.14
Body mass index (BMI)	15.06	32.87	21.39	3.49

BMI: Body mass index; SD: Standard Deviation; Min.: Minimum; Max.: Maximum.

Table II. The morphometric and strength parameters of 193 nursing students.

Measurements	Minimum (Min.)	Maximum (Max.)	Mean	Standard Deviation (SD)
Carrying angle of dominant side	159.00	177.00	169.11 (10.89)	4.21
Carrying angle of non-dominant side	153.00	178.00	168.16 (11.84)	4.30
Bi-trochanteric distance	35.74	63.32	49.50	4.94
Hand grip strength (dominant side)	20.00	80.00	45.99	11.24
Hand grip strength (non-dominant side)	20.00	72.00	45.89	11.34
Pinch strength (dominant side)	10.00	27.00	19.55	3.75
Pinch strength (non-dominant side)	10.00	26.50	19.31	3.45

BMI: Body mass index; SD: Standard Deviation; Min.: Minimum; Max.:Maximum.

In the evaluation of the measurements' correlation, there were strong, positive and significant correlations between BKI and bi-trochanteric distance (r=0.793;p<0.001), strong, positive, and significant correlation between hand grip strength and lateral pinch strength dominant sides (r=0.756;p<0.001), and very strong, positive, and significant correlation between hand grip and lateral pinch strength non-dominant sides (r=0.830;p<0.001), respectively. A striking finding was also found between carrying angle and bi-trochanteric distance: a weak, negative, and significant correlation was found between two measurements (-0.154;p=0.032 and -0.267;p<0.001). In Table IV, the comparison of the dominant and non-dominant side measurements according to BMI and to Post Hoc test results.

Table III. The dominant and non-dominant sides comparison of the carrying angle, lateral pinch strength and hand grip strength measurements.

Dominant and non-dominant side measurements	Correlation	Significance
Carrying angle (CA)	0.839<0.001	<0.001
Hand grip strength (HGS)	0.765<0.001	0.600
Lateral Pinch Strength (LPS)	0.576<0.001	<0.358

CA: Carrying angle; HGS: Hand grip strength; LPS: Lateral pinch strength; p=significance level; r: correlation coefficient; *p<0.05.

Table IV. The comparison of the dominant and non-dominant side measurements according to Body mass index.

Measurements	Group 1 (BKI<18.5	Group 2 (18.5≤BKI≤24.99	Group 3 (25.0≤BKI≤29.99	Group 4 (BKI≥30.00; 6	P
	46 subjects)	121 subjects)	; 20 subjects	subjects)	
CA-DS	169.09±4.68	169.30±4.02	168.85±4.54	166.33±2.94	0.406
CA-NDS	168.85±4.20	168.14±4.34	167.80±4.40	164.67±2.58	
Bi-trochanteric distance	44.55±3.49	49.32±3.34	55.93±3.99	61.79±2.80	0.153
HGS-DS	43.09±8.87	45.62±10.87	57.35±12.51	35.00±6.45	<0.001
HGS-NDS	40.35±11.04	46.87±11.11	53.55±9.19	34.00±3.58	<0.001
LPS-DS	18.79±3.44	19.55±3.84	21.87±3.24	17.17±2.04	0.007
LPS-NDS	17.64±3.50	19.79±3.39	20.95±2.28	17.17±3.45	<0.001

CA-DS: Carrying angle dominant side; CA-NDS: Carrying angle non-dominant side; HGS-DS:Hand grip strength dominant side; HGS-NDS: Hand grip non-dominant side; LPS-DS:Lateral pinch strength dominant side; LPS-NDS: Lateral pinch strength dominant side. *p<0.05.

DISCUSSION

In the current study, nursing female students were investigated in respect of the effects of the carrying angle, bi-trochanteric distance, hand grip strength and, lateral pinch strength. In reviewing studies in the literature, no study could be found that investigated the effect and relation of the carrying angle on the hand grip and lateral grip strength.

There are many studies regarding factors affecting carrying angle; hand dominance (Paraskevas *et al*., 2004; Zampagni *et al*., 2008; Manandhar *et al*., 2022), constitution, age (Balasubramanian *et al*., 2006; Koh *et al*., 2010; Dey *et al*., 2013; Shah & Naqvi, 2020; Kushwaha *et al*., 2022), gender (Zampagni *et al*., 2008; Charrabarti *et al*., 2021; Lim *et al*., 2014; Srivastava & Solanki, 2015; Shah & Naqvi, 2020), race (Dey *et al*., 2013; Lim *et al*., 2014), and distance between trochanters (Shah & Naqvi, 2020). However, the relationship between carrying angle, and hand index has not been researched yet. This is the first study considering the association between hand functional test, grip-pinch strength, morphometric measurements, and carrying angle in detail to investigate changes in dominant and non-dominant sides, and body mass index in nursing students. Therefore, it was aimed to determine the effects of occupation on hand grip-pinch strength, carrying angle of dominant, non-dominant hand as well as the association of the hand functional index with morphometric measurements like strength, the carrying angle, bi-trochanteric diameter in healthy nursing students.

The elbow joint which has a fine motor skills, and an important function, is a complex anatomical system: powerful grasping, and fulcrum for the forearm. It has a special bony geometry, articulation, and the amount of force transmitted across the joint depends on the loading systems and the angular orientation of the joint (Zampagni *et al*., 2008). The carrying angle allows the forearms to clear hips in swinging movements during walking and carrying anything and helps to keep our hand in position with stability (Srivastava & Solanki, 2015). Moreover, Manandhar *et al*. (2022) reported that this angle is of critical value in walking, swinging, and carrying things. This angle is broader on the dominant side because of the exertion forces on the elbow joint. Also, the racial and growth factor may influence the dominant side carrying angle (Shah & Naqvi, 2020; Manandhar *et al*., 2022). The differences in CA between gender may originate from secondary sexual characteristics (Shah & Naqvi, 2020). Anatomically, in males and females, the carrying angle was reported as 10° (or 170°) and 13° (or 167°), respectively. The angle increase may be a sign of elbow instability or fracture risk of elbow or dislocation. Also, this may create pain during throwing sports. There was a decreased elbow flexion. While CA is over 15 degrees, a risk factor for non-traumatic ulnar neuropathy at the elbow develops (Srivastava & Solanki, 2015; Kushwaha *et al*., 2022). In Indian females, the carrying angle's right and left values with the goniometer were found as 166.20° and 165.23°, respectively, whereas, the same values were 168.29° and 169.31° on the right and left sides, respectively (Srivastava & Solanki, 2015). In a study performed in Malaysia with 201 subjects aged between 18-25 years, a significant difference was found between both gender and the right and left sides. A wider carrying angle among females was present. The means of females were measured as 169.70° and 168.30° on right and left sides. Additionally, Lim *et al*. (2014), reported that the differences in carrying angle between the right and left hands might be ligamentous laxity at the medial elbow and asymmetrical bone growth. Moreover, the carrying angle in the right hand of 71 Nepal females was reported as 167.42°. In a study performed with Italian females, the carrying angle was found as 168.21° (Zampagni *et al*., 2008). In another study about carrying angle and its correlation with different parameters height, length of forearm, and age in Indian females aged between 18-22 years, the carrying angle was reported as 167.37° and 167.75° on the right and left sides. Additionally, a negative relation between the carrying angle and height was found. The lowest value was at height>180 cm, whereas the highest value was at 141-150 cm, followed by 161-170 cm and 151-160 cm and 171-180 cm (Shah & Naqvi, 2020). In our study, the carrying angle was found as 12.60°, 12.05° and 9.82° in Group 1 (height 150-159 cm), Group 2 (height 160-169 cm), and Group 3 (height 170-174 cm), respectively. Additionally, there was a negative and moderate relationship between the carrying angle and height (r=-0,402; p=<0.001). There was an increase with age.

The nursing profession requires a power grip to provide standing support to the patient, and ambulate client. Assist transfer from bed to chair, bed to bed, chair to commode, clinical sites, and sustain repetitive movements. For this reason, it is important for nurses to succeed in their profession (Shah *et al*., 2016). Pinch strength is used in many professions such as orthopedic surgeons, nurses, other clinicians, physiotherapists, or dentists with different aims. The nursing professionals use the pinch grip to Pick up objects like syringe, or grasp small objects like pills, use a computer, pinch/pick or otherwise work with fingers like syringe glove, small equipment, turn knobs with hands-on equipment, squeeze an eye dropper, put on caps, gown gloves, mask, apply pressure to a wound, pinch/manipulative work with fingers like dressing, grasp small objects with hands (Shah *et al*., 2016). Additionally, lateral pinch strength is clinically described as lateral prehension or pulp-to-side pinch where the thumb contacts the lateral side of the index finger. Mathiowetz *et al*., found lateral pinch strength scores to be stable for adults aged between 20 to 59 years, and a gradual decline was recorded from 60 years to 79 years. Hock & Lindstrom (2021) findings showed that the greatest amount of lateral pinch strength within 30 to 39 years of age after a slight reduction was recorded. This reference data may provide greater clinical relevance, and the amount of lateral pinch strength required to complete many of basic daily living activities, allowing clinicians to predict which pinch tasks may be difficult with age as strength declines (Hock & Lindstrom, 2021).

In 1995, Dreiser *et al*. (1995) designed and created a functional index to quantify manual function in hand osteoarthritis. This index is a 10-item self-reported questionnaire using a semi- quantitative four point scale scoring. It is practical, reliable, and sensitive to change. FIHOA was originally published in many countries such as France, Portugal, The Netherlands, Italy, and Norway (Dreiser *et al*., 1995; Wittoek *et al*., 2009; Moe *et al*., 2010; Gandini *et al*., 2012; Kilicoglu *et al*., 2022; Cruz *et al*., 2022). Also, the Turkish version of FIHOA was performed by Kılıçog˘lu *et al*., in hand osteoarthritis. This index has been translated into approximately 20 different countries. Osteoarthritis has a high prevalence and is a common illness. The most effected is females (Dreiser *et al*., 1995; Wittoek *et al*., 2009; Moe *et al*., 2010; Gandini *et al*., 2012; Kilicoglu *et al*., 2022; Cruz *et al*., 2022). For this reason, we used FIHOA and only two parameters of nursing students were seen affected. The Dreiser functional index for hand arthropathies score was found as 0.0526±0.022 in the parameter of lifting a full bottle with the hand. Only 10 nursing subjects perform this job with slight difficulty. The parameter including writing for a long period of time was evaluated as 0.5105±0.050. 97 nursing subjects can perform this job with slight difficulty. It is no wonder, since no subjects have hand osteoarthritis. We aimed to evaluate the relationship between hand functional index and carrying angle. Because, an increase in carrying angle results from many musculoskeletal problems as other researchers have previously stated. There was a moderate, positive, and significant correlation between Dreiser FIHOA and right ($r=0.398$; $p<0.001$) and left carrying angle ($r=0.355$; $p<0.001$).

CONCLUSION

This paper's findings may be important for some experts such as anatomists, clinicians, surgeons, forensic scientists, anthropologists, and nurses- health professionals keep in touch with patients. Nurses expend physical effort and perform daily routine activities related to their work; moving, repositioning, or transferring patients. It means that they have a high risk of stress and pain. They complain about many musculoskeletal problems. Additionally, these findings would shed light on decreasing injury or trauma and help in the management of disorders of the elbow and its reconstruction after fractures. FIHOA score was not found high because of no presence of hand osteoarthritis in nursing subjects. However, hand osteoarthritis has been seen as common among health professionals, especially nurses. We think that these results have been achieved because our study group has not yet started working life and intensive internships. For this reason, we should point out that; If the negativities brought by the intense work tempo and heavy workload of nurses are reduced, the possible risks would also be reduced.

ACKNOWLEDGEMENTS. We would like to thank for the support of Prof. Dr. Evsen Nasik and Prof. Dr. Sevban Arslan.

POLAT, S.; ISIK, E. I.; KELLE, B. & GÖKER; P. Evaluación de la asociación entre el ángulo de carga, la fuerza de agarre de la mano, la fuerza de pellizco lateral y el índice funcional de la mano en estudiantes de enfermería. *Int. J. Morphol., 41(5)*:1357-1363, 2023.

RESUMEN: Los profesionales de la salud, especialmente las enfermeras, se mantienen en contacto con los pacientes y pueden tener una alta incidencia de problemas musculoesqueléticos. En consecuencia, la fuerza de agarre y el ángulo de carga son parámetros importantes para que todos los profesionales de la salud tengan éxito en su trabajo y eviten las lesiones. El objetivo de este estudio fue determinar los efectos de la fuerza de prensión y pinzamiento de la mano, el ángulo de carga de las manos dominantes y no dominantes, así como la asociación del índice funcional de la mano con medidas morfométricas en 193 estudiantes de enfermería. Las medias del ángulo de carga de los lados dominante y no dominante fueron 169,11±4,21° y 168,16±4,30°, respectivamente. Las medias de los lados dominante y no dominante de la fuerza de prensión manual fueron 45,99 ± 11,24 kg y 45,89 ± 11,34 kg, respectivamente. La media de la fuerza de pellizco lateral se midió como 19,55 ± 3,75 kg y 19,31 ± 3,45 kg, respectivamente. Los hallazgos de este artículo pueden ser importantes para algunos expertos, como anatomistas, médicos clínicos, cirujanos, científicos forenses, antropólogos y enfermeras y profesionales de la salud que se mantienen en contacto con los pacientes. Además, creemos que el conocimiento apropiado y efectivo del ángulo de carga, el agarre de la mano y la fuerza de pellizco lateral ha creado una oportunidad para investigar en términos de reducción de los factores de riesgo relacionados con el trabajo.

PALABRAS CLAVE: Ángulo de acarreo; Distancia bitrocantérea; Fuerza de prensión manual; Fuerza de pellizco lateral; Estudios de enfermería.

REFERENCES

Alperovitch-Najenson, D.; Treger, I. & Kalichman, L. Physical therapists versus nurses in a rehabilitation hospital: comparing prevalence of work-related musculoskeletal complaints and working conditions. *Arch. Environ. Occup. Health, 69(1)*:33-9, 2014.

Amgain, K.; Subedi, P.; Yadav, G.K.; Neupane, S.; Khadka, S. & Sapkota, S. D. Association of anthropometric ındices with menstrual abnormality among nursing students of Nepal: a cross-sectional study. *J. Obes., 2022*:6755436, 2022.

Andrade, M. F.; Chaves, É. C. L.; Miguel, M. R. O.; Simão, T. P.; Nogueira, D. A. & Iunes, D. H. Evaluation of body posture in nursing students. *Rev. Esc. Enferm. USP, 51*:e03241, 2017.

Balasubramanian, P.; Madhuri, V. & Muliyil, J. Carrying angle in children: a normative study. *J. Pediatr. Orthop. B, 15(1)*:37-40, 2006.

Chakrabarti, S. & Raj, B. H. S. Carrying angle its relation to height in young adult males and females. *Eur. J. Mol. Clin. Med., 8(1)*:1352-7, 2021.

Cruz, M.; Marques, M. L.; Capela, S.; Lopes, S. A.; Tavares, V.; Branco, J. C. & Maheu, E. Validation of the Portuguese version of the Functional Index for Hand Osteoarthritis (FIHOA). *ARP Rheumatol., 1(2)*:143-51, 2022.

Dey, S.; Mandal, L.; Kundu, B.; Mondal, M. & Sett, T. K. Carrying angle of the elbow: ıt's changes from childhood to adulthood: morphometric study in Eastern India. *Indian J. Basic Appl. Med. Res., 8(2)*:823-9, 2013.

Dreiser, R. L.; Maheu, E.; Guillou, G. B.; Caspard, H. & Grouin, J. M. Validation of an algofunctional index for osteoarthritis of the hand. *Rev. Rhum. Engl. Ed., 62(6 Suppl. 1)*:43S-53S, 1995.

Fess, E. The effect of Jamar dynamometer handle position and test protcol on normal grip strength. *J. Hand Surg., 7*:308-10, 1982.

Gandini, F.; Giannitti, C.; Fattore, G.; Giordano, N.; Galeazzi, M. & Fioravanti, A. Validation of an Italian version of the functional index for hand osteoarthritis (FIHOA). *Mod. Rheumatol., 22(5)*:758-65, 2012.

Hock, N. & Lindstrom, D. Normative data for the Baseline® 5 position hydraulic pinch meter and the relationship between lateral pinch strength and pinch span. *J. Hand Ther., 34(3)*:453-62, 2021.

Is¸ik, E. I˙.; Soygun, K.; Kahraman, Ö. C. & Koçak, E. F. The effect of the menstrual cycle on the sense of touch, grip strength and manual dexterity of dental students. *Int. J. Occup. Saf. Ergon., 28(2)*:1167-75, 2022.

Kilicoglu, M. S.; Rezvani, A.; Yurdakul, O. V.; Kucukakkas, O.; Aydin, T. & Maheu, E. Cross-cultural adaptation and validation of the Turkish version of the Functional Index for Hand Osteoarthritis (FIHOA). *J. Orthop. Sci., 27(3)*:635-41, 2022.

Koh, K. H.; Seo, S. W.; Kim, K. M. & Shim, J. S. Clinical and radiographic results of lateral condylar fracture of distal humerus in children. *J. Pediatr. Orthop., 30(5)*:425-9, 2010.

Kushwaha, N. S.; Verma, V.; Singh, A.; Sharma, Y. & Singh, A. A study of factors associated with carrying angle of the human elbow in pediatric age group. *Cureus, 14(5)*:e25478, 2022.

Lim, V.; Jacob, N. A.; Ghani, M. F. S.; Wang, D. C. & K, A. D. An anthropometric study on the carrying angle of elbow among young adults of variou. *NJIRM, 5(6)*:20-3, 2014.

Manandhar, B.; Shrestha, I. & Shrestha, R. Dominance of carrying angle in right-hand among dental students of a teaching hospital: a descriptive cross-sectional study. *J. Nepal. Med. Assoc., 60(247)*:282-5, 2022.

Moe, R. H.; Garratt, A.; Slatkowsky-Christensen, B.; Maheu, E.; Mowinckel, P.; Kvien, T. K.; Kjeken, I.; Hagen, K. B. & Uhlig, T. Concurrent evaluation of data quality, reliability and validity of the Australian/Canadian Osteoarthritis Hand Index and the Functional Index for Hand Osteoarthritis. *Rheumatology (Oxford), 49(12)*:2327-36, 2010.

Naoum, S.; Mitseas, P.; Koutserimpas, C.; Spinthouri, M.; Kalomikerakis, I.; Raptis, K.; Sarafis, P.; Govina, O. & Konstantinidis, T. Musculoskeletal disorders and caring behaviors among nursing staff in greek hospitals: a prospective multicenter study. *Maedica (Bucur), 17(1)*:52-63, 2022.

Nodooshan, H. S.; Choobineh, A.; Razeghi, M. & Khales, G. T. S. N. A survey of patient handling between bed and stretcherand associated problems in hospital environments. *J. Ergon., 3(4)*:74-81, 2016.

Paraskevas, G.; Papadopoulos, A.; Papaziogas, B.; Spanidou, S.; Argiriadou, H. & Gigis, J. Study of the carrying angle of the human elbow joint in full extension: a morphometric analysis. *Surg. Radiol. Anat., 26(1)*:19-23, 2004.

Shah, P. & Naqvi, W. M. Carrying angle and its co-relation with different parameters height, length of forearm, and age. *Int. J. Physiother., 7(5)*:211-5, 2020.

Shah, U. N.; Mohan, N.; Saad, S. & Shaikhji, N. M. Analysis of power grıp and pınch grıp among health care professıonals. *Int. J. Physiother., 3(1)*:45-52, 2016.

Srivastava, A. K. & Solanki, S. Comparative study of goniometric and radiographic carrying angle in human. *Int. J. Sci. Res., 4(2)*:292-6, 2015.

Wittoek, R.; Cruyssen, B. V.; Maheu, E. & Verbruggen, G. Cross-cultural adaptation of the Dutch version of the Functional Index for Hand Osteoarthritis (FIHOA) and a study on its construct validity. *Osteoarthritis Cartilage, 17(5)*:607-12, 2009.

Zampagni, M. L.; Casino, D.; Martelli, S.; Visani, A. & Marcacci, M. A protocol for clinical evaluation of the carrying angle of the elbow by anatomic landmarks. *J. Shoulder Elbow Surg., 17(1)*:106-12, 2008.

Ziv, E.; Patish, H. & Dvir, Z. Grip and pinch strength in healthy subjects and patients with primary osteoarthritis of the hand: a reproducibility study. *Open Orthop. J., 2*:86-90, 2008.

Corresponding author:
Dr. Sema Polat
Cukurova University Faculty of Medicine
Department of Anatomy
Adana
TURKEY

E-mail:sezaoz@hotmail.com