Bulletin of Environment, Pharmacology and Life Sciences
Bull. Env. Pharmacol. Life Sci., Vol 12 [9] August 2023: 269-276
©2023 Academy for Environment and Life Sciences, India
Online ISSN 2277-1808
Journal's URL:http://www.bepls.com
CODEN: BEPLAD

ORIGINAL ARTICLE **OPEN ACCESS**

Ergonomic Assessment and Evaluation of Musculoskeletal Disorders in Combative Sports

Shaheed Ahmed[1] and Ajita[2]
[1]Researcher, Department of Sports Science
[2]Professor, Department of Sports Science
Punjabi University, Patiala
Email ID - shahidsaif27@yahoo.co.in

ABSTRACT
This research study was conducted at Tejli stadium, Yamunnagar, in India. It was a pre- and post-test, controlled trial. 45 healthy individual sports people were chosen for the study. Body mass index (BMI), point-of-fit (PFI), muscle tone (NMQ), and weight-enhancing exercise (WERA) were calculated. The results showed that individuals playing combative sports have a higher risk of developing muscle-related disorders.
Keyword's: Body mass index, PFI, NMQ, Musculoskeletal related disorder.

Received 14.05.2023 Revised 19.07.2023 Accepted 17.08.2023

INTRODUCTION

Sports and outside leisure fundamentally influence people's daily psychological and physical wellness and happiness. Sports and outdoor activities also have significant growth-related, monetary, and social advantages, even though this mainly pertains to being physically active (regular moderate intensity physical activity reduces the risk of cardiovascular diseases, diabetes, cancers, and depression; World Health Organisation (WHO) 2006). Given their significance to society as a whole, it is probably not unexpected that the field of ergonomics is gaining more attention as a means of comprehending and improving systems for outdoor sports and recreation.

Wrmsds may be prevented, and preventative measures seek to identify possibly dangerous biomechanical work settings early on before WRMSDs manifest. Risk evaluation is the method of determining and categorizing the risk factors for WRMSDs. The company must routinely do risk evaluations, although there may occasionally be a need for an ergonomist with more in-depth expertise in working circumstances. Risk analysis ought to look at the task at hand instead of concentrating on the person in question, even if a risk assessment is sometimes employed on an individual level, for instance, in evaluating whether a single worker's disability may be connected to their unique job. Furthermore, risk evaluations must be carried out utilizing legitimate and dependable procedures or impartial and right. A risk evaluation must be completed whenever the work assignment is put into manufacturing, such as throughout the preparation phase or while rebuilding preexisting places of employment. It is simpler to describe the various requirements required to do the particular task by analyzing the warmed risk at this point. The effectiveness of a workplace intervention may also be evaluated using ergonomic risk analysis. It appears more practical to analyze the influence on ergonomic hazards instead of the incidence of accidents, as most research on the effects of workplace changes attempts to assess the decrease in WRMSDs. However, this strategy is hampered by a significant number of technical challenges. The pace and length of the production line, the number of goods dealt with, the size and form of the goods being handled, the dimensions of the equipment employed, the length of the production cycles, and the frequency of stops are just a few examples of multiple variables that employees on a production line may be subjected to. The amount and the quality of activity, capacity to change physique orientations, the number of employees on the job, the number of connections involved, working hours, time of day, environmental variables (light, temperatures, noise, vibrations), psychological workplace conditions, etc. When assessing the risk in this complicated environment, it is crucial to divide the risks into several categories based on the pathophysiological causes of WRMSDs. In an ideal world, a risk evaluation would consider all relevant factors, but in practice, it is sometimes necessary to concentrate on the two or three most significant risks in order to identify appropriate responses. In multivariate surround ings, one might either use a specialized assessment approach that is designed to evaluate one particular threat in one specific job over just a short duration, or one might employ a broader risk evaluation technique that evaluates the overall workload over an extended amount of time.7

As a result, there is a strong worldwide agreement that musculoskeletal illnesses are directly linked to workplace ergonomic stressors, such as noise, violent effort, non-neutral positions, repeated and stereotypical movements, and mixtures of these factors. Many governmental and non-governmental organizations, including the American Conference of Governmental Industrial Hygienists (1999+), the European Agency for Safety and Health at Work, the Washington State Department of Labor and Industries (2000), the SALTSA Joint Programme for Working Life Studies in Europe, and others have codified this proof in the shape of the ergonomics regulations intended for avoiding job-related MSDs.

Based on this, we can conclude that WMSD is the outcome of known risk variables related to physical characteristics, including a fixed brought-up posture, repeated arm movements, heavy loads, inadequate rest, humidity, and stationary alignment. In addition, internal specific risk factors for an individual's physical attributes, such as anthropometry, gender, physical ability, and personality, also play a significant role in sports injuries. To develop an Ergonomic Assessment and evaluation of the posture and movements for risk assessment in combative sports-related musculoskeletal disorder

MATERIAL AND METHODS

A sample of 45 healthy subjects were recruited for the study aged 13 to 18 years. Combative sports are Badminton, Fencing, Table tennis, wrestling boxing. Subjects were selected from Tejli Stadium at Yamunanagar, Haryana.

Method of selection

Subjects were selected based on inclusion and exclusion criteria

Inclusion criteria

Both Male and female sports persons, Age group from 13 to 18 years, having Body mass index range of 18.4 to 34.7 kg/m

Exclusion criteria

Any systematic disorder like diabetes mellitus etc., and Any history of recent surgical intervention will be excluded; Any infection and inflammatory disorder was excluded and Reported by the subject/coach

Method of assigning

A sample of 45 subjects will be conveniently selected.

Design of Study

descriptive cum diagnostic research design.

Instrumentation

Stepper

Measuring Tools

1. Digital watch
2. Measuring tape
3. Weighing machine
4. Digital camera

Measurement

Harvard step test

Body mass index

Procedure

Individuals participating in the study were recruited from Tejli Stadium on the basis of inclusion and exclusion criteria. The study's goal and processes were described to the topics coach and guardians. The coach provided a written permission form that explained the freedoms enjoyed as participants in the study because the participants were minors, and written authorization was collected from the trainer before their enrollment. Subjects were urged to work as hard as possible while providing support. There were no limitations on the subject's degree of activity.

Group 1: - combative sports

PROTOCOL

Pre Testing

All subjects were told to fill out the Nordic musculoskeletal questionnaire and descriptive data with the help of the researcher; then, body mass index was assessed, and then Physical Fitness Index by using the following methods Step test.

Prior to recording measurements, subjects were explained about assessment testing.

Instructions to the subjects

1. Subjects were asked to be regular for the testing as deemed by the researcher.
2. Subjects were asked to carry on their normal activities and refrain from any lower limb balance training except that is required for the study.
3. Subjects were asked to report any discomfort during the study period.

Physical Fitness Index

Harvard Step test protocol

The learner climbs and descends the ladder at a pace of 30 footsteps per min for five minutes till they are completely out of breath. When pupils can no longer keep up the stepping pace for 15 seconds, they are said to be exhausted. When the exam is over, the participant lies down right away, and approximately one and one and a half minutes later, the entire amount of heartbeats is recorded. If utilizing the test's short version, just this measure is needed. An additional heart rate measurement is made at 2 to 2.5 minutes and 3 to 3.5 minutes if the lengthy variant of the test is being administered. A polar stopwatch was utilized to determine the pulse. The subsequent calculations provide the Fitness Index score. The long-term form Fitness Index result will be (100 x 300) / (240 x 2) = 62.5, for instance, if the overall test duration was 300 seconds (if finished in its entirety, 5 minutes), and the total number of pulse between 1-1.5 minutes was 90, between 2-2.5 minutes was 80, and between 3-3.5 minutes was 70. Note that you are utilizing the total number of heartbeats throughout the 30 seconds, not the average rate (beats per minute). [18]

Physical Fitness Index (PFI) (short form) = (100 x test duration in seconds) divided by (5.5 x pulse count between 1 and 1.5 minutes).

2. Body Mass Index

Body Mass Index (BMI) was calculated using the formula BMI = kg/m2 from measured height and weight[17]

Ergonomic assessment

Workplace Ergonomic Risk Assessment (WERA) Tool

To swiftly check an occupational work for susceptibility to the physiological dangers linked with job-related musculoskeletal disorders (WMSDs), the work environment Ergonomic Risk Assessment (WERA) [9] was established. The WERA examination involves the five major body areas of the shoulder area, hand, back, neck down, and foot and includes six risky physical variables, comprising stance, recurrence strong motion, contact tension, and work length. In order to perform more thorough evaluations, it contains a system of scores and action levels which act as a reference to the amount of risk [12, 13].

Statistical Analysis

Data analysis was performed using SPSS -16 for window software. Data were tabulated in a master chart (appendix H). Descriptive data were used to compare all groups at baseline on Age, Sex, Weight, Height, sports, Experience type of sports, BMI, PFI, WERA, and NMQ-G. The WERA final test has further nine variables – shoulder, wrist, back, neck leg forceful vibration. NMQ-G has further two subsets, NMQ-L and NMQ-NAS were analyzed. ANOVA test was used. Between groups, analysis was done using an independent T-test. The significance level was set to $P \leq 0.05$.

RESULTS AND DISCUSSION

In contrast to most legal frameworks, while weighing risks, each factor must be assumed to be true unless otherwise demonstrated. When the musculoskeletal mechanism is subjected to continuous or one-time interaction with several lengthy or severe exertions, WMSD may result. This study was to determine the ergonomic assessment and evaluation of musculoskeletal disorders in individual sports and the relationship of other factors, age, gender, experience, sports, BMI, PFI and WERA, and NMQ in which evaluation and association with subsequent symptom logy were made. The primary aim of the study was to conduct an ergonomic assessment of sports person and to calculate the risk associated with the WERA score.

Adolescent

In our study mean age was 15.07 years. We chose adolescents for our study because they are readily available in sports academy due to their less hectic schedule compared to adult athletes. The following article gives us support for choosing adolescents.

The group of teenagers in the current research showed a significant incidence of MSDs. The pain that they described is mostly felt in the head, arms, dorsal area, lumbar region, thigh/hips, and knees. Despite the fact that the majority of the teens' patterns of discomfort ranged from mild to modest, it is vital to take these data into account because they indicated serious as well as serious pain. In this demographic of young people, MSDs are more common in girls, between people who devote longer each day using modern technology, and in the mode of travel used to get to school because walking or riding a bicycle becomes more dangerous, as expected given the determiners mentioned in comparable research. We draw the conclusion that the causes of musculoskeletal disorders in adolescents are changing, complex, and multidimensional. While certain variables, like those of mechanical origin, are particularly significant since they directly impact the emergence of these manifestations, additional variables also have an indirect impact, primarily those that have culture, society, and company origins [9].

PFI

The present research used an altered version of the Harvard step technique to assess the athletic ability of adolescent athletes. We came to the conclusion that men had greater levels of cardiovascular health than women. The increased FFM in men could be the cause of this.12It might be explained by the reality that the male participants had greater PFIs than female subjects and those female subjects had substantially greater fat percentages. The higher level of physical fitness may also be explained by the larger body fat percentage, lower blood hemoglobin content, somewhat smaller female hearts relative to their body sizes than male hearts, and different androgen receptor densities in the female hearts.

Increasing participant age affects the PFI marginally lower score but can play an important factor. As the participant's age increases from adolescent to adult, his or her PFI is expected to be increased. Studies show that higher PFI will have less chance of having WMSD—experience in playing sports, giving mixed results in the PFI score. But the higher the experience higher should be the PFI. Correlation studies show that there is no correlation between BMI and PFI.

Understanding the degree of wellness is crucial for trainers and academics in sporting. The Harvard Step Test is one tool for measuring it. A Harvard Step Test constructed using combined electronic devices and furnished with a handbook is the end outcome of this study. The Harvard Step Test, which depends on integrated digital technology, successfully measures endurance in every age category, according to the study findings and efficacy [2].

BMI

Our average weight is 50.12 kg. BMI is 21.48, and height is 4.99 feet on average. According to the research's outcomes, healthy young people with higher degrees of fat-freefall in their bodies have considerably higher levels of athletic ability than those with higher rates of fat mass proportion. Moreover, being overweight as measured by % fat mass indicates poor wellness more than BMI. The gender of the participant sports person does affect the BMI score suggesting that each gender has a different risk of developing WMSD. Gender differences in WMSD may be attributed to internal factors associated with female like hormone, menstrual abnormalities, more fat distribution and iron and calcium deficiency compared to males. Participants' age affects the BMI score but can play an important factor. As the age of the participant increases from adolescent to adult BMI score is gradually set to a lower limit. Experience in playing sports affects the BMI score higher the experience better will be the BMI Correlation studies shows no correlation between BMI and PFI. Grossly, we saw more studies suggesting a correlation between higher BMI and increased risk for injury.

BMI and Lower Extremities

We discovered three runner-specific future research studies that amply demonstrated the link between higher BMI and an increased risk of lower-extremity injuries [14].

The findings of this research, however, contradict the notion that a rise in BMI is related to a rise in sports injuries. Choreographers with a BMI below 19.0 experienced more days with a low-grade injury (mean, 24.05) than dancers with a higher BMI (mean, 11.63) (P G 0.05), according to research by Benson et al. Dancers with irregular periods suffered noticeably higher fractures in their bones (mean = 15.00) than dancers with regular periods (mean = 4.97). Due to self-reported information and an absence of background data, the study was impeded. The performers with lower BMI are frequently the ones with greater visibility [4].

Overall, our findings were heterogeneous, showing different patterns in BMI and risk of athletic injury. Gender, athletic training intensity and sport-specific injury patterns were observed, as well as various patterns in acute versus overuse injury. These trends and many others similar to them are interrelated and interdependent. In the near future, it may be useful to evaluate BMI's role in athletic injury when looking for a specific injury in specific activities or athletics, taking into account sex and athletic exposure [1].

NMQ

Mean NMQ G is 11.67 NMQ L, 4.47, NMQNAS 7.67. The gender of the participant sports person does not affect the NMQ score suggesting that each gender has an equal risk of developing wrmsd but with terms of movement intensity and duration, but internal factors like hormones, menstrual cycle more fat predispose females to develop wrmsd. The age of participants does not affect the NMQ score but can play an important factor. As the age of participants increases from adolescence to adulthood, chances of developing WMSD increase; this may be attributed to more gameplay and competition. Experience in playing sports does affect the NMQ score because the higher the experience more game play, and the more competition, so chances of getting wrmsd.Correlation studies show that there is no correlation NMQ has with BMI and or with PFI.

The research aims to examine the Nordic Musculoskeletal questionnaire's reliability and validity with both official and unofficial sector employees. The created gadget can help employees with genuine discomfort in their arms, head, and lumbar back[3].

This study aimed to (1) create a musculoskeletal symptom assessment tool for younger individuals using the NMQ-E and NMQ French versions and (2) evaluate the adaption's accuracy and reliability. Conclusions: There are only very slight differences among tests, according to kappa coefficients for consistency and criterion validity, and there is strong concordance among the questions on the survey and the information in the clinical files. According to these studies, the modified NMQ-E is a reliable self-administered musculoskeletal symptom screening tool for adolescents. Utilizing attendance information from sports and school, further verification of elements relating to the effects of complaints might be beneficial [5].

WERA

WERA final mean value is 43.84. Our results by WERA show that combative sports is a very high risk for work-related musculoskeletal disorders (WMSDs).

The gender of the participant sportsperson does not affect the WERA score suggesting that each gender has the same risk with respect to intensity, duration, and frequency of movements. Gender differences in wrmsd may be attributed to internal factors associated with female like hormone, menstrual abnormalities, more fat distribution and iron and calcium deficiency compared to males. The age of participants does not affect the WERA score but can play an important factor. As the age of participants increases from adolescence to adulthood, chances of injury also increase with competition and aggression in sports resulting in high intensity and explosive movements, which can lead to WMSD. Experience in playing sports does not affect the WERA score, but experience added the advantage of prevention of injury by early recognization of symptoms and controlling the unnecessary risk-taking behavior.

So it seems that all types of sports carry the risk for work-related musculoskeletal disorders (WMSDs). The best explanation may be attributed to wrmsd may be assessed based upon.

Intensity, Frequency, and Duration

Three crucial signs of ergonomic exposure must be considered while evaluating the dangers associated with ergonomics: I) the "intensity" of the workload, for example, unnatural positioning of the body and/or the legs (posture)3 and the generation of force during carrying, pushing, and dragging tasks, F) the "frequency" of the workload, for example, recurrent motions, and D) the "duration" of the workload, for example, static work, lack of position shifts (9). Several of the typical ergonomic dangers may be distinguished by employing the aforementioned groups, including manual handling (I), uncomfortable posture (I/D), repetitive labor (F), and stationary work (D).

This research maps a wide range of measures that may be used to evaluate the danger factors for ergonomic wrmsd. A list of the bodily sections and important indications (I, F, and D) that these devices look at. All of the devices evaluate posture (intensity), but not all approaches to observation take into account the other two crucial aspects of biomechanical exposure (frequency and duration). Six instruments— SI, HARM, kim I–II and kim III, RAMP, and wera—assess all three critical indications. Of such, only wera determines the biomechanics wrmsd danger for every body area. There are several empirical evaluation instruments accessible to ergonomists that conduct risk evaluations, and it is crucial to realize that many techniques may be employed in tandem to estimate the objective wrmsd risk levels.

In the investigations that followed, we discovered that WERA had strong reliability and accuracy. They described how the Workplace Ergonomic Risk Assessment (WERA) was created to look into the physical danger variable connected to work-related musculoskeletal diseases (WMSDs). When it comes to the accessibility of the WERA tool, everyone who took part, such as managerial and skilled groups, concurred that model had been quick and simple to utilize, suitable for job evaluations for various jobs/tasks, and useful at operation. The validity trials' variability in leads to indicate moderate agreement among those who observed. It was established that no special training was necessary to conduct WERA assessments. The WERA evaluation has thus been created to be simple to use and rapid, and individuals taught to use it do not require prior knowledge of observational methods, although it might be advantageous. WERA evaluation may be performed in any workplace area without interfering with the activity being watched because it is a pen-and-paper approach [10].

The present research used a newly developed ergonomic risk evaluation technique called Workplace Ergonomic Risk Assessment (WERA) to explore the physical danger variable among wall-plastering employees. It demonstrates that the WERA evaluation accurately diagnosed occupational musculoskeletal problems, which may be described as pain, aching, or discomfort in the relevant body location [11].

This study aimed to look at the prevalence of work-related musculoskeletal diseases (WMSDs) among construction industry workers who plaster walls. These investigations demonstrated that the statistical importance of the hand, arm, and vertebral areas of the individual WERA body part scores were having an impact on the worker and contributing to the emergence of pain or discomfort among wall plastering employees [13].13Because of its simplicity, capacity to be utilized by several users with no specialized training, and short operating times, observation instruments have found various applications in the ergonomic evaluation of musculoskeletal diseases (MSD). The validity of their findings continues to be their biggest obstacle, though. Since MSD is a multidisciplinary issue, professionals from several fields must employ precise monitoring tools. The present research examined the workplace ergonomic risk assessment (WERA) observation tool's intra- and inter-rater dependability. Thirteen ergonomics and safety stakeholders from various occupations underwent training before independently assessing the risk of ten distinct work actions that had been caught on film. The participants' exposure to six physical MSD risk factors in six body locations was assessed using WERA to establish their risk level. This study clarified the reliability evaluation and showed agreement across the various WERA-using experts. As a result, the evaluated work environment's duties must be promptly redesigned, and ergonomic improvements must be carried out. They investigate the use of the workplace ergonomic risk assessment (WERA) approach to lower the risk of musculoskeletal disorders (MSDs) associated with wire harness workstations. According to Indonesia's Bureau of Labor Statistics, musculoskeletal disorders (MSD) are the primary category of injury causes at work, accounting for 30% of reimbursement expenditures. Given the issue, this study was carried out to determine the action levels using the WERA approach and to offer recommendations for improvement to address the issue of musculoskeletal problems. With ratings of 31.23, 28.87, and 30.9, the WERA results demonstrated a need for more research and development in torque, grommet, and offline occupations. Personal protective equipment (PPE) suggestions were then made to lower the risk factor scores for contractual tension, create a new design for workstations for twisting jobs, and include assistance for resolving other pain issues [15].

However, certain studies are not entirely in favor of WERA. For example, the present investigation aimed to determine if the WERA approach could be applied to determine the possibility of musculoskeletal problems by correlating findings with QEC. They concluded that there was a significant relationship between the two ways after looking at the mean scores of the two approaches. It may have concluded that the QEC approach was better suitable for ergonomics evaluation of musculoskeletal conditions risk in various occupations in this study based on the relationship among frequency of diseases and QEC and WERA scores, which demonstrated that QEC findings proved more compatible with Nordic findings [6].

Table No.1

Combative						
DESCRIPTIVE STATISTICS	**Mean**	**SD**	**Maximum**	**Minimum**	**Median**	**N**
AGE	15.07	1.64	18.00	13.00	15.0	45

Table No.2

Combative						
DESCRIPTIVE STATISTICS	**Mean**	**SD**	**Maximum**	**Minimum**	**Median**	**N**
WEIGHT	50.12	10.37	75.00	32.00	50.0	45

Table No.3

Combative						
DESCRIPTIVE STATISTICS	**Mean**	**SD**	**Maximum**	**Minimum**	**Median**	**N**
HEIGHT	4.99	0.53	6.10	4.00	5.0	45

Table No.4

Combative						
DESCRIPTIVE STATISTICS	**Mean**	**SD**	**Maximum**	**Minimum**	**Median**	**N**
BMI	21.48	3.22	30.70	16.50	20.7	45

Table No.5

Combative						
DESCRIPTIVE STATISTICS	**Mean**	**SD**	**Maximum**	**Minimum**	**Median**	**N**
PFI	68.43	12.25	86.95	40.26	72.3	45

Table No.6

Combative						
DESCRIPTIVE STATISTICS	**Mean**	**SD**	**Maximum**	**Minimum**	**Median**	**N**
WERA FINAL	43.84	4.54	49.00	37.00	44.0	45

Table No.7

Combative						
DESCRIPTIVE STATISTICS	Mean	SD	Maximum	Minimum	Median	N
NMQ G	11.67	1.91	13.00	9.00	13.0	45

Table No.8

Combative						
DESCRIPTIVE STATISTICS	**Mean**	**SD**	**Maximum**	**Minimum**	**Median**	**N**
NMQL	4.47	5.50	13.00	1.00	1.0	45

Table No.9

Combative						
DESCRIPTIVE STATISTICS	**Mean**	**SD**	**Maximum**	**Minimum**	**Median**	**N**
NMQNAS	7.67	7.35	17.00	2.00	2.0	45

Limitations of the study

1. Results cannot be generalized to all sports, Psychological factors were not considered. And there was a lack of control over external factors like temperature, diurnal variation in training, etc.
2. Recommendation and scope for future research
3. The study can be carried out on a large sample size for better credibility.
4. Generalizability of the result can be increased by carrying the study on females and other types of sports

CONCLUSION

The study has been prepared in such a way as to give information about the ergonomic assessment of combative sports. WERA has found that combative sports carry the risk for wrmsd. So we must be prepared to face the wrmsd in sports. Coaches and trainers should work on BMI and PFI as these components can play an important role in the prevention of wrmsd.

REFERENCES

1. Adae O. Amoako. (2017). Body Mass Index as a Predictor of Injuries in Athletics. American College of Sports Medicine. Current Sports Medicine Reports.Volume 16, Number 4:90-97
2. Arief Nuryadin, Siswantoyo. (2021). Development of harvard step test an-515 based on digital integrated technology. medikora, Vol. 20 No. 1, Hal 10-22
3. Aulia Chairani. (2020). Validity and reliability test of the nordic musculoskeletal questionnaire with formal and informal sector workers. The 7th International Conference on Public Health Solo, Indonesia,November 18-19, |100
4. Benson JE, Geiger CJ, Eiserman PA, Wardlaw GM. (1989). Relationship between nutrient intake, body mass index, menstrual function, and ballet injury. J. Am. Diet. Assoc. 89:58Y63.

5. Élise P Legault. (2014). Assessment of musculoskeletal symptoms and their impacts in the adolescent population: adaptation and validation of a questionnaire. BMC Pediatrics ,14:173
6. Esmaeil Shoja1 . Feasibility of Using WERA Method to Assess Ergonomic Risk of Musculoskeletal Disorders. Iran J Ergon.; 7 (3): 2019, 66-74
7. Grooten WJ, Mulder M, Josephson M, Alfredsson L, Wiktorin C. (2007). The Influence of Work-Related Exposures on the Prognosis of Neck/Shoulder Pain. Eur Spine J.16(12):2083-91.
8. Jafri Mohd.Rohania. (2018). the inter-rater and intra-rater reliability analysis of workplace ergonomic risk assessment. Ademola James Adeyemi et al/jumal Teknologi (Science and Engineering)80:1; 53-50
9. Martins RL, Carvalho N, Albuquerque C, Andrade A, Martins C, Campos S, et al. (2020). Musculoskeletal disorders in adolescents: a study on prevalence and determining factors. Acta Paul Enferm. 33:e-APE20190173
10. Mohd Nasrull Abd Rahman, Mat Rebi Abdul Rani and Jafri Mohd Rohani (2011). Investigation of the Physical Risk Factor in Wall Plastering Job using WERA Method. proceeding of the international multiconference of engineers and computer scientist 2011vol 2,IMECS,march 16-18,hong kong
11. Mohd Nasrullbad rahman. (2011). WERA. an observational tool develop to investigate the physical risk factor associated with wmsds.J.human ergonomics.40:19-36
12. Mohd Nasrull Abdol Rahman. (22012). WERA tool for assessing exposure risk factors of work related musculoskeletal disorders - a reliability and validity study. Proceedings of the 2012 International Conference on Industrial Engineering and Operations Management Istanbul, Turkey, 6, 20-25.
13. Mohd Nasrull Abdol Rahmana. (2012). Investigation of work-related musculoskeletal disorders in wall plastering jobs within the construction industry. Work 43 2012 507–514. DOI 10.3233/WOR-2012-1404 IOS Press
14. Plisky MS, Rauh MJ, Heiderscheit B, et al. (2007) Medial tibial stress syndrome in high school cross-country runners: incidence and risk factors. J. Orthop.Sports Phys. Ther. 37:40Y7.
15. Sugiono SUGIONO, et al. (2018). Reducing musculoskeletal disorder (MSD) risk of wiring harness workstation using workplace ergonomic risk assessment (WERA) method. Scientific Review – Engineering and Environmental Sciences (4), 536–551.
16. Verbeek J, Pulliainen M, Kankaanpaa E. (2009). A Systematic Review of Occupational Safety and Health Business Cases. Scandinavian journal of work, environment & health.;35(6):403-12.
17. Viktoryia Karchynskaya et al.Is BMI a Valid Indicator of Overweight and Obesity for Adolescents? Int. J. Environ. Res. Public Health 2020, 17, 4815; doi:10.3390/ijerph17134815
18. Walid Soliman Ismail Mahmoud Elsaidy. (2011). .Evaluating the Validity and Reliability of Harvard Step Test to Predict VO2max in Terms of the Step Height According to the Knee Joint Angle. Theories & Applications the International Edition. Volume 1, No. 2 Pages (126 - 132)
19. Yagi S, Muneta T, Sekiya I. (2013). Incidence and risk factors for medial tibial stress syndrome and tibial stress fracture in high school runners. Knee Surg. Sports Traumatol. Arthrosc. 21:556Y63.

CITATION OF THIS ARTICLE

Shaheed Ahmed and Ajita. Ergonomic Assessment and Evaluation of Musculoskeletal Disorders in Combative Sports. Bull. Env. Pharmacol. Life Sci., Vol 12 [9] August 2023:269-276