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ORIGINAL ARTICLE **OPEN ACCESS**

Ergonomic Assessment and Evaluation of Musculoskeletal Disorder in Individual Sports

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

ABSTRACT
To develop an Ergonomic Assessment and evaluation of the posture and movements for risk assessment in selective sports-related musculoskeletal disorder. The design of the study was descriptive cum diagnostic. This research study was conducted at the the Tejli stadium in Yamunnagar, India. Forty-five healthy individual sports persons were selected for the study. BMI, PFI, NMQ, and WERA were calculated. Based on BMI, PFI NMQG, NMQL NMQNAS, and WERA, individual sports possess a higher risk for musculoskeletal-related disorders. Individual sports carry a higher risk for musculoskeletal-related disorders.
Keywords: BMI, PFI, NMQ-Nordic Musculoskeletal Questionnaire questioner, WERA-The Workplace Ergonomic Risk Assessment, WRMD- work-related musculoskeletal disorder.

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INTRODUCTION

Sport and outside activity are important factors in the population's daily bodily and within well-being. It could mainly relate to involvement in bodily exertion (where typical moderately strenuous bodily exertion reduces the risk of heart disease, cancer, illness, and depressive symptoms; World Health Organization [19]; sport and outdoor activities play as well a role important part in practical, profitable and cultural advantages. Given its significance to the community in general, it is not surprising who the field of ergonomics is gaining more prominence as a medium to understand and optimize outdoor recreational and athletic systems. Recovery and preventive action are more valuable than WRMSDs prevention, and we aim to identify potentially dangerous ergonomic work situations early before they start WRMSDs The method of mapping and categorizing the threat situations for WRMSDs is known as threat evaluation. The risk evaluation must be carried out entirely through the investigator, however ergonomists with a greater understanding of workplace circumstances are frequently needed. In fact, the threat analysis for a single position is used to illustrate when assessing whether a particular worker's MSD could be related to their specific facility. Threat assessments should decompose the work task rather than being limited to what already exists. Threat analyses should be carried out which are neutral and true; we can say reliable and valid. It is all the more valuable that the risk evaluation is carried out prior to the assigned task is implemented, for instance, in the initial stages of planning or once converting workplaces. By evaluating the WRMSDs threat at this point, you can specify the unique requirements required to accomplish the assignment. Ergonomic threat analysis may additionally be carried out if the experimenter is attempting to gauge the effect of crop intervention [1-8].

Numerous studies on crop strategies seek to estimate the decrease of wrmsds16. However, this strategy is beset by many methodological problems, and it seems more practical for investigating the effects of ergonomic experiences compared to the fact of damage. Utilizing a production line as an illustration, employees are subjected to several simultaneous variables that may result in WRMSDs, such as B. the pace and size of the production line, the number of objects dealt with the size and form of the objects, the quantity of the instruments employed, the length of the work periods and the amount of breaks. The amount of employees at the workplace, the quantity of joints to consider, the amount and type of movement, the capacity to change posture, psychological strain, deadlines, hours of operation, time of day, external factors (light, temperature, noise, climate) and the psychological workplace setting, etc. the threat

analysis of… In a multifaceted atmosphere, one might employ a particular scoring system that is completely ready to evaluate a particular danger in an individual task across just a few days or use a broader danger rating system that rates every task over an extended amount of time [7]. There is a transnational one Almost acceptance that musculoskeletal illnesses are directly associated with work-related ergonomic stresses, such as recurrent and hackneyed movements, profuse sweating, non-neutral positions, motion, and mixtures of these stresses. Numerous governmental and non-governmental organizations have formalized this rationale in a variety of codes of ergonomics intended to help job-related musculoskeletal disorders, including the American Conference of Governmental Industrial Hygienists (1999); the European Agency for Safety and Health at Work, EU (1999); the SALTSA Joint Program for Working Life Research in Europe (2000); and the Washington State Department of Labor and Diligence (2000).
And the Washington State Department of Labor and Diligence (2000). Grounded upon all this, WRMSD combines the honored external and internal threat factors in physical attributes. External factors involve a fixed raised- posture, recreating arm movement, heavy cargo, short rest, temperature, and static posture. To assess all this, we will use WERA tools for internal threats, including similar anthropometry, gender, physical capability, and personality also play a significant part in sports injuries. To assess all this, we will also study age, gender, height, weight, sports type of sports experience, body mass indicator, and physical performance indicator. To develop an Ergonomic Assessment and evaluation of the posture and movements for risk assessment in selective sports-related musculoskeletal disorder

MATERIAL AND METHODS

A sample of 45 healthy subjects was recruited in our study with ages ranging from 13 to 18 years and Individual events athletes. Subjects were selected from Tejli Stadium at Yamunanagar Haryana.

Method of selection

players were included in the study based on inclusion and exclusion criteria

Inclusion criteria

Both gender sports persons, Age group from 13 to 18 years, Body mass index range 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

1. stepper

Measuring Tools

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

Measurement

Harvard step test
Body mass index

Procedure

We explained to all Subjects/coaches and parents about the research and methodology of the study. As the players were minors, the coach was given an informed consent form explaining the subjects' rights as research subjects, and the consent forms were taken from the coach. Players were asked for their full cooperation and to work to the best of their ability. There were no restrictions placed on the subject's activity levels.

Group 1: - Individual events - Athlete

PROTOCOL

Pre Testing

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

Before recording measurements, subjects were explained about assessment testing

Instructions to the subjects

1. players were asked to be regular for the testing.

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

1. Harvard step test
2. Body mass index.

1. Harvard Step test protocol player does step upward and downward on their foot at a rate of 30 ways per nanosecond over five twinkles until complete prostration. Prostration occurs when the player is unable to keep a steady step rate for a period of fifteen seconds. The player incontinently sits down following the end of the test, and the entire figures of heartbeats are recorded between 1 to 1.5 twinkles after completion. It's the sole evaluation needed if employing the brief version of the examination. However, there's a new heart rate evaluation between 2 to 2.5. If the lengthy version of the examination has been performed five twinkles, as well as between 3 to 3.5 twinkles. The heart's rate was determined with a contrasting stopwatch.

The Fitness Index score is determined by the subsequent equations. For instance, if the entire duration of the test was three hundred seconds (if finished all five twinkles), as well as the total number of beats per minute between 1-1.5 twinkles became 90, among 2-2.5, the number was 80, and between 3-3.5 it had been 70, also the long version of the Fitness Index score would correspond to (100 x 300)/(240 x 2) = 62.5. Remember that you're calculating the overall amount of heartbeats in the 30 alternate periods, rather than the rate (beats per nanosecond) throughout the period in question 18 Physical Fitness indicator (PFI) (short form) = (100 x test duration in seconds) divided by (5.5 x palpitation count between 1 and1.5 twinkles).

2. Body Mass Index.) we calculate Body Mass Index (BMI) by using the formula BMI = kg/ m2 from measured height and weight[17]

Ergonomic assessment

Workplace Ergonomic Risk Assessment (WERA) Tool A Workplace Ergonomic Risk Evaluation (WERA) (9) was administered to form a system of assessment a job task swiftly for being exposed to a tangible risk aspect connected with a work-related musculoskeletal complaint (WMSDs). This WERA evaluation includes six tangible threat variables, such as posture, reiteration, forcefulness, motion, interaction anxiety, and duration of work, and it involves the five significant areas of the body (shoulder, the hand, back, head, and leg). It comprises a system for scoring and steps situations that give a companion for the position of threat and the requirement for steps for carrying out more detailed evaluations. Figure 1 illustrates the Workplace Ergonomic Risk Assessment (WERA) tool [12, 13].

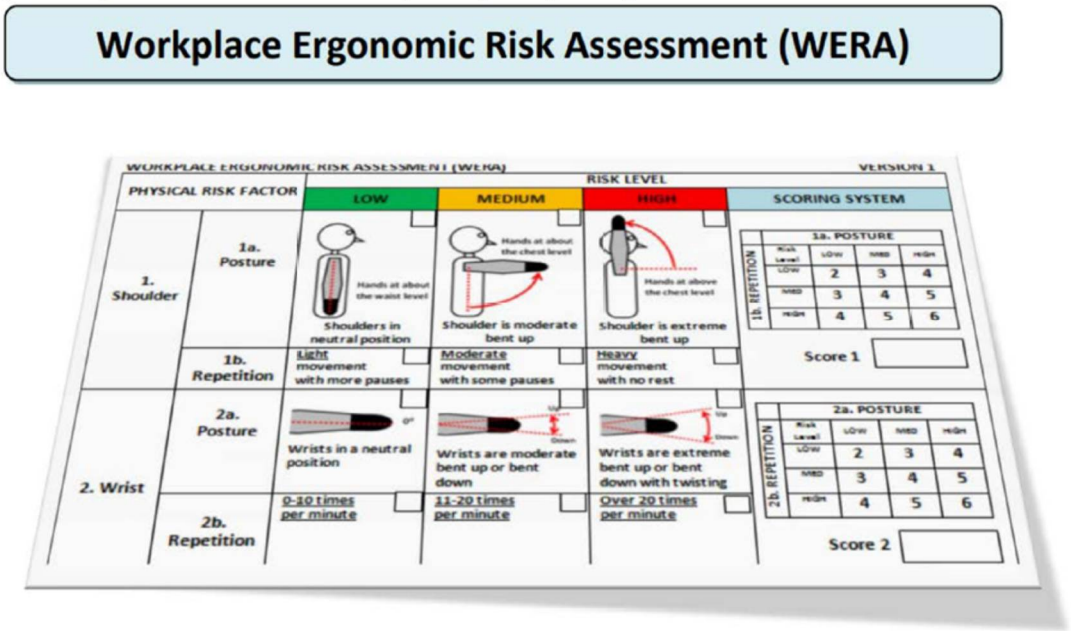

Figure 1: illustrates the Workplace Ergonomic Risk Assessment (WERA) tool.

DATA ANALYSIS

Data analysis was calculated by using SPSS -16 for window software. 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 nine further variables – shoulder, wrist, back, neck leg forceful vibration. NMQ-G has two different subsets, NMQ-L and NMQ-NAS were analyzed. ANOVA test was used.

RESULTS AND DISCUSSION

Any variable should be conjectured until proven otherwise when pitfalls are considered. WMSD can occur when the musculoskeletal system is pushed beyond its physiological limits, which means combined or single exposure to one or more prolonged or excessive sweats WRMSDs) This study determined the ergonomic assessment and evaluation of musculoskeletal diseases 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 posterior symptom logy were made. Our Aim of the study was to conduct an ergonomic assessment of an individual sportsperson and to calculate the threats associated with the WERA score.

Adolescents In our study mean age 15.46 times. We chose adolescents for our study because they're readily available in sports academe due to lower excited schedules than the adult athlete, and the following composition gives us support for choosing adolescents. Actors in this study sample showed a high incidence of musculoskeletal disorders. The complaints addressed are essentially localized in a number of anatomical regions: head, arms, buttocks, lumbar spine, thighs/hips, as well as knees. Although the discomfort magnitude structure for the actors' maturity ranged between mild and moderate, this is essential to account for various results due to growing inflexibility as they reported severe and actual severe discomfort. Knowing the determinants identified in comparable research, MSDs are more common within this group of actors among girls as well as those who devote longer per week employing modern technology, and the modes of transport they used to go to class since they are down or riding a bike turns a greater risk. We have learned that the emergence of adolescent musculoskeletal conditions is changing, complex, and multifaceted because there are several variables that are of particular significance as they impact the development of such instantiations to illustrate the mechanical causes; on the other hand, there are additional variables that act laterally, essentially those associated with interpersonal, artistic as well as managerial background [9].

PFI

Our study estimated the physical fitness of youthful sports persons using a modified Harvard step system. We've established that cardiorespiratory fitness is more advanced in males than in ladies. This may be due to advanced FFM in males [1, 2]. It may be attributed to the fact that the body fat chance of ladies is much more advanced than the males, and the PFI is advanced in the males as compared to womanish subjects. It may be due to the advanced physical fitness in the high body fat chance, lower blood hemoglobin content, the womanish heart is slightly lower to body size than the manly heart, and the differences in androgen receptor viscosity in the womanish heart may also be a new explanation. Adding the Age of actors does affect the PFI hardly lower score, but it can play an important factor. As the party's age increases from adolescence to adulthood, their PFI is anticipated to be increased. Studies show that advanced PFI lower will be chances of having WMSD will be less. Experience in playing sports, giving blended results in the PFI score. But advanced experience advanced should be the PFI. Correlation studies show that there's no correlation between BMI and PFI. It's important to know the position of physical fitness by trainers and preceptors. We can measure physical fitness by Harvard Step. This study concluded that a Harvard Step Test was based on integrated digital technology and equipped with a primer. The results and effectiveness of this study show that the Harvard Step Test, which is based on integrated digital technology, is suitable for measuring physical fitness in all age groups [2].

BMI

Mean Weight in our is 44.88 Mean height is 5.05 bases. The study's findings suggest that an enhanced fat mass chance is associated with low physical fitness, and an increase in fat-free mass significantly enhances physical fitness in healthy, youthful grown-ups. Also, rotundity in terms of chance Fat mass is a better determinant than BMI of low physical fitness. The Coitus of a party sports person does affect the BMI score suggesting that each coitus has a different threat of developing WMSD. Gender differences in WMSD may be attributed to internal factors associated with womanish hormones, menstrual abnormalities, further fat distribution, and iron and calcium insufficiency compared to the joker. Actors' age affects the BMI score, but it can play an important factor. As the party's age increases from adolescent to adult, the BMI score is gradationally set to a lower limit. Experience in playing sports does affect the BMI score. The experience will be BMICorrelation studies show no correlation between BMI and PFI. A literature review shows a correlation between advanced BMI and increased threat of injury. BMI and Lower Extremity Literature review show that three prospective studies in runners indicate and support that high BMI increases the

threat of lower-extremity injuries 14, And the finding of this study opposes the view that an increase in BMI is associated with an increase in sports injuries. Benson et al.(5) found that hops with a BMI less than 19.0 spent more days with a minor injury (mean 24.05) than hops with a lower BMI (mean 11.63) (PG 0, 05). Hops with abnormal menses had significantly more bone injuries (mean = 15.00) than normally menstruating hops (mean = 4.97). Sound reports, and minimum exposure data hampered the study. Hops with a lower BMI are often also the hops that are further exposed4. Our studies yielded mixed results, showing colorful trends for BMI and sports injury risk. We establish trends about differential coitus, athletic training position, and sports-specific injuries. We also saw different trends in acute versus overuse injuries. Numerous factors and trends are interdependent and interconnected. For fetal research, it would be helpful to assess the role of BMI in sports injuries when looking for a specific injury in a specific sport or sports when counting for coitus and sports exposures [1].

NMQ

Mean NMQ G is10.77 NMQ L individual2.67 NMQNAS individual2.00 Gender of party sports person doesn't affect the NMQ score suggesting that each gender has the equal threat of developing warmed but with terms of movements intensity frequency and duration but internal factors like menstrual hormone cycle further fat dispose of womanish for developing warmed. The age of actors doesn't affect the NMQ score, but it can play an important factor. As the party's age increases from adolescence to adulthood, the chances of developing WMSD increase. This may be attributed to further gameplay and further competition. Experience in playing sports does affect the NMQ score because it advances experience, more gameplay, and further competition, so chances of getting RMS. Correlation studies show no correlation NMQ has with BMI and or with PFI. This study focused on determining the validity and certainty test of the Nordic Musculoskeletal Questionnaire with formal and informal sector workers. Conclusion The constructed tool can clear workers with real low back, neck, and shoulder pain and (2) assess the validity and trustworthiness of the acclimatized interpretation of the tool. The conclusion results show that the kappa coefficients for certainty and validity of the criterion range from mild to complete consensus without risk, suggesting little variation between the tests and good agreement among the survey responses and the medical documents. This concluded that an acclimated interpretation of the NMQ-E is a useful tonally given musculoskeletal signs webbing tool for adolescent people. Details on the effect of signs could benefit to reconfirmation through academy and sports visit records[5]

WERA

WERA final mean value34.00 Our results by WERA show that individual sports carry a high threat for work-related musculoskeletal diseases(WMSDs). The gender of the party sportsperson doesn't affect the WERA score suggesting that each gender has the same threat concerning intensity, duration, and frequency of movements. Gender differences in arms may be attributed to internal factors associated with womanish-like hormones, menstrual abnormalities, further fat distribution, and iron and calcium insufficiency compared to males.The age of actors doesn't affect the WERA score, but it can play an important factor. As the age of the party increases from adolescence to adulthood, chances of injury also increase with adding in competition and aggression in sports performing into high intensity and explosive movements, which can lead to WMSD.Experience in playing sports doesn't affect the WERA score. Still, experience added the advantage of forestalling injury by early recognition of symptoms and controlling the gratuitous threat, taking,geste. So it's clear that all individual sports types carry the threat of work-related musculoskeletal diseases (WMSDs). The stylish explanation may be attributed to worms. It may be assessed grounded upon While evaluating the ergonomic pitfalls, the following primary signs of ergonomic contact ought to be considered: I) the difficulty of the workload, e.g., unfavorable position for the box and extremities (posture) 3 and force result while pulling, and pushing (due to transferring weight, pulling and dragging activities), the amount of repetition of the work item; e.g., recurrent motions and D) the length of the workload; e.g., stationary job, lack of altered posture (9). Using these instructions, numerous of the common ergonomic pitfalls associated with self-paced running (I), awkward sitting positions (I/D), repetitive tasks (F), and stationary work (D) can be associated. This study mentioned that numerous tools could be used to assess wind ergonomic threat factors. covering the body corridor and principal factor pointers (I, F, D) are evaluated by such instruments. They all evaluate position (intensity), but one of the two crucial aspects of physiological loading (the frequency and duration) were not considered in all experimental styles. With this in mind, only six scores for all three critical indicators SI, HARM, Kim I-II, and Kim III, RAMP, and wear, and of these, only the Wera tool measures warmed biomechanical threat for all body corridors [18].

Numerous experimental assessment tools are available to ergonomics experimenters conducting threat assessments. It is essential to know that various tools may be utilized concurrently to assess the target armed threat situations. The subsequent studies demonstrated the validity and trustworthiness of the WERA instruments. They explained the concept of Workplace Ergonomic Risk Assessment (WERA)

development to examine a physical risk factor linked to work-related musculoskeletal disorders (WMSDs). In the trust trials, the inter-observer trustworthiness results show moderate agreement among the viewers. At the same time, all actors, including the experts and the operational brigades, agreed to the review of the WERA tool usability feedback questionnaire that the model of the WERA tools was simple to use and swift to use, useful to asset evaluation for a broad spectrum of jobs/tasks and helpful at employment. It has been set up so that we do not need special education for the WERA evaluation. Thus, the WERA Evaluation was intended to be simple and fast to use, as well as no prior knowledge of observational techniques is required for those trained in its use. Still, it can be an added benefit knowing that WERA is a paper-and-pen fashion that may be utilized with no special clothing. The WERA evaluation could be performed at any workplace without disrupting the observed task of wall-banging workers through the use of a new evolution in ergonomic threat assessment tool identified as Workplace Ergonomic Risk Assessment (WERAThe study concluded that the WERA assessment indicated employment-related musculoskeletal issues, that could be noted as aches, pains, or annoyance in the impacted region11 wall posting jobs in construction. The results show statistically significant differences for the wrist, shoulder and back areas of each WERA part of the body score that affected the employee and led to the development of pain or discomfort in workers in wall-posting occupations (MSD) due to their simplicity of usage and capacity for formation to be utilized by several drug addicts in less specialized instruction and shorter duration of operation. Nevertheless, the main problem is the validity of their results. Because MSD is a multiple disciplines challenge, observational tools must be accurate if utilized by interpreters from various occupations. This investigation deepened the intra-rater and inter-rater confidence in the observation instrument for assessing the ergonomic threat from plants (WERA). Thirteen ergonomists from four occupations were trained and later individually asked to conduct a risk evaluation on 10 videos - recorded job conditioning. TO DETERMINE THEIR THREAT STANCE, the WERA tool was used to estimate actors' interaction with six physical danger variables associated with MSDs in six body locations. This research explained that the trustworthiness analysis showed the strength between various WERA experts. Hence, there's an imperative to change the design of the tasks and perform ergonomic improvements in the work being evaluated conditioning. The Bureau of Labor Statistics in Indonesia states that musculoskeletal disorders (MSDs) are the leading cause of workplace injuries that result in 30 reimbursement costs [19-13]. On this basis, investigations were carried out to find out the handling situations with the WERA system and to give recommendations for improvement to address the issue of muscular skeletal disorders. WERA's discovery proved that necklace, grommet, and off-line jobs scored 31.23, 28.87, and 30.9 required further investigation and improvement. They received assistance in the shape of Special Defense Equipment (PPE) to lower Contract Stress Threat Factor scores, necessitating a new workplace design of the necklace job, and to add aids for working other pain problems [15, 16]. However, some research questions the validity of WERA. For illustration, the present research aimed to estimate the possibility of using the WERA system to evaluate the threat of musculoskeletal diseases via its association with the outcomes of QEC. They set up that study of the relationship among the mean ratings of the two styles gesture towards a slight relationship between them. And Correlation among the frequency of diseases and QEC and WERA ratings proved that QEC leads to were more harmonious with Nordic outcomes, and this may be stated that the QEC system had been far more appropriate for ergonomic evaluation of musculoskeletal diseases threat for distinct assignments in this study [6].

Table No.1: SOCIO-DEMOGRAPHIC DATA

SECTION-1 SOCIO-DEMOGRAPHIC PROFORMA		Individual (%)	Individual (f)
SEX	Male	22.2%	30
	Female	9.6%	13

Table No.2

SECTION-1 SOCIO-DEMOGRAPHIC PROFORMA		Individual (%)	Individual (f)
AGE	13-14 Years	13%	17
	15-16 Years	7%	10
	17-18 Years	12%	16

Table No.3

SECTION-1 SOCIO-DEMOGRAPHIC PROFORMA		Individual (%)	Individual (f)
BMI	Underweight	16%	22
	Normal weight	15%	20
	Pre-obesity	1%	1
	Obesity	0%	0
SECTION-1 SOCIO-DEMOGRAPHIC PROFORMA		Individual (%)	Individual (f)
EXPERIENCE (years)	Up to 1 Year	25%	34
	2 Years	3%	4
	3 Years	1%	2
	4 Years	0%	0
	5 Years	0%	0
	6 Years	1%	1
	7 Years	1%	2

Table No.4 AGE

	Individual					
DESCRIPTIVE STATISTICS	Mean	SD	Maximum	Minimum	Median	N
AGE	15.46	1.73	18.00	13.00	16.0	43

Table No.5 WEIGHT

	Individual					
DESCRIPTIVE STATISTICS	Mean	SD	Maximum	Minimum	Median	N
WEIGHT	44.88	8.91	64.00	28.00	45.0	43

Table No.6 HEIGHT

	Individual					
DESCRIPTIVE STATISTICS	Mean	SD	Maximum	Minimum	Median	N
HEIGHT	5.05	0.50	6.20	4.00	5.2	43

Table No.7 BMI

	Individual					
DESCRIPTIVE STATISTICS	Mean	SD	Maximum	Minimum	Median	N
BMI	18.86	2.18	25.70	16.40	18.3	43

Table No.8 PFI

	Individual					
DESCRIPTIVE STATISTICS	Mean	SD	Maximum	Minimum	Median	N
PFI	66.77	13.26	83.79	32.77	70.8	43

Table No.9 WERA FINAL

	Individual					
DESCRIPTIVE STATISTICS	Mean	SD	Maximum	Minimum	Median	N
WERA FINAL	34.00	0.00	34.00	34.00	34.0	43

Table No.10 NMQ G

Individual						
DESCRIPTIVE STATISTICS	**Mean**	**SD**	**Maximum**	**Minimum**	**Median**	**N**
NMQ G	**10.77**	**2.01**	**13.00**	**9.00**	**9.0**	**43**

Table No.11 NMQL

Individual						
DESCRIPTIVE STATISTICS	**Mean**	**SD**	**Maximum**	**Minimum**	**Median**	**N**
NMQL	**2.67**	**4.21**	**13.00**	**1.00**	**1.0**	**43**

Table No.12 NMQNAS

Individual						
DESCRIPTIVE STATISTICS	**Mean**	**SD**	**Maximum**	**Minimum**	**Median**	**N**
NMQNAS	**2.00**	**0.00**	**2.00**	**2.00**	**2.0**	**43**

Limitations

Results cannot be generalized to all sports; Psychological factors were not included. And there, we could not control external factors like temperature diurnal variation in our study.

Recommendation for future research

A future study can be conducted on a large sample size for better credibility.

GeneralizabilityThe 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 individual sports. WERA has found that individuals carry the risk of worms. So we must be prepared to face the world in sports. Coaches and trainers should work on BMI and PFI as these components can play an important role in preventing worms.

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