Correation of Work-Related Mechanical Low Back Pain with Lower Limb Muscle Strength in Industrial Workers

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Abstract—**Background: Musculoskeletal disorders that occur because of work have been identified as a serious health risk in the workplace. Musculoskeletal disorders were strongly linked to working long hours. Prevalence of low back pain in industrial workers is 62%. Logistic regression revealed that low back discomfort was statistically significantly associated with age, the type of occupation, the number of hours worked, improper body mechanics, frequent bending or twisting, and extended sitting. Patients with low back pain may have weaker lower limb muscles compared to healthy controls.**

Materials and Methods: 91 young adults (age: 30-45yrs, male: 91) with low back pain and long-standing occupation (hours: 9±5) were assessed. Isometric muscle strength was measured using Baseline Hydraulic Hand-Held Dynamometer. Statistical analysis of reliability and validity comprised intraclass correlation coefficients (ICC) and Pearson correlations using GraphPad Prism software.

Results: In the study it was found that the Correlational graph between Hours of standing and MODQ score shows that as Hours of standing increases, MODQ score increases which means the data points have a positive association [r value (CI): 0.7850, P value: <0.0001]. Correlational graph between Hours of standing and individual lower limb muscle strength shows that the data do not have any association.

Conclusion: This study shows that as hours of standing increases, the MODQ score also increases. This proves that there is a correlation between hours of standing and low back pain.

This study also shows that there is no correlation between Hours of standing and lower limb muscle strength of both the lower limbs of the following muscles-Hip flexor, Hip extensor, Hip abductor, Hip adductor, Hip MR, Hip LR, Knee flexor, Knee extensor, Ankle PF, Ankle DF.

Index Terms—**Hours of standing, low back pain, lower limb muscle strength, MODQ, correlation, long standing occupation, hand-held dynamometer.**

I. INTRODUCTION

Work Related Musculoskeltal Disorders-
Musculoskeletal disorders that occur because of work have been identified as a serious health risk in the workplace. Musculoskeletal disorders were strongly linked to working long hours [11]. Prevalence of low back pain in industrial workers is 62% [13].

Industrial workers frequently experience musculoskeletal issues, particularly while doing production- related jobs. The main issue with most musculoskeletal problems is low back discomfort [13]. Studies have shown that a person's unique muscle coordination skills have distinct biomechanical effects on the musculoskeletal system, thus showing that muscle coordination affects muscle strength which further affects musculoskeletal system [2]. Research shows that long hours on the job are bad for people's health [11]. Logistic regression revealed that low back discomfort was statistically significantly associated with age, the type of occupation, the number of hours worked, improper body mechanics, frequent bending or twisting, and extended sitting [13]. Lumbar pain may be the result of an imbalance between the pelvis and the pelvic girdle due to weak hip flexors. The stability of the lumbar spine depends in large part on the strength of the hip muscles. The hip and trunk can function as a unit because of the strength and proper activation of the lower limb muscles when forces are transferred from the lower body to the lumbopelvic region [1]. Patients with low back pain may have weaker lower limb muscles compared to healthy controls [1].

Muscle strength refers to the capacity of skeletal muscles to produce force, which in turn provides support for and freedom of movement of the skeletal system [10].

Factors Determining Muscle Strength
The total area of structure meaning of muscle, the tightness of the tendons and muscles, the activation of motor units, rate encoding, motor neuron synchronization, and neuromuscular inhibition, all of which are morphological and neurological features that influence physical power [6,9, 10].

Type of Muscle Contraction:
1) Isometric Contractions-Without increasing muscle length, isometric contractions create a constant compression with a variable and supporting tension [10].

2) Isotonic Contractions-Isotonic contractions change muscle length but maintain tension. Forms of isotonic contractions: concentric and eccentric contractions [10].
3) Eccentric Contraction: A muscle lengthens when it yields to a force greater than its contractile force. The

muscles do not lengthen; they only return from their shorter position to their regular length.

Major factors influencing muscle strength- [10].

Age, Gender, Physical activities, Measuring Muscle Strength

Muscular endurance testing is done to measure the capacity of the muscle group or muscles to operate in movements in addition their capacity to supply support and stability, is vital aspect in terms of the bodily exam. It gives knowledge which is helpful in accurate diagnosis, prognosis, and treatment and neuromuscular orthopedic problems [10].

Manual Muscle Testing

It's a technique for rating power of a single or group of muscles, according to the effectiveness of a shift in proportion due to gravity pull or human resistance through the possible Motion range [10].

Outcome Measuring Muscular Strength: Muscular endurance testing is used to measure the capacity of the muscles or groups of muscles to operate in movements and its capacity for give support and consistency and is a vital aspect of the physical exam. It gives details that can be helpful in physical exams, prognosis and therapy of neuromuscular and orthopedic illnesses [10].

Oxford Scale- It is a technique used to assess a muscle or a group of muscles strength due to how well a movement is executed in relation to gravity or other manual opposition while utilizing the full range of motion [6,9].

Grade Description:

0- No Contraction, 1- Flickering Contraction, 2- Full Range of Motion with Gravity eliminated, 3- Full Range of Motion Against gravity, 4 - Full Range of Motion Against Gravity with Minimal Resistance, 5 - Full Range of Motion Against Gravity with Maximal Resistance.

Devices used to measure strength:

1) Pressure bio feedback: Pressure biofeedback is a device used to aid in the retraining of muscles by monitoring the position of the lumbar spine in respect to an air reservoir during deep abdominal contractions [7].

2) Dynamometry- it is a more accurate and objective way to measure the amount of force that a muscle can produce; it also makes it possible to compare the strength of muscles in different extremities or track the development of muscles during rehabilitation. [6,9].

3) Isokinetic Machines- Mechanical measurement of muscle performances [6,9].

II. NEED OF STUDY

Occupation stress is one of the major hazards of workplace. Previous studies have concluded that long-working hours are significantly associated with musculoskeletal symptoms. Studies have even shown the dimensions and characteristics of musculoskeletal symptoms whether they exist or not due to occupational stress (5). Lower limb muscles engaged in standing posture include - intrinsic muscles of feet, plantar flexors, dorsiflexors, evertors, knee extensors and hip extensors. As there are few literatures present, where the lower extremity muscle strength is evaluated and correlated with work-related mechanical low back pain in industrial workers with long standing occupation this study is been conducted.

III. PROCEDURE

The study was conducted at Engenius Metals, 5 STAR-MIDC, Kolhapur for period of 6 months. It was an observational study. 91 patients were fulfilling the inclusion and exclusion criteria were included in the study.

Inclusion Criteria: Participants belonging to 30-45 years age group of all genders having mechanical lower back pain who were industrial workers standing for more than 6 hours a day with a work experience (for more than 4 years) having no recent musculoskeletal injuries.

Exclusion Criteria: Participants having history of Spinal surgeries, any recent trauma, pain other than low back.

Methodology: Ethical Approval was been obtained from Protocol committee of D. Y. Patil education society, Kolhapur and D.Y Patil college of Physiotherapy, Kolhapur. Correlation of work- related mechanical low back pain with lower limb muscle strength in industrial workers is an observational study which was conducted at Engenius Metals, PVT LTD company with prior permission.

The participants were included in the study based on inclusion and exclusion criteria by simple random sampling method and the procedure was explained to them in their vernacular language. Written informed consent was taken from the participants willing to participate. A brief demographic data including details like, name, age, gender, duration of work, hours of standing as per data collection sheet was recorded. Further, to assess the lower limb muscle strength Hand-Held Dynamometer device was used. The participants muscle strength was assessed in supine, prone and sitting positions for hip flexor, hip extensor, hip abductor, hip adductor, knee extensor, knee flexor, ankle plantarflexor and ankle dorsiflexor. The participants were informed to apply pressure against the Hand-held Dynamometer and a pressure reading was shown by the device simultaneously. The pressure reading was thus concluding the strength in the muscle present. Modified Oswestry Low Back Pain Disability

Questionnaire was used for evaluating low back pain. The questionnaire was in the vernacular language of the participant and was also be explained to them. The interpretation of the study was done based on the Hand-Held Dynamometer and Modified Oswestry Low Back Pain Disability Questionnaire. The study was concluded by statistical analysis of the outcome measures and device use.

The following testing positions described below have demonstrated excellent reliability for the assessment of isometric strength for the hip [17], knee [18], and ankle [18] muscle groups in earlier research.

The participants were examined for isometric muscular strength while seated, supine, or prone. In the seated position, the hip flexors, knee extensors, and knee flexors, as well as the hip medial rotators and hip lateral rotators, were measured; hip extensors in a prone posture; ankle plantarflexors, ankle dorsiflexors, hip abductors, and hip adductors in a supine position. To increase the possibility of testing in a clinical context, these positions were selected to limit participant position changes. Maximum voluntary isometric contractions were performed for each test.

The initial step was assessment with the HHDs. Testing positions for strength assessment were:(A) Hip flexors: The subjects were seated with their knees and hips bent 90 degrees. Dynamometer placed close to the knee joint, on the anterior part of the thigh (Fig 22). (B) Knee extensors: The subjects were seated with their knees and hips bent 90 degrees. Dynamometer placed close to the knee joint, on the anterior part of the shank (Fig 24). (C) Knee flexors: The subjects were seated with their knees and hips bent 90 degrees. Dynamometer placed close to the ankle joint, on the posterior part of the shank. (Fig 23). (D) Hip medial rotators: The subjects were seated with their knees and hips bent 90 degrees. Dynamometer placed close to the ankle joint, on the medial side of the shank. (E) Hip lateral rotators: The subjects were seated with their knees and hips bent 90 degrees. Dynamometer placed close to the ankle joint, on the lateral side of the shank. (F) Ankle plantarflexors: The subjects were in a supine position, their hips and knees extended, and their ankles plantarflexed. Dynamometer positioned on the foot sole, above the metatarsal heads (Fig 25). (G) Ankle dorsiflexors: The subjects were in a supine position, their hips and knees extended, and their ankles relaxed. Dynamometer positioned on the dorsum of the foot, above the metatarsal heads. (H) Hip abductors: The participant was in a supine position, their hips and knees extended. Dynamometer placed close to the ankle joint, on the lateral side of the shank. (I) Hip adductors: The participant was in a supine position, their hips and knees extended. Dynamometer placed close to the ankle joint, on the medial side of the shank. (J) Hip extensors: The participant was in a prone position, their hips and knees extended. Dynamometer placed close to the ankle joint, on the posterior part of the shank.

Participants were instructed to push or pull as hard and quickly as they could at the count of three, and to hold that contraction until I said to them to relax. Every test had a duration of three to five seconds, and it concluded when the subject delivered a constant, maximum force. All during the test, verbal support was given continuously. Both the limbs of each participant were assessed. All individual muscle strength mentioned above were assessed only once.

Participants were also assessed for lower limb leg dominance. Participants were instructed to kick a ball placed in front of them (Fig 26) The first leg which came ahead to kick the ball was chosen as the dominant leg [8].

IV. STATSITICAL ANALYSIS

Data were assessed for correlation between Hours of standing and MODQ score and between Hours of standing and individual muscle strength using GraphPad Prism software. The descriptive statistics (r value (CI) and P value) were used to describe the correlation as positive or negative of the above given data.

The first step in analysis was to calculate the correlation between Hours of standing and MODQ score, the statistical values for which were r value= 0.7050 and P value= <0.0001 showing that the data had a positive association between each other which is represented in the form of table and line graph(Fig.1)

Second step was to find the correlation between Hours of standing and individual muscle strength of both the lower limbs which is represented in the form of table and line graphs.

Fig 2. Correlation between Hours of standing and RT hip flexor muscle strength was calculated, the statistical values for which were r value= 0.09372 and P value= 0.3784 showing that the data had no association between each other.

Fig 3. Correlation between Hours of standing and LT hip flexor muscle strength was calculated, the statistical values for which were r value= 0.02 and P value= 0.8 showing that the data had no association between each other.

Fig 21. Correlation between Hours of standing and RT hip extensor muscle strength was calculated, the statistical values for which were r value= -0.01318 and P value= 0.9013 showing that the data had no association between each other.

Fig 4. Correlation between Hours of standing and LT hip extensor muscle strength was calculated, the statistical values for which were r value= -0.04503 and

P value= 0.6717 showing that the data had no association between each other.

Fig 5. Correlation between Hours of standing and RT hip abductor muscle strength was calculated, the statistical values for which were r value= 0.1013 and P value= 0.339 showing that the data had no association between each other.

Fig 6. Correlation between Hours of standing and LT hip abductor muscle strength was calculated, the statistical values for which were r value= 0.1201 and P value= 0.2570 showing that the data had no association between each other.

Fig 7. Correlation between Hours of standing and RT hip adductor muscle strength was calculated, the statistical values for which were r value= 0.1359 and P value= 0.1991 showing that the data had no association between each other.

Fig 8. Correlation between Hours of standing and LT hip adductor muscle strength was calculated, the statistical values for which were r value= 0.1638 and P value= 0.1208 showing that the data had no association between each other.

Fig 9. Correlation between Hours of standing and RT hip MR muscle strength was calculated, the statistical values for which were r value= -0.05248 and P value= 0.6213 showing that the data had no association between each other.

Fig 10. Correlation between Hours of standing and LT hip MR muscle strength was calculated, the statistical values for which were r value= -0.08813 and P value= 0.4061 showing that the data had no association between each other.

Fig 11. Correlation between Hours of standing and RT hip LR muscle strength was calculated, the statistical values for which were r value= 0.1210 and P value= 0.2533 showing that the data had no association between each other.

Fig 12. Correlation between Hours of standing and LT hip LR muscle strength was calculated, the statistical values for which were r value= -0.01509 and P value= 0.9207 showing that the data had no association between each other.

Fig 13. Correlation between Hours of standing and RT knee flexor muscle strength was calculated, the statistical values for which were r value= 0.1424 and P value= 0.1783 showing that the data had no association between each other.

Fig 14. Correlation between Hours of standing and LT knee flexor muscle strength was calculated, the statistical values for which were r value= 0.08347 and P value= 0.4315 showing that the data had no association between each other.

Fig 15. Correlation between Hours of standing and RT knee extensor muscle strength was calculated, the statistical values for which were r value= 0.09372 and

P value= 0.3784 showing that the data had no association between each other.

Fig 16. Correlation between Hours of standing and LT knee extensor muscle strength was calculated, the statistical values for which were r value= 0.07173 and P value= 0.4992 showing that the data had no association between each other.

Fig 17. Correlation between Hours of standing and RT ankle DF muscle strength was calculated, the statistical values for which were r value= 0.1345 and P value= 0.2037 showing that the data had no association between each other.

Fig 18. Correlation between Hours of standing and LT ankle DF muscle strength was calculated, the statistical values for which were r value= 0.07252 and P value= 0.4945 showing that the data had no association between each other.

Fig 19. Correlation between Hours of standing and RT ankle PF muscle strength was calculated, the statistical values for which were r value= 0.1308 and P value= 0.2166 showing that the data had no association between each other.

Fig 20. Correlation between Hours of standing and LT ankle PF muscle strength was calculated, the statistical values for which were r value= -0.03305 and P value= 0.7558 showing that the data had no association between each other.

V. RESULT

A total 91 participants, all genders industrial workers standing for more than 6 hours a day since more than 4 years, complaining of mechanical low back pain were selected for study from Engenius Metals, Kolhapur. Age of the participants was between 30 to 45 years. Participants with history of spine surgeries, recent trauma and pain other than low back were excluded.

In our study we found that there is a positive correlation between hours of standing and low back pain in industrial workers with a standing occupation a shown in table annexure and line graph data collection1.

The current study also proves that there is no correlation between hours of standing and lower limb muscle strength in industrial workers with a standing occupation as shown in the table annexure and line graphs data collection from 2-20.

VI. DISCUSSION

The aim of the current study is to find the correlation between mechanical low back pain and lower limb muscle strength in industrial workers. 62% of industrial workers report having low back pain [13].

Workers in the industrial sector who experience unsatisfactory working conditions are partially at fault for LBP. Workers in every industry frequently handle a large number of unexpected projects with a variety of responsibilities. Industrial labor requires a lot of physical effort [14].

Musculoskeletal problems are a common occurrence for industrial workers, especially when doing occupations involving production. Low back pain is the primary symptom of the majority of musculoskeletal disorders. According to logistic regression, there was a statistically significant correlation between low back discomfort and age, the kind of employment, the number of hours worked, poor body mechanics, frequent bending or twisting, and prolonged sitting [13].

The main aim of the current study was to find the correlation between these: - (i) hours of standing and low back pain (ii) hours of standing and lower limb muscle strength.

The study was carried out with 91 industrial workers having a long-standing occupation. In the current study, the correlation was found out using the GraphPad Prism software. In this study, we found out that there is significant correlation between hours of standing and low back pain. Low back pain was proven by using the Modified Oswestry Disability Questionnaire (MODQ).

As, Julie.M.Fritz et al(2001) concluded that the MODQ had better measurement qualities and had a higher test-retest reliability when it came to measuring disability(4). The current study concluded that there is correlation between hours of standing and low back pain. The two data have a positive association between each other.

According to Tetsuya Hasyawa et al (2018), workplace back pain may be associated with a habit of bad standing posture. Research on the connection between back pain and standing posture has shown that deviation from a neutral posture increases the likelihood of experiencing low back pain [16].

This study proves that there is no correlation between hours of standing and individual lower limb muscle strength. The two data do not have any association between each other.

The following muscles of both the lower limbs were assessed- Hip flexor, Hip extensor, Hip abductor, Hip adductor, Hip MR, Hip LR, Knee flexor, Knee extensor, Ankle PF, Ankle DF.

According to Kisner, many other factors additionally influence quadriceps activity in knee extension during weight-bearing activities. The gluteus maximus and soleus are helpful with knee extension. As the line of gravity travels anterior to the knee axis for flexion as well as extension, a gravitational extension torque is produced that keeps the joint in extension, resulting in minimal quadriceps activity when an upright posture is reached [15].

Thus, showing that multiple factors come together during weight bearing and not just an individual muscle. The instrument used for measuring the lower limb muscle strength was Hand Held Dynamometer.

According to Benjamin.F.Mentiplay et. al. (2015), For almost all of measures of isometric lower limb power and strength in a healthy population, hand-held dynamometry provides good to exceptional validity and reliability, especially for proximal muscle groups.

Table. I : Correlational   Data with r and P Value

Co-relation between		r value	P value
Hours of standing during work(in hours)	MODQ score (in %)	0.7050	<0.0001
Hours of standing during work(in hours)	RT hip flexor (kg)	0.09372	0.3784
Hours of standing during work(in hours)	LT hip flexor (kg)	0.02	0.8
Hours of standing during work(in hours)	RT hip extensor (kg)	-0.01318	0.9013
Hours of standing during work(in hours)	LT hip extensor (kg)	-0.04503	0.6717
Hours of standing during work(in hours)	RT hip abductor (kg)	0.1013	0.3393
Hours of standing during work(in hours)	LT hip abductor (kg)	0.1201	0.2570
Hours of standing during work(in hours)	RT hip adductor	0.1359	0.1991
Hours of standing during work(in hours)	LT hip adductor	0.1638	0.1208

| Hours of standing during work(in hours)	RT hip MR (kg)	-0.05248	0.6213
Hours of standing during work(in hours)	LT hip MR(kg)	-0.08813	0.4061
Hours of standing during work(in hours)	RT hip LR(kg)	0.1210	0.2533
Hours of standing during work(in hours)	LT hip LR(kg)	-0.01509	0.9207
Hours of standing during work(in hours)	RT knee flexor (kg)	0.1424	0.1783
Hours of standing during work(in hours)	LT knee flexor (kg)	0.08347	0.4315
Hours of standing during work(in hours)	RT knee extensor (kg)	0.1019	0.3365
Hours of standing during work(in hours)	LT knee extensor (kg)	0.07173	0.4992
Hours of standing during work(in hours)	RT ankle DF (kg)	0.1345	0.2037
Hours of standing during work(in hours)	LT ankle DF (kg)	0.07252	0.4945
Hours of standing during work(in hours)	RT ankle PF (kg)	0.1308	0.2166
Hours of standing during work(in hours)	LT ankle PFA (kg)	-0.033505	0.7558

XY data: Correlation of Data 1
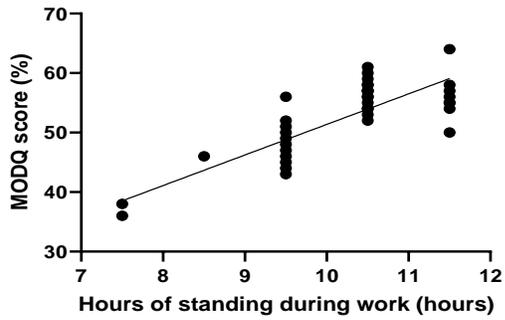
Fig 1: Graph showing that all of the data points are in a pattern trending upwards from left to right. The graph shows that as Hours of standing increases, MODQ score increases which means the data points have a positive association. r value (CI): 0.7850, P value: <0.0001.
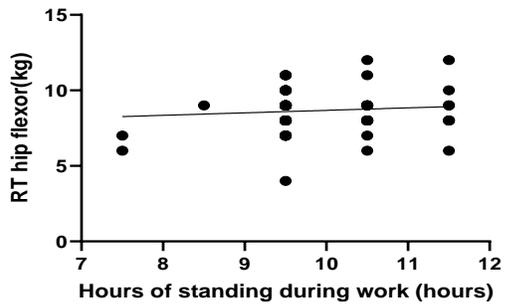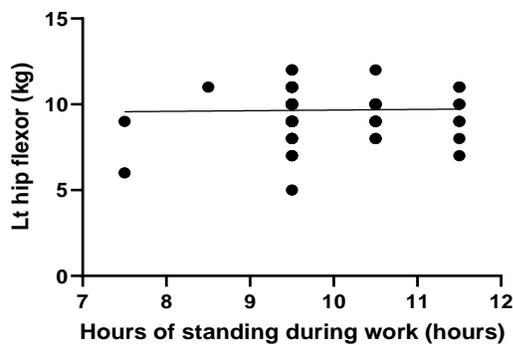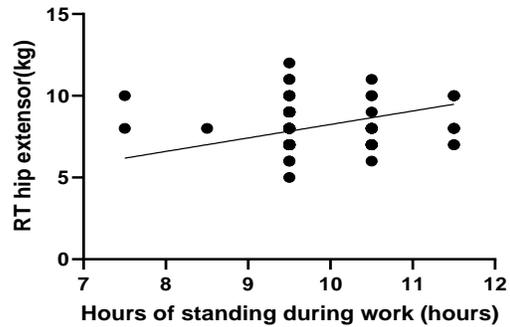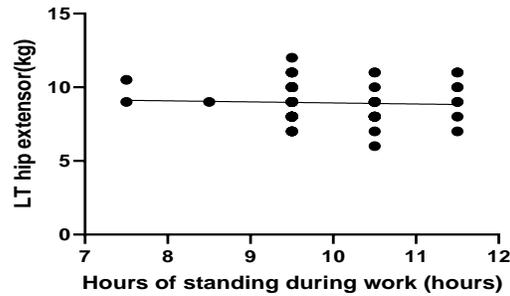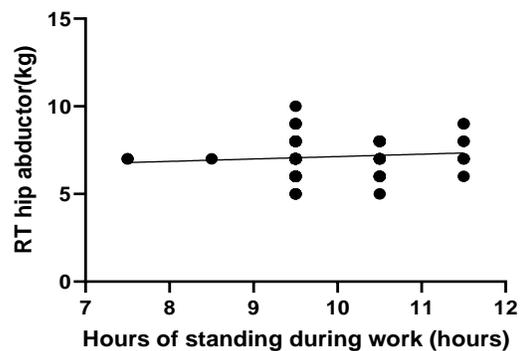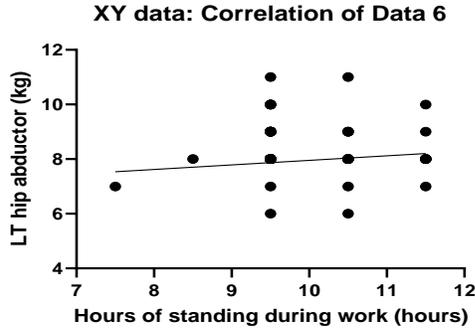
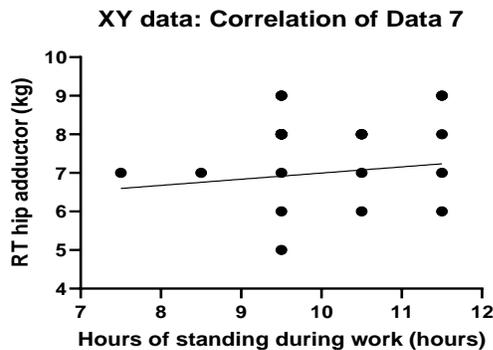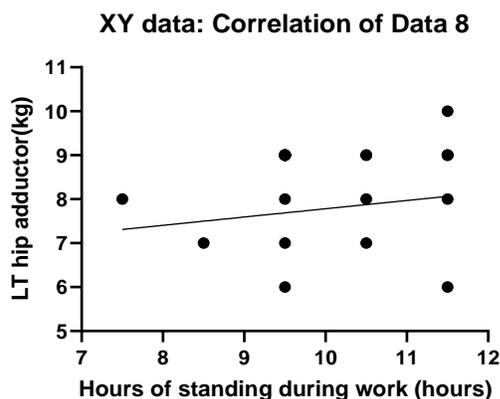**XY data: Correlation of Data 2**

Fig 2: Graph showing there is no pattern to the data from left to right. The graph shows that there is no correlation between Hours of standing and RT hip flexor muscle strength which means that the data points do not have any association. r value (CI): 0.09371, P value: 0.3784.

XY data: Correlation of Data 22

Fig 3: Graph showing there is no pattern to the data from left to right. The graph shows that there is no correlation between Hours of standing and Lt hip flexor muscle strength which means that the data

points do not have any association. r value (CI): 0.02315, P value-: 0.8276.
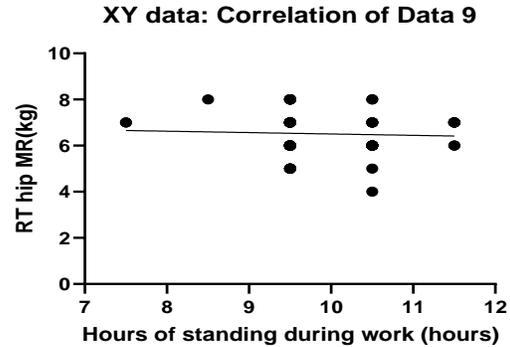
XY data: Correlation of Data 21

Fig 4: Graph showing there is no pattern to the data from left to right. The graph shows that there is no correlation between Hours of standing and Rt hip extensor muscle strength which means that the data points do not have any association. r value (CI): -0.01318, P value: 0.9013.
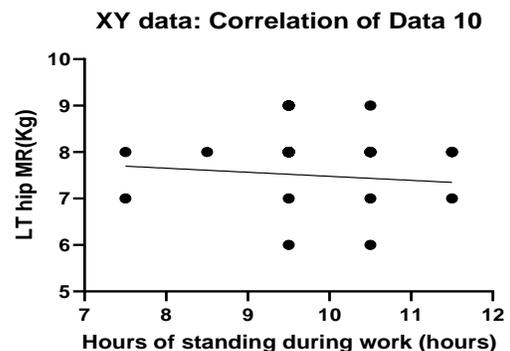
XY data: Correlation of Data 4

Fig 5: Graph showing there is no pattern to the data from left to right. The graph shows that there is no correlation between Hours of standing and Lt hip extensor muscle strength which means that the data points do not have any association. r value (CI) -0.04503, P value 0.6717.
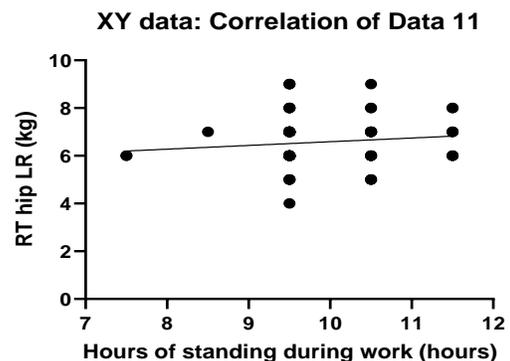
XY data: Correlation of Data 5

Fig 6: Graph showing there is no pattern to the data from left to right. The graph shows that there is no correlation between Hours of standing and Rt hip abductor muscle strength which means that the data points do not have any association. r value (CI): 0.1013, P value: 0.3393.

XY data: Correlation of Data 6

Fig 7: Graph showing there is no pattern to the data from left to right. The graph shows that there is no correlation between Hours of standing and Lt hip abductor muscle strength which means that the data points do not have any association. r value (CI): 0.1201, P value: 0.2570.

XY data: Correlation of Data 7

Fig 8: Graph showing there is no pattern to the data from left to right. The graph shows that there is no correlation between Hours of standing and Rt hip adductor muscle strength which means that the data points do not have any association. r value (CI): 0.1359, P value: 0.1991.

XY data: Correlation of Data 8

Fig 9: Graph showing there is no pattern to the data from left to right. The graph shows that there is no correlation between Hours of standing and Lt hip adductor muscle strength which means that the data points do not have any association. r value (CI): 0.1638, P value: 0.1208.

XY data: Correlation of Data 9

Fig 10: Graph showing there is no pattern to the data from left to right. The graph shows that there is no correlation between Hours of standing and Rt hip MR muscle strength which means that the data points do not have any association. r value (CI): -0.05248, P value: 0.6213.

XY data: Correlation of Data 10

Fig 11: Graph showing there is no pattern to the data from left to right. The graph shows that there is no correlation between Hours of standing and Lt hip MR muscle strength which means that the data points do not have any association. r value (CI): -0.08813, P value: 0.4061.

XY data: Correlation of Data 11

Fig 12: Graph showing there is no pattern to the data from left to right. The graph shows that there is no correlation between Hours of standing and Rt hip LR muscle strength which means that the data points do not have any association. r value (CI): 0.1210, P value: 0.2533
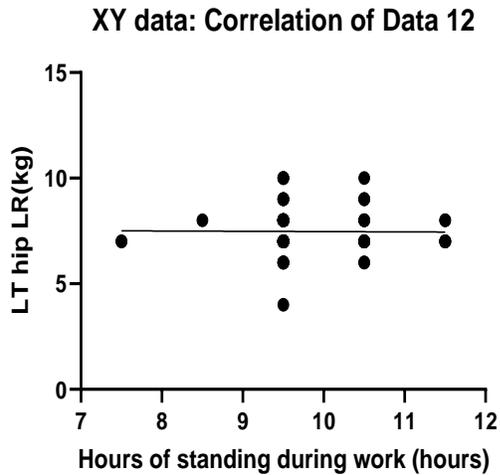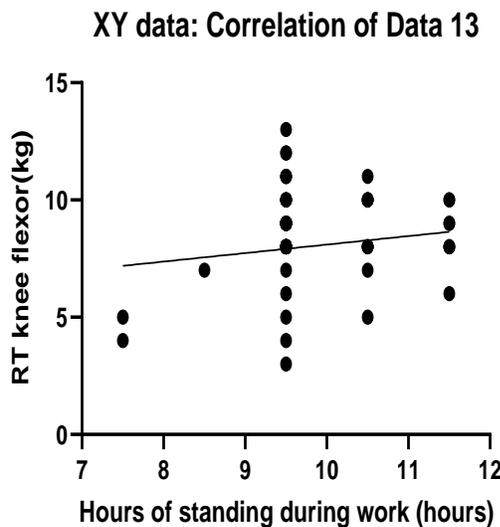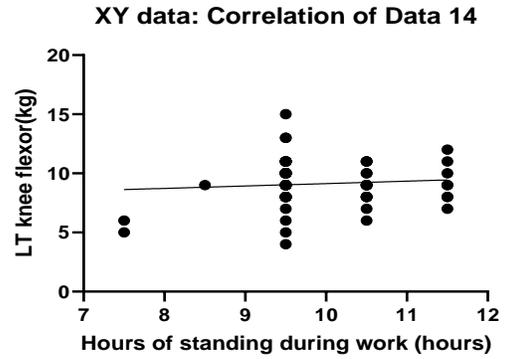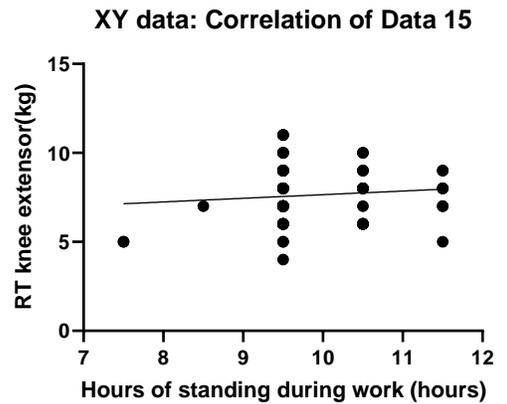

XY data: Correlation of Data 12

Fig 13: Graph showing there is no pattern to the data from left to right. The graph shows that there is no correlation between Hours of standing and Lt hip LR muscle strength which means that the data points do not have any association. r value (CI): -00.01509, P value: 0.9207.

XY data: Correlation of Data 13

Fig 14: Graph showing there is no pattern to the data from left to right. The graph shows that there is no correlation between Hours of standing and Rt knee flexor muscle strength which means that the data points do not have any association. r value (CI):0.1424, P value: 0.1783

XY data: Correlation of Data 14

Fig 15: Graph showing there is no pattern to the data from left to right. The graph shows that there is no correlation between Hours of standing and Lt knee flexor muscle strength which means that the data points do not have any association. r value (CI): 0.08347, P value: 0.4315.

XY data: Correlation of Data 15

Fig 16: Graph showing there is no pattern to the data from left to right. The graph shows that there is no correlation between Hours of standing and Rt knee extensor muscle strength which means that the data points do not have any association. r value (CI): 0.1019, P value: 0.3365.
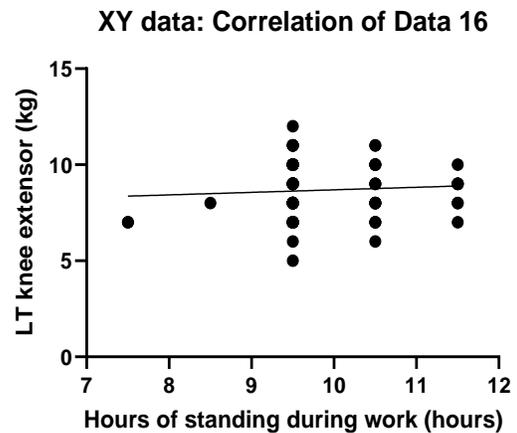

XY data: Correlation of Data 16

Fig 17: Graph showing there is no pattern to the data from left to right. The graph shows that there is no correlation between Hours of standing and Lt knee extensor muscle strength which means that the data points do not have any association. r value (CI): 0.07173, P value: 0.4992.
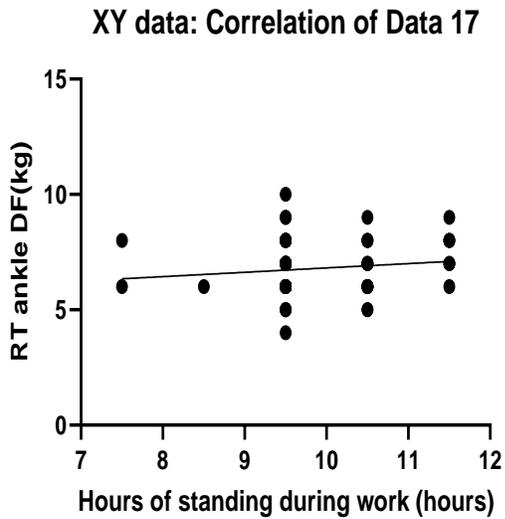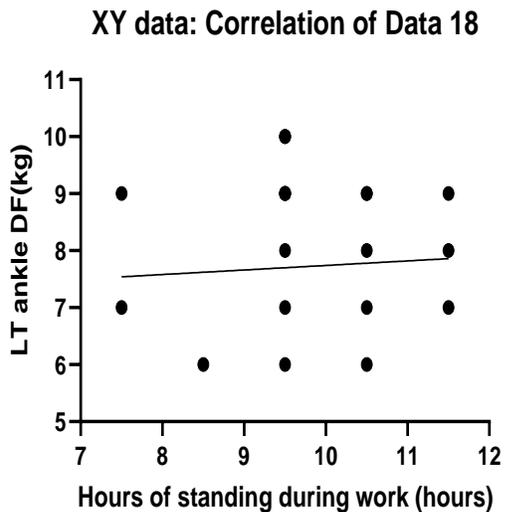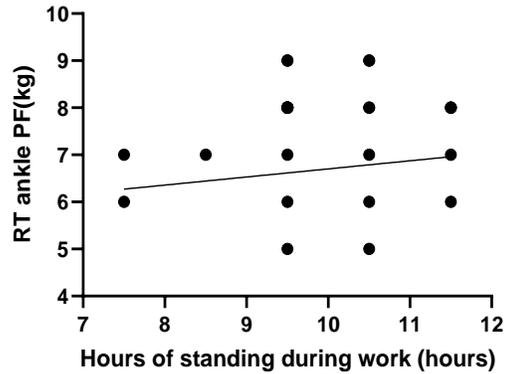
XY data: Correlation of Data 17

Fig 18: Graph showing there is no pattern to the data from left to right. The graph shows that there is no correlation between Hours of standing and Rt ankle DF muscle strength which means that the data points do not have any association. r value (CI): 0.1345, P value: 0.2037.

XY data: Correlation of Data 18

Fig 19: Graph showing there is no pattern to the data from left to right. The graph shows that there is no correlation between Hours of standing and Lt ankle DF muscle strength which means that the data points do not have any association. r value (CI): 0.07252, P value: 0.4945.

XY data: Correlation of Data 19

Fig 20: Graph showing there is no pattern to the data from left to right. The graph shows that there is no correlation between Hours of standing and Rt ankle PF muscle strength which means that the data points do not have any association. r value (CI): 0.1308, P value: 0.2166.

Fig 22. Assessing strength of hip flexors.

Fig23. Assessing strength of knee flexors.

Fig 24. Assessing strength of knee extensors.

Fig25. Assessing strength of ankle plantarflexors.

Fig 26. Assessing the lower limb dominance

A. *Abbreviations and Acronyms*

Fig.	Figure
MODQ	Modified Oswestry Disability Questionnaire
HHD	Hand Held Dynamometer
PVT.LTD	Private Limited
RT	Right
LT	Left
MR	Medial Rotators
LR	Lateral Rotators
PF	Plantar Flexors
DF	Dorsi Flexors

VII. CONCLUSION

The current study concludes that there is a positive correlation between hours of standing and low back pain in industrial workers with a standing occupation. The current study also proves that there is no correlation between hours of standing and lower limb muscle strength in industrial workers with a standing occupation.

VIII. ACKNOWLEDGMENT

IX. CONFLICT OF INTEREST

The authors declare no conflict of interest.

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