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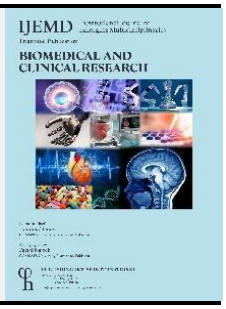

Correlation Between Musculoskeletal Pain And Cognition Among University Level Students Using The Ruff Figural Fluency Test

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ABSTRACT

BACKGROUND: Hand grip strength and function are important for day- to-day tasks. Although chronic pain has long been known to affect cognitive outcomes, new research published in the last decade has focused on the multi-dimensional impacts of pain on multiple cognitive areas.

OBJECTIVE: To study cognitive impairment and musculoskeletal pain in university level students and to evaluate the relationship between musculoskeletal pain and cognition in university level students.

METHODOLOGY: Study design is cross sectional and observational with sample size87 at MGM SCHOOL OF PHYSIOTHERAPY With age 18 to 27 years having any musculoskeletal pain.

RESULTS: The statistical significance of the participants' pain in days with the p value is 0.001 ($p<0.001$). The amount of errors made by participants with a p value of 0.001 (i.e., $p<0.001$), the correlation coefficient r-value between the length of the pain episode and the length of the rough figural fluency test was recorded as -0.068, which is statistically insignificant at the 5% level with a non-linear link with a non-linear link, the correlation coefficient r-value for pain duration and ruff figural fluency test errors was observed as -0.11, which is statistically insignificant at the 5%

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level. **CONCLUSION:** This study concluded that there is a significant relation between pain and cognition and has a positive correlation between pain and cognition.

KEYWORDS: Cognition, Musculoskeletal Pain, Physiotherapy, Ruff Figural Fluency Test, University Students.

1. Introduction

Pushing ourselves to do too much despite the pain will not result in any gain so this study focuses on students who are required to know whether musculoskeletal pain is affecting their cognition or not. The number of patients experiencing discomfort is increasing. Between the ages of 41 and 60, 37.9% of those questioned were, with 33.87 percent between the ages of 21 and 40, and 19.36 percent between the ages of 61 and 80. Cases involving people under the age of 20 made up 8.87 percent of the total. [1]

The subjective experience of pain has several cognitive components, including cognitive appraisal, learning, memory of prior experiences, and active decision-making. The presence of pain is frequently accompanied by cognitive impairment. This disability is a significant barrier to everyday life and recovery [2] .Critical components of cognition include verbal and linguistic abilities, attention, perception, memory, motor coordination, executive functioning(EF), and memory [3]. The ability for information processing known as attention involves directed or concentrated consciousness [4].

From a conceptual standpoint, memory is made up of a series of storage systems that are necessary for information flow from the environment to a short-term memory store, which then feeds long-term memory [5]. Studies on perception, executive functioning, processing speed, and decision- making in people with chronic pain have shown that pain has a negative impact on perceptual learning and emotional decision-making [6].

The QOL of individuals is significantly impacted by musculoskeletal (MSK) discomfort. Sleep disruption, exhaustion, depression, activity constraints, and participation restrictions are all effects of chronic musculoskeletal pain [7]. Muscles, ligaments, tendons, and bones can all experience musculoskeletal discomfort.

Musculoskeletal discomfort has a variety of causes. The wear and strain of regular activities can harm muscle tissue. Musculoskeletal discomfort can also result from trauma to a region, such as jerking movements, fractures, sprains, dislocations, and direct impacts to the muscle. Muscle

shortening and spinal alignment issues may result from changes in posture or poor body mechanics, which in turn can cause other muscles to be abused and become uncomfortable. People have different symptoms; however the following ones are frequently seen Pain, fatigue, and disturbed sleep [8]. In addition to the psychosocial effects of pain, they include the functional domains and overall quality of life. [9].

A loss in EF, which is utilized to direct and organize cognitive activities and behavior, is one of the early symptoms of cognitive decline [10]. Planning, organizations, thinking control, self-regulation, goal- directed activities, initiation, and action analyses are just a few of the complex cognitive tasks that executive function helps with. Cognitively challenging tasks can be used by young adults and people in their middle years to divert their attention and, to some extent, self-manage discomfort. [11].

The verbal fluency domain and the non-verbal fluency domain can be distinguished within the executive functioning domain. Examinations measuring non-verbal fluency should be chosen over tests measuring verbal fluency because they are more sensitive to identifying changes in EF over the course of a lifetime [12], [13], [14].

The RFFT, a paper-and-pencil assessment of non-verbal fluency, is more sensitive to spotting non-verbal fluency alterations early on [12]. The RFFT consists of a task in which responders must create as many original designs as they can in 60 seconds on a sheet with 35 boxes. Using a sheet with various point arrangements, this assignment is repeated five times. Designs that are repeated receive a preservative error score [14]. By totaling the unique designs and preservative mistakes (also known as double designs) from these five sheets, the performance on the RUFF FIGURAL FLUENCY TEST is evaluated. Previous studies demonstrated the RFFT's strong construct validity [15] and can effectively distinguish between various age and educational level [16], [17], [18].

The Nordic Council of Ministers supported a research that resulted in the creation of the Nordic Musculoskeletal Questionnaire (NMQ). [(19)]In order to compare low back, neck, shoulder, and general symptoms in epidemiological study a standardized questionnaire approach was developed and tested. The instrument wasn't created for medical diagnosis. Both a questionnaire and a structured questionnaire may be conducted using the NMQ. However, when the NMQ was given as part of a targeted investigation on MSK disorders and job variables rather than as part of

a routine general health assessment, considerably greater rates of musculoskeletal pain were reported. [20]

Section 1: a broad questionnaire with 40 forced-choice questions that pinpoint the parts of the body where musculoskeletal issues are present. A body map that highlights the nine symptom sites helps with completion. Respondents are asked if they have experienced any musculoskeletal pain that has limited regular activities in the last year and the past week.

Section 2: Additional questions concerning the lower back, shoulders, and neck reveal more details about relevant issues. Twenty- five MCQ's are used to gather information on incidents that have affected each area, the functional impact at home and at work (such as a change in job responsibilities), the length of the issue, a doctor's assessment, and musculoskeletal issues in the previous week [21].

University level students are exposed to higher workload which includes sitting and standing activities and also exposed to more stress; this may have impact on musculoskeletal/ cognition level.

Hand grip strength and function are important for day-to-day tasks. Despite the fact that the effects of chronic pain on cognition are well-known, recent studies have emphasized the multifaceted impacts of pain on several cognitive domains. Till now there are no studies done on finding musculoskeletal pain related to cognition on studying students.

1.1 Aim of Study

To find out the Correlation between Musculoskeletal Pain and Cognition among University level students using the RUFF FIGURAL FLUENCY TEST.

1.2 Need for Study

Students in higher education are subjected to tasks that require both sitting and standing, as well as increased stress. Students spend a lot of time carrying heavy objects and sitting for extended amounts of time in uncomfortable chairs which frequently call for speed, and this causes them to assume unsuitable postures. This encourages exposure to risk factors for the development of musculoskeletal discomfort, and the symptoms might affect their quality of life and general well-being as practitioners. The recent study has shown that pain is a summative experience in a person's physiological, emotional, social and psychological aspects contribute in an equal proportion. As far my search till now there are no study done on finding whether musculoskeletal pain is related to cognition on studying study.

2. Materials and Methods

2.1Partcipants and data source

The data were collected by using an outcome measures Ruff Figural Fluency Test and Nordic Questionnaire. Observational research design was used with Pre and posttest. The study was conducted in MGM School of Physiotherapy, MGM Medical College and Hospital, Aurangabad, Maharashtra, India – 431005. Population of the Study was 87 Subjects, with 18 months of study duration. Convenient sampling technique was used for sample collection.

2.2 Inclusion and Exclusion Criteria

Inclusion Criteria:

1. Healthy adults (Both Male and Female)
2. Age above 18 years
3. Subjects with Musculoskeletal pain

Exclusion Criteria*:* Not willing to participate or any other systemic disease

2.3 Outcome Measures

The outcome measure used were Ruff Figural Fluency Test and Nordic questionnaire.

2.2 Procedure

The subjects were selected according to inclusion and exclusion criteria and those who were willing to participate in the study were given an informed consent form. After having their consent for the study, they were first given Nordic Questionnaire to evaluate the musculoskeletal pain.

Then subjects were given ruff figural fluency test sheet to draw as many unique designs as they can on a sheet containing 35 boxes within 60s.This task was repeated five times, each time using a sheet containing different point configurations. Repetitions of designs were scored as preservative errors. The performance was assessed by counting the total number of unique designs and the total number of preservative errors (i.e., double designs) from these five sheets.

2.3 Statistical Analysis

Data was entered by MS Excel and analyzed by using SPSS (statistical package for the social sciences) software version 23 for advanced analysis. The collected data is tabulated by taking demographic variables such as age, gender, height, weight, etc. Also, data was represented in form of visual impressions like bar diagram and tables etc. Along with that Mean, SD, SE means, percentage, frequency, analysis of variances, were used. Data will be stored for 5 years in a password protected file after completion of the study / after publication on the researcher's personal computer.

2.4 Ethics approval of research

Formal permission from the research committee of the MGM-ECRHS was obtained approval. Approval of the study was obtained from the Ethical Committee for research on human subjects. Permission was obtained from the member secretary MGMECRHS, MGM Medical College, Aurangabad. Confidentiality was maintained by using obtained data only for study purposes. Informed consent was taken from the subjects before the study in written form.

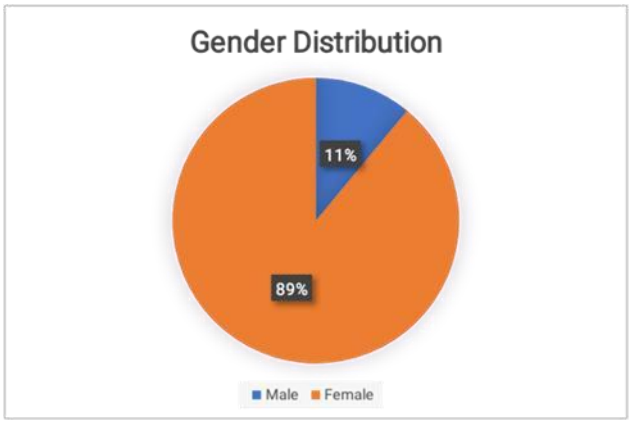
2.5 Clinical Trial Registration

Clinical trial registration is not required as it was an observational study.

3. Results

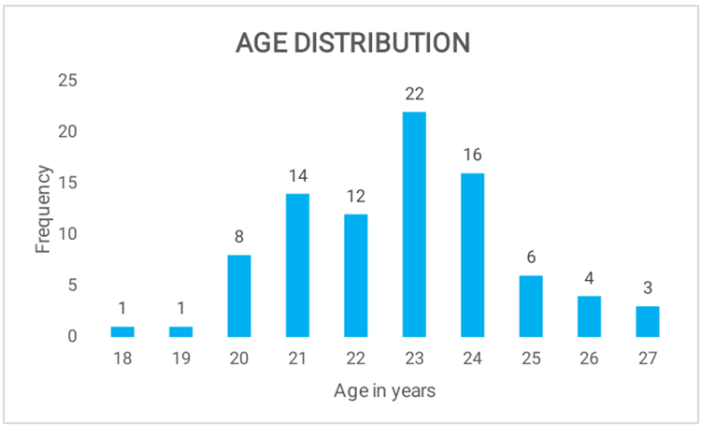
The statistical significance of the demographic variable of gender is displayed in Graph 1 with frequency and percentage at a p value of 0.001 ($p<0.001$).

Graph 1: Shows Gender Distribution of Male and Female



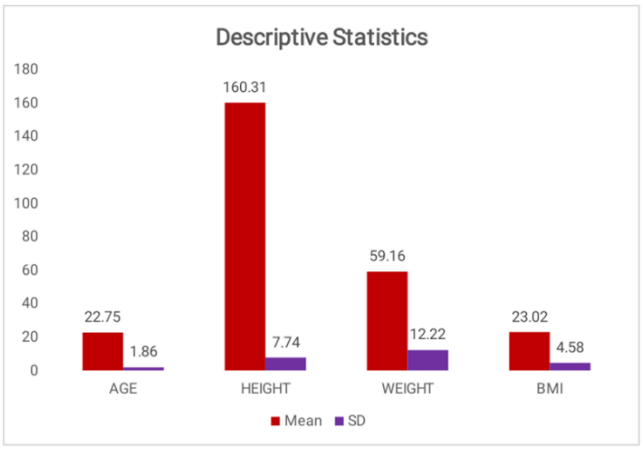
Age is statistically significant with frequency and percentage in Graph 2, where the p value is 0.001 ($p<0.001$).

Graph 2: Shows Age Distribution of Participants



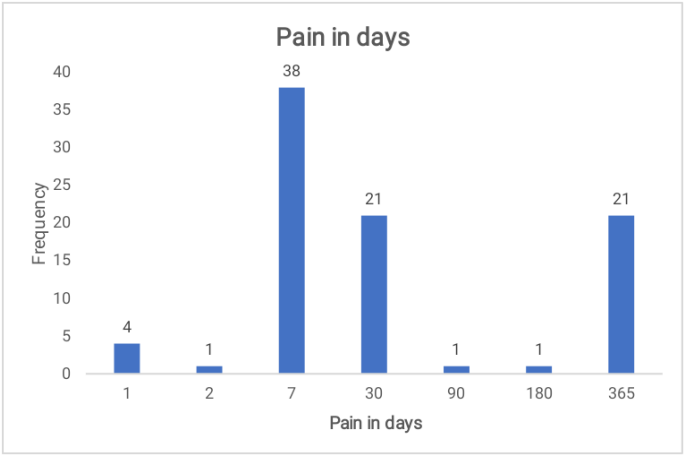
Participants' age (mean: 22.75 and SD: 1.86), height (mean: 160.31 and SD: 7.74), weight (mean: 59.16 and SD: 12.22), and BMI are shown in Graph 3. (Mean is 23.02 and SD is 4.58)

Graph 3: Shows Descriptive Statistics of Age Height BM



The statistical significance of the participants' pain in days with frequency and percentage is shown in Graph 4, where the p value is 0.001 ($p<0.001$).

Graph 4: Shows Pain in Days of Participants



The amount of errors made by participants in Table 5 are statistically significant, with a p value of 0.001 (i.e., $p<0.001$).

Table 5: Frequency and Percent of Number of Errors in Participants

ERROR	**Frequency**	**Percent**	p-value
.00	3	3.4	0.001*
2.00	11	12.6	
3.00	2	2.3	
4.00	7	8.0	
5.00	3	3.4	
6.00	11	12.6	
7.00	9	10.3	
8.00	9	10.3	
9.00	7	8.0	
10.00	7	8.0	
11.00	4	4.6	
12.00	3	3.4	
13.00	4	4.6	
14.00	1	1.1	
15.00	1	1.1	
16.00	1	1.1	
17.00	2	2.3	
18.00	2	2.3	
Total	87	100.0	

Table 6 and graph 6 display the subjects' mean and standard deviation for pain (mean:

101.57 SD: 151.01), time (mean: 175.10 SD: 100.13), and error (mean is 7.49 SD is 4.22).

Graph 6: Shows Descriptive Statistics of Participants Pain, Time and Error

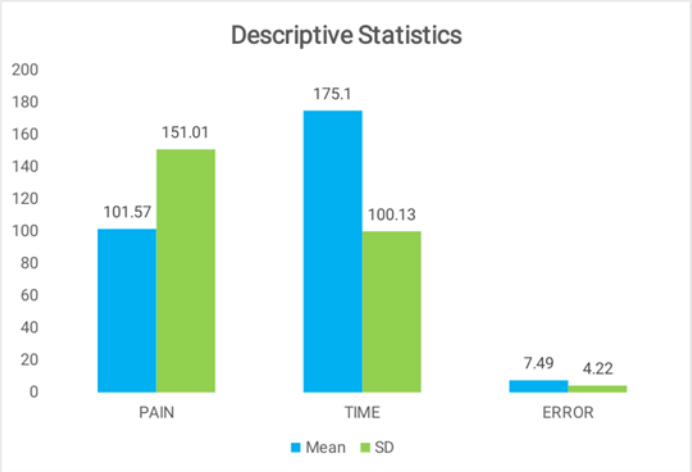


Table 7- displays a cross-tabulation of error and pain numbers.

TABLE 7: ERROR & PAIN Cross Tabulation

Particular		PAIN duration in days							Total
		1.00	2.00	7.00	30.00	90.00	180.00	365.00	
	.00	1	0	0	1	0	0	1	3
	2.00	2	0	3	2	0	0	4	11
	3.00	0	0	2	0	0	0	0	2
	4.00	1	0	3	2	0	1	0	7
	5.00	0	0	0	2	0	0	1	3
	6.00	0	0	6	1	0	0	4	11
	7.00	0	0	4	1	1	0	3	9

ERROR	8.00	0	0	6	1	0	0	2	9
	9.00	0	0	3	2	0	0	2	7
	10.00	0	0	4	2	0	0	1	7
	11.00	0	0	0	3	0	0	1	4
	12.00	0	0	2	1	0	0	0	3
	13.00	0	1	1	1	0	0	1	4
	14.00	0	0	0	1	0	0	0	1
	15.00	0	0	0	0	0	0	1	1
	16.00	0	0	1	0	0	0	0	1
	17.00	0	0	2	0	0	0	0	2
	18.00	0	0	1	1	0	0	0	2

Total	4	1	38	21	1	1	21	87

Table 8 displays a cross-tabulation of pain in a specific place over the course of seven days.

TABLE 8: Area & PAIN Cross Tabulation

Particular		PAIN AREA OF PAST 7 DAY
Area	Knees	2
	lower back	3
	lower back, ankle	1
	neck	5
	neck, lower back	3
	neck, lower back, knees, ankle	1
	neck, lower back, knee, ankle	1
	neck, lower back, knees	1
	neck, lower back, thigh ,ankle	1
	neck, shoulder, upper back	1
	neck, shoulder, upper back, knees, ankle	1
	neck, shoulders, wrist, upper back,	1
	neck, upper back	3
	neck, upper back, ankle	1

	neck, upper back, lower back	1
	neck, upper back, lower back, ankle	1
	Neck ,upper back, lower back	1
	neck, wrist	1
	Neck ,wrist, lower back	1
	neck, wrist, upper back, lower back	1
	neck, wrist, upper back, lower back, thigh, ankle	1
	neck, wrists, upper back, lower back, thighs	1
	shoulder, wrist, upper back, lower back ,knees, ankle	1
	upper and lower back	2
	upper back ,lower back, knees, ankle	1
	wrist, upper back, knees, ankle	1
Total		38

According to Table 9, the correlation coefficient r-value between the length of the pain episode and the length of the rough figural fluency test was recorded as -0.068, which is statistically insignificant at the 5% level with a non-linear link. It indicates that two variables are changing at the same moment, but in the opposing direction. It is also known as the variables' indirect connection.

TABLE 9: Karl Pearson Correlation Analysis

Variable X	Variable Y	r-value	p-value	Result
Pain duration in days	Ruff figural fluency test Time	-0.068	0.534	Non-Significant at 5% Non-Linear association
	Ruff figural fluency test Errors	-0.111	0.306	Non-Significant at 5% Non-Linear association

According to Table 10, the r-value for the connection between the ruff figural fluency test time and errors is -0.055, which is statistically insignificant at the 5% level with a nonlinear association. It indicates that two variables are changing at the same moment, but in the opposing direction. It is also known as the variables' indirect connection.

TABLE 10: Karl Pearson Correlation Analysis

Variable X	Variable Y	r-value	p-value	Result
RFFT Time	RFFT errors	-0.055	0.612	Non-Significant at 5% Non-Linear association

4. Discussion

The study was performed to evaluate the relationship between musculoskeletal pain and cognition in university level students. According to the findings of our study, 89% of female reported feeling pain, which was more prevalent in women than in males. It was found that the students

experienced pain as a result of poor body mechanics, repetitive trauma, long periods of standing or sitting, and poor ergonomics.

One more literature support my finding by Husna Haroon, Safia Mehmood, and colleagues also discovered that medical students in Pakistan were at a significant risk of musculoskeletal pain. [22]. Which shows that study involvement is highest among those between the ages of 22 and 24 where the age group range between 18-27, and Descriptive statistic value of SD is 1.86 and Mean value is 22.75 and Mean value of BMI is 23.2 and SD is 4.58. Descriptive statistics was done the Mean value of pain was reported 101.57 and SD value is 151.01.which was also proven in study by John Ashutosh Santoshi, Siddharth Jain et al [23].

After analysis, three university-level individuals were identified following the study whose cognitive abilities remained unaffected; when speaking with them, it was discovered that they were creative and energetic. When the other students' daily schedules were questioned, it was discovered that they spent nearly the entire day attending classes, which involved a lot of sitting and a small amount of standing. Before or after university, they were so exhausted that they didn't engage in any physical activity for fitness, in contrast to these three students, who used to go to the gym and engage in art and craft projects for relaxation.

During the observation of my study there are certain points where students with creative minds had less of an impact on their cognitive abilities than others. Similar to something like this, Radwa Khalil Ben Godde's study found a connection between creativity, cognition, and creative drives [24]. Similar study which was done by Travis J. Saunders, Travis McIsaac et al .in that authors concluded that excessive sedentary behavior is linked to poor cognitive function in those over the age of 18, considering old age [25].

Nordic Questionnaire was used to measure the students' pain, and it revealed that the neck, lower back, upper back, ankle, knees, wrist, thigh and shoulder were the area's most often affected. One more literature supports my finding which was done by Michael Ogunlana et.al. in that authors concluded that pain in the neck area (66.2%) and low back region (64.4%) were the two most common locations [26].

Research demonstrates that pain has long-term impacts on physiotherapy students as professional, manifesting as symptoms including emotional weariness, anxiety, sadness, memory, and attention. Which is similar to the study of Kailyn M. Turner, Gabrielle Wilcox, and colleagues, participants with chronic pain performed considerably worse than control group members on

multiple performance-based tasks of working memory/divided attention, inhibition, flexibility, and alternating attention. It was demonstrated in this study, showing that college students with chronic pain made more mistakes on cognitive tests [27].

The two outcome measures I used—The Nordic Questionnaire and The RUFF FIGURAL FLUENCY TEST —to evaluate pain and cognition, respectively, were quite effective. Additionally, Thomas P Ross claims in his study that RFFT has an excellent validity and reliability [28]. Similarly, Gidey Gomera Wele lassie has also utilized the Nordic Questionnaire to evaluate the pain experienced by medical students in his research [29].

In my study Pain duration and the figural fluency test mistakes were correlated with an observed r-value of -0.11, which is statistically insignificant at the 5% level. This association is due to a non-linear relationship. It means that at the time of their association, both variables are moving in the opposite direction. The relationship between the variables is sometimes referred to as an indirect relationship, meaning that as pain intensity rises, cognition falls (number of errors are more). Similar to something like this, according to a research by Emily A. Beckmann utilizing a different methodology, youth with chronic musculoskeletal pain show statistically significantly greater executive functioning impairment. [30]

Overall, it was shown that those who lead sedentary lifestyles were more likely to experience cognitive impairment than those who led active lifestyles. It was also shown that cognitive abilities were more negatively impacted by dysmenorrhea, increased pain severity, and chronic pain and people who didn't get breaks or didn't take breaks during their everyday tasks, which has aggravated discomfort, had higher cognitive skills issues**.** Hence proof that there is a correlation between musculoskeletal pain and cognition.

3.1 Future Scope

Future research may concentrate on the relationship between specific pain areas and cognition. Can emphasize on the connection between cognition and dysmenorrhea. Additionally, the impact of acute and chronic pain on cognitive abilities can be determined. Can determine personally which creative factor, such as attention, memory, thought, or decision making was affected.

5. Conclusion

This study concluded that there is a significant relation between pain and cognition and has a positive correlation between pain and cognition. There is also negative correlation between Pain duration and Ruff figural fluency test which means both the variables are moving in the opposite direction at the time association with each other.

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Conflict of interest: We have no conflict of interest to declare.

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