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Prevalence of Riding Related Musculoskeletal Disorders and Disability Among Motorcyclists in Pune Region - A Cross-Sectional Study

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ABSTRACT

Motorcycles in India are regarded as popular and convenient means of transport, especially in large tier 2 cities. Factors influencing on rider during riding the motorcycle are assumed to cause Musculoskeletal pain in motorcyclist. Long term exposure to the static postures and deviations from normal posture of body can worsen the existing musculoskeletal problems, leading to more significant pain, stiffness, and potential long-term complications. These types of exposures cause musculoskeletal disorder to a greater extend. There is a very little literature available about musculoskeletal pain and disabilities arising due to it concerned with riding a motorcycle.

OBJECTIVES:

1. To assess the prevalence of Riding Related Musculoskeletal Disorders and disability with respect to type of motorcycle among motorcyclists.
2. To find out the association between intensity of musculoskeletal pain with respect to type of motorcycle
3. To find the Region wise distribution of pain and disability among motorcyclists.

METHODOLOGY: To know the prevalence of riding related musculoskeletal disorders and disability among motorcyclists a peer reviewed questionnaire was given individually to the group of motorcyclists in and around Pune. A total of 163 motorcyclists participated which included male and females both. Three types of motorcycle were considered i.e. Sports, cruiser and commuter. Individual responses were collected to analyze the data.

RESULTS: Out of 163 participants, 130 i.e. 80% motorcyclists experienced pain and discomfort during their riding sessions and 33 i.e. 20% did not experience. Prevalence of pain and discomfort in motorcyclists was seen highest in cruiser category i.e. 94.3% then in sports category i.e. 90.5% followed by commuter category i.e. 66.6%. For SPORTS and CRUISER Categories P-value of 8.751e-8 and 2.828e-8 found respectively, which is statistically significant as $P < 0.05$. COMMUTER category association is not statistically significant between the intensity of musculoskeletal pain with commuter type of motorcycle as p-value>0.05.

CONCLUSION: The study concluded that there is high prevalence of riding related musculoskeletal disorders among motorcyclists. There is significant association found between intensity of musculoskeletal pain and type of motorcycle ridden by motorcyclists i.e. SPORTS and COMMUTER group of motorcycle. Region wise prevalence of

musculoskeletal disorders was found highest in Upper Back, Lower back, shoulder and neck among all three categories.

Keywords: *Motorcyclists, Riding related Musculoskeletal disorders, Riding bikes*

INTRODUCTION

Musculoskeletal pain is one of the most frequent disorders occurring in general population. Several studies reflect the overall lifetime prevalence of low back pain (LBP) to be as high as 84% of population causing major concern. Neck pain occurs in about 23.1% of general population, which places it on the second place after LBP. Shoulder pain and wrist pain occurs in about 22.2% and 10% respectively. In Lower limb, knee pain and ankle pain occurs in about 28.1% and 11.7% respectively in general population. The factors determining occurrence of pain are, among others, long time maintained static position, whole body vibrations (WBV) and awkward sitting positions. These factors may be a result of prolong duration of riding the motorcycle. Two-wheeler vehicles are regarded as one of the fastest as well as a fuel-efficient means of transport. In Indian conditions of living, which demands low cost means of commute that can provide fast living standards, two-wheeler is a necessary part rather than a commodity for possession for both urban and rural areas. Two-wheeler can be used for occupational purposes or non-occupational purposes Furthermore; motorcycle related issues have been a concern in road safety. Most of the studies on motorcycle problems were concentrated on the crash involving motorcycle rather than the motorcycle riding process itself. It is a fact that being involved in a motorcycle crash poses greater injuries as compared to motorcycle riding. However, the risk of developing MSDs by only riding a motorcycle possess a major concern which requires to be addressed. This is because the quality of life may be affected for those experiencing the symptoms of MSDs. It has been revealed that people who experience LBP were likely to be absent from work and this has also affected the organization and society as a whole as well as the work productivity of the motorcycle rider. Riding a two-wheeler for long periods in the same posture can cause discomfort, muscle stiffness, and fatigue due to limited movement and restricted blood flow. The rider's posture is influenced by the design of the vehicle (seat, handlebars, footrests) and the rider's body size. Poor posture can reduce comfort and increase the risk of accidents. Improving the ergonomics of the two-wheeler can enhance rider comfort and safety.

Pune, being a 2tier leading metro city there are more numbers of motorcyclists in the city and more active age motorcycle riders. Different types of bikes affect the rider's body in different ways. However, the prevalence of musculoskeletal disorders among motorcyclists which includes widespread spectrum of injuries depending upon type of motorcycle is yet to be studied. Hence the present study is carried to know the prevalence of RMSDs among Motorcyclists and the data obtained can be used to give proper ergonomic riding posture advices to reduce the stresses acting on the whole body in prolonged fixed riding posture among bike riders. Physiotherapy exercise protocols can be given to condition riders prior to longer riding sessions. The present study is carried out with the primary objective to assess the prevalence of Riding Related Musculoskeletal Disorders and disability with respect to type of motorcycle among motorcyclists. The other secondary objectives of the study involve to find out the association between intensity of musculoskeletal pain with respect to type of motorcycle among motorcyclists and to know the region wise distribution of pain and disability with respect to type of motorcycle among motorcyclists. The results could be beneficial to educate the motorcyclists about the postural corrections and pre conditioning exercises to reduce the risk of Riding related Musculoskeletal Disorders in future.

MATERIALS & METHODS

- Study design: Cross sectional study
- Study setting: Motorcycle riding groups in and around Pune
- Sample population: minimum sample size of 159
- Sample size with justification: considering the prevalence of Riding related musculoskeletal disorders in motorcyclists of 83% as reported in study of G. A. Anoop, S A Binoosh (2019) and type 1 error of α= 0.01 and allowable error of 10% the minimal required sample size is 159.
- Formula: - $(Z)\alpha$ 2 2 pq (L)2 Where, p is prevalence q is incidence L is precision Z is statistic for level of confidence.

Study Procedure: Approval was taken from the Institutional ethics committee of MAEER MIT Pune's Physiotherapy College. According to the inclusion and exclusion criteria, healthy individuals from motorcycle riding groups in and around Pune were included in this study and informed consent was taken from them.

The aim of the study was explained to all the participants prior the data collection. The privacy of every participant was preserved throughout the whole procedure and after the data collection also.

It was a cross-sectional study in which a structured questionnaire having three domains: Demographic data, Pain and disability and Bike riding characteristics was prepared to know the prevalence of Riding Related musculoskeletal disorders and disability among Motorcyclists depending upon motorcycle type.

This questionnaire was given for a detailed peer review for its content and face validity. The final version was prepared by incorporating the suggestions and was circulated to the riding groups in and around Pune.

All participants were from different riding groups and were approached in person. The questionnaire was circulated to the participants of Riding groups in and around Pune and the data was collected. After completion, the data was analyzed statistically.

CRITERIA FOR SELECTION OF SAMPLES

i. Inclusion criteria:

- Gender: - Male and female
- Age: - 21 to 45
- Motorcycle type: - Sports, Cruiser, Commuters.
- Engine size: - More than 110cc
- Minimum kilometres done: - 10000 kms
- Minimum riding Duration: -08-09hrs/week

ii. Exclusion criteria:

- Vertebral fractures within last 1 year.
- Any pathological and inflammatory condition related to spine.
- Recent Road Traffic Accident (RTA) within 6 months.
- Recent lower limb injuries within last 6 months.
- Any Motorcyclist who is on medication for his musculoskeletal problems.
- Recent spinal injury and neurological deficit.

STATISTICAL ANALYSIS

The result of the above study was represented statistically.

1. The demographic characteristic that is age, gender was presented through graphical pie charts in the form of percentage.
2. The prevalence of riding related musculoskeletal disorders among motorcyclists in and around Pune region was expressed as percentages in the form of graphical pie charts and bar diagrams.
3. Chi-square test for association was used to determine the association between the intensity of pain of musculoskeletal pain with respect to type of motorcycle among motorcyclists.
4. Also, the region wise distribution of pain and disability with respect to type of motorcycle among motorcyclists was expressed in tabular form.

RESULTS

The results of the study were represented by the data received via the completed questionnaires from the participating motorcyclists in the form of three domains. A total of 163 motorcyclists in and around Pune completed the questionnaire and the data was calculated.

Domain 1 consisted of demographic data (age and gender) of the motorcyclists Domain 2 consisted of the data representation of the motorcycle riding characterstics.

Domain 3 consisted of the data representation of the pain and discomfort experienced by motorcyclists while riding the motorcycle.

DOMAIN 1: DEMOGRAPHIC DATA-

TABLE NO. 1 – Representation of age groups:

Age	No. Motorcyclists
21 to 29 years	101
30 to 38 years	47
39 to 45 years	15

TABLE NO. 2: Representation of Gender of motorcyclist

Genders	No. of Motorcyclists
Males	140
Females	13

DOMAIN 2: MOTORCYCLE RIDING CHARACTERSTICS-

TABLE NO.1: Representation of type of Motorcycle used by Motorcyclists

TYPE	NO. OF MOTORCYCLISTS
Sports	53
Commuter	57
Cruiser	53

TABLE NO.2: REPRESENTATION OFANY PROTECTIVE ACCESSORIES LIKE HELMET, GLOVES, RIDING JACKETS, RIDING SHOES USED WHILE RIDING

Response	No. of Motorcyclists
YES	136
NO	27

TABLE NO.3: REPRESENTATION OF WHETHER ANY BODY CONDITIONING (WARM UP/COOL DOWN) PERFORMED PRIOR TO LONG RIDING SESSION

Response	No. of Motorcyclists
YES	20
NO	143

TABLE NO.4: REPRESENTATION OF PHYSIOTHERAPY EXERCISE OR TREATMENT TAKEN FOR ANY AILMENT DUE TO MOTORCYCLE RIDING

Response	No. of Motorcyclists
YES	18
NO	145

DOMAIN 3: PAIN, DISORDERS AND DISABILITY-

TABLE NO.1: REPRESENTATION OF PAIN AND DISCOMFORT EXPERIENCED BY MOTORCYCLISTS:

Response	No. of Motorcyclists
YES	130
NO	33

TABLE NO.2: REPRESENTATION OF PREVALENCE OF PAIN AND DISCOMFORT EXPERIENCED BY DIFFERENT MOTORCYCLE TYPE:

TYPE	YES	NO
SPORTS	48	5
COMMUTER	32	25
CRUISER	50	3

Graphical Representation of Prevalence of Pain and Discomfort Experienced by Motorcyclists riding different types of bikes:

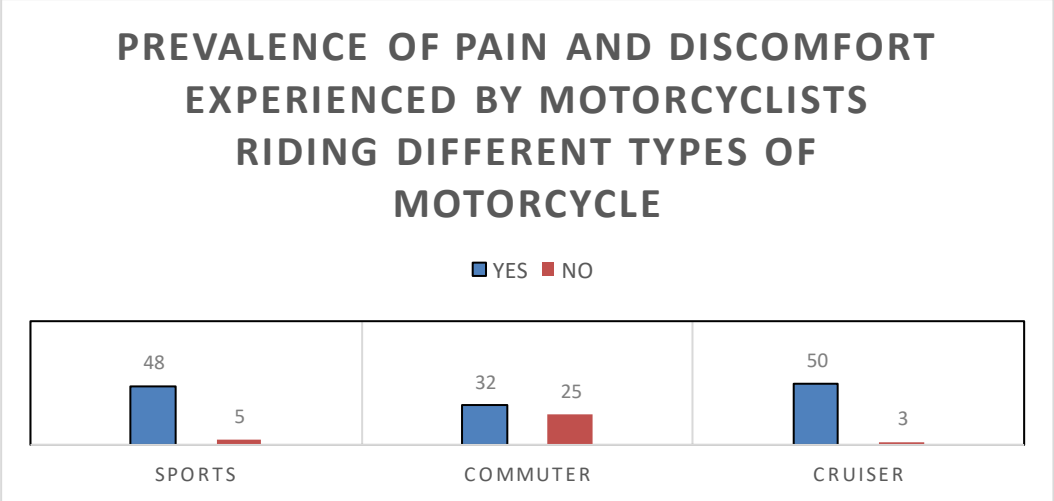


TABLE NO.3A: REPRESNTATION OF INTENSITY AND REGION WISE DISTRIBUTION OF PAIN AMONG MOTORCYCLISTS USING SPORTS MOTORCYCLE:

REGION	MILD	MODERATE	SEVERE
Upper back	14	13	15
Lower back	11	14	21
Neck	11	17	16
Shoulder	15	16	10
Elbow	22	13	00
Wrist /hand	16	23	01
Hip/thighs	15	19	03
Knee	17	18	01
Ankle/foot	14	17	03

TABLE NO.3B: REPRESNTATION OF INTENSITY AND REGION WISE DISTRIBUTION OF PAIN AMONG MOTORCYCLISTS USING COMMUTER MOTORCYCLE:

REGION	MILD	MODERATE	SEVERE
Upper back	13	18	02
Lower back	14	21	06
Neck	15	16	03
Shoulder	18	10	02
Elbow	21	05	00
Wrist /hand	17	09	01
Hip/thighs	24	05	01
Knee	18	08	00
Ankle/foot	20	04	02

TABLE NO.3C: REPRESNTATION OF INTENSITY AND REGION WISE DISTRIBUTION OF PAIN AMONG MOTORCYCLISTS USING CRUISER MOTORCYCLE:

REGION	MILD	MODERATE	SEVERE
Upper back	07	19	22
Lower back	03	19	30
Neck	09	16	21
Shoulder	11	27	03
Elbow	21	20	02
Wrist /hand	21	18	08
Hip/thighs	14	26	05
Knee	15	24	04
Ankle/foot	05	25	13

Table 4 shows Chi-square test of association between intensity of musculoskeletal disorders with respect to type of motorcycle:

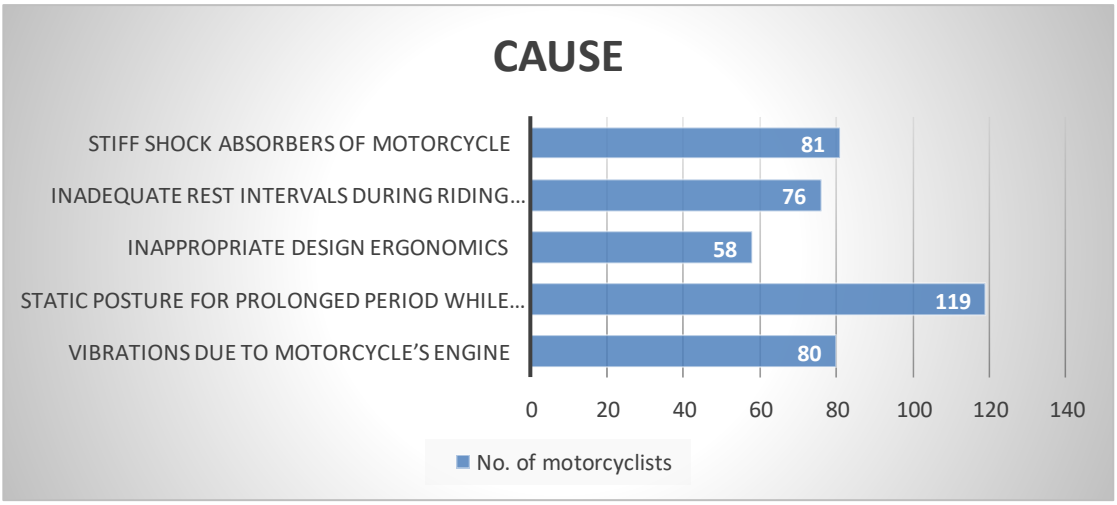
Type	Chi-Square	Degree Of Freedom	P-Value
Sports	45.997	16	8.751e-8
Commuter	4.837	16	0.679
Cruiser	48.511	16	2.828e-8

The aforementioned data displays for SPORTS and CRUISER Categories that the chi-square value is 45.997 and 48.511 respectively with degrees of freedom= 16 and P-value of 8.751e-8 and 2.828e-8respectively, which is considered statistically significant as P<0.05, indicating that there is association between intensity of musculoskeletal pain with respect to type of motorcycle. However, in COMMUTER category association is not statistically significant between the intensity of musculoskeletal pain with commuter type of motorcycle as p-value >0.05

TABLE NO. 5: REPRESENTATION OF CAUSE OF PAIN:

Cause	Vibrations due to motorcycle's engine	Static posture for prolonged period while riding	Inappropriate design ergonomics of bike	Inadequate rest intervals During Riding sessions	Stiff shock absorbers of motorcycle
No. of motorcycles	80	119	58	76	81

Graphical Representation of cause of pain:



DISCUSSION

The current study was done to know thePrevalence of Riding Related Musculoskeletal Disorders and Disability among Motorcyclists. In this study total of 165 motorcyclists participated among which 2 were dropouts and 163 completed the survey.

Several findings emerged from this study: Domain no. 1 is Demographic data showing that out of 163 motorcyclists 92% were male and 8% were female as shown in table no. 2. The motorcyclists were divided in three groups according to their age i.e. Group 1: 21 to 29 years, Group 2: 30 to 38 years and Group 3: 39 to 45 years. Group 1 consisted of 101 motorcyclists i.e. 62% of total sample size, group 2 consisted of 47 motorcyclists i.e. 29% of total sample size and group 3 consisted of 15 motorcyclists i.e. 9% of total sample size as shown in

Table no. 2. The mean age of these motorcyclists was 28 years.

Domain no. 2 consisted questions related to the motorcycle characteristics. Table no. 1 represents the type of motorcyclists used by motorcyclists which was divided into 3 groups i.e. Sports, Commuter and Cruiser. Out of 163 motorcyclists 53 ride Sports type motorcycle, 57 ride Commuter type of motorcycle and 53 ride Cruiser type of motorcycle. Table no. 2 represents no. of motorcyclists wearing protective gears like helmet, gloves, riding jackets, riding shoes, etc. out of 163 Motorcyclists 136 i.e. 83% uses protective gears and 27 i.e. 17% don't use protective gears. A higher number of motorcyclists wearing protective gears while riding motorcycles indicate a good level of awareness of the role of wearing protective gears to prevent frequent riding related musculoskeletal injuries among motorcyclists.

Warm up and cool down exhibits several vital benefits for motorcycle riders. It prepares the body and mind to perform at its best. A good and adequate warm up session will not only ease bike riding experience for the motorcyclists but are also essential for optimal bike riding performance. The aim of warm up is to switch the aerobic energy on prior to starting main bike riding effort. This will ensure more efficient usage of energy, less fatigue, gradual and progressive increase in Heart rate (HR) enabling more oxygen to be transported from blood and to be used by working muscle. It will also relax joints. Range of motion of joints will improve ensuring optimal efficiency ideal warp up time before bike riding sessions should be of 10-15 minutes.

Cool down exhibits critical benefits like removal of metabolic waste products from muscle minimalizing peripheral blood pooling, feeling of dizziness, fainting episodes post riding sessions. It also allows blood to redistribute around body helping the body to gradually return to its pre riding state adding in recovery process and minimalizing injury.

Table no. 3 represents no. of motorcyclists performing body conditioning (warm up/cool down) out of 163 participants only 20 i.e. 12% performs body conditioning and 143 i.e. 88% do not perform a sc conditioning exercises prior to bike riding This brings an ardent need for all riders to be made aware of basic warm up and cool down exercises before and after bike riding sessions based on different types of motorcycle so as to ensure smooth riding experience and minimalize the risks of developing riding related musculoskeletal disorders. Table no. represents no. of motorcyclists who take Physiotherapy treatment for their riding related musculoskeletal disorders. Out of 163 motorcyclists 145 motorcyclists i.e. 89% does not and 18 motorcyclists i.e. 11% takes Physiotherapy treatment for their ailment. A Physiotherapist plays a crucial role in training all bike riders of all age groups riding a bike type viz Sports, Commuter and Cruiser.

Domain 3 represents the pain, disorders and disability. As shown in the table no. 1 in domain 3 out of 163 participants, 130 i.e. 80% motorcyclists experienced pain and discomfort during their riding sessions and 33 motorcyclists i.e. 20% did not. As shown in table no. 2 motorcyclists riding Sports bike e.g.: -R15, KTMDUKE, NINJA, BMW, prevalence of pain and discomfort was experienced by 48 motorcyclists out of 53 participants and 5 did not. In motorcyclists riding cruiser bike e.g.: - BULLET, CLASIC350, HARLEY DAVIDSON, etc 50 motorcyclists experienced pain and discomfort and 3 did not. In motorcyclists riding commuter bike e.g.: - Activa, splendor, shine, etc 32 experienced pain and discomfort out of 57 participants while 25 did not. Prevalence of pain and discomfort in motorcyclists was seen highest in cruiser category i.e. 94.3% then in sports category i.e. 90.5% and then in commuter category i.e. 66.6%. Table no. 3 represents the intensity and region wise distribution of pain with respect to type of motorcycle among motorcyclists.

Table no. 5 represents the cause of pain while riding according to motorcyclist multiple causes were given to the motorcyclists to choose from 119 motorcyclists consider static posture for prolonged period of time is the cause for their pain. 81 motorcyclists consider stiff shock absorbers to be the cause of their pain,80 motorcyclists consider vibrations from motorcycles engine to be the cause of pain, 76 motorcyclists consider inadequate rest intervals during riding session to be the cause of their pain and 58 blames inappropriate ergonomics of the motorcycle. However, in present study it was seen that the pain experienced by majority motorcyclists was due to maintaining static posture for prolonged period of time. static posture for prolonged period on a motorcycle. M.I. Mohd Hafzi1, S. Rohayu1, P. Noor Faradila1 and S.V. Wong1 studied Prevalence and risk factors of musculoskeletal disorders of motorcyclists and found association between prolonged sitting static posture and pain in motorcyclists. Maintaining static posture for prolonged period of time leads to poor metabolic waste clearance from the affected structures under stress leads to poor muscle function leading to musculoskeletal disorders.

Table 4 shows Chi-square test of association between intensity of musculoskeletal disorders with respect to type of motorcycle. For SPORTS and CRUISER Categories the chi-square value is 45.997 and 48.511 respectively with 16 degrees of freedom and a P-value of 8.751e-8 and 2.828e-8respectively, which showed statistically significant as $P < 0.05$, indicating that there is association between intensity of musculoskeletal pain with respect to type of motorcycle. This was in accordance with a finding of a study by Wójcik, R., Trybulec, B. (2017) titled "Occurrence and Intensity of Spinal Pain in Motorcyclists Depending on Motorcycle Type" and it concluded that 1] The motorcycle type significantly influences on occurrence of neck pain to which the most susceptible are sport type motorcycles drivers. 2] The type of motorcycle predominantly influences on spinal pain occurrence which was seen the highest in cross type drivers. In sports motorcycle the riding posture is committed and maintained for long times which contributes to the musculoskeletal disorders. And other several studies [1],[2],[4] state the effect of motorcycles engine vibrations on motorcyclists contribtes to the development of musculoskeletal disorders. As cruiser motorcycle compared to other two types produce more engine vibrations hence the prevalence of musculoskeletal disorders was highest and there was significant association found between intensity of musculoskeletal pain and cruiser type of motorcycle.

A higher proportion of motorcyclists in the current study are unaware about Physiotherapy interventions and its importance for riding related musculoskeletal disorders. In order to ensure correct warm up and cool down, Physiotherapeutic exercises and ergonomic advices prior and after riding sessions can be taught by Physiotherapist which can include targeted muscle strengthening exercises, stretches and flexibility exercises, Core strengthening protocol, various methods to deal with riding injuries so that riders can use it in their daily routine to minimize the overuse injuries and can improve their performance and enhance their riding experience. The vital information obtained from this study regarding the prevalence of musculoskeletal injuries among motorcyclists and their association between pain intensity and type of motorcycle can be useful to guide the motorcyclists a targeted and specific Physiotherapy exercise protocol. Furthermore, this study highlights the importance of developing injury prevention programs for motorcyclists, including ergonomic advice, proper warm-up and cool-down routines, and adequate rest. By identifying risk factors for musculoskeletal disorders (MSDs), Physiotherapists can offer timely interventions to reduce injury severity. The study also emphasizes

educating riders on safe practices to prevent MSDs and suggests physiotherapeutic exercises and counseling to avoid serious complications that could lead to surgery.

LIMITATIONS

- ❖ It was just a prevalence study focused solely on finding prevalence of musculoskeletal disorders among motorcyclist in three motorcycle type (sports, commuter, cruiser)
- ❖ No treatment protocol was given to the motorcyclists
- ❖ In this study the no. of male motorcyclists was higher than female motorcyclists. There were fewer female motorcyclists involved in this study.
- ❖ No follow up treatment protocol was given to the motorcyclists.

CONCLUSION

- The study concluded that there is high prevalence of riding related musculoskeletal disorders among motorcyclists.
- The prevalence of musculoskeletal disorders is seen highest in cruiser group of motorcyclists followed by sports group of motorcyclists and least prevalence is seen in commuter group of motorcyclists.
- There is significant association found between intensity of musculoskeletal pain and type of motorcycle ridden by motor cyclists i.e. SPORTS and COMMUTER group of motorcycle. However, there was no association found between intensity of musculoskeletal pain and commuter type of motorcycle.
- Region wise prevalence of musculoskeletal disorders was found highest in Upper Back, Lower back, shoulder and neck among all three categories.

Abbreviations: *RMSD's- Riding related Musculoskeletal Disorders, MSD's- Musculoskeletal Disorders*

Declaration by Authors

Ethical Approval: Approved. Ethical approval obtained by the institutional ethics committee of MAEER MIT Pune's Physiotherapy College.

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Conflict of Interest: The authors declare no conflict of interest.

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