

DEVELOPMENT OF A MUSCLE FATIGUE INDEX FOR MOTORCYCLIST IN PROLONGED RIDING

ABSTRACT

For prolonged motorcycling, it is very common for motorcyclist to experience physiological discomfort such as muscle numbness or strain. These symptoms are known as muscle fatigue and upon continuous occurrences may leads to road accident as reported by a study. In determining motorcyclist's perception, survey research using the questionnaire tool were performed among the undergraduate students from the Faculty of Mechanical Engineering, Universiti Teknologi MARA Shah Alam. The questionnaires were analyzed via Statistical Package for the Social Science (SPSS) with the level of confidence of 95%. From the questionnaires, a specialized discomfort rating index system of various body regions for motorcycling named Motorcycle Fatigue Hazard Indexing Scale (MoFaHS) was established. The index system allows for the muscle fatigue evaluation of most major body region which are affected during motorcycling to be performed. From here, the muscle activities of selected muscles that best represent these body regions were further analyzed via surface electromyography (sEMG) measurement. The data were tabulated and published in two International Ergonomics Conferences as chapter in books. The sEMG measurements were performed on a newly established and award winning Postura Motergo motorcycle test rig setup (bronze medal in the Invention, Innovation and Design Exposition 2014 (IIDEX2014)).

PROBLEM STATEMENT

- There are several research and literature reviews related with muscle fatigue in prolonged riding for motorcyclist but are not fully documented yet.
- Although most researchers agreed that the main causes of motorcycle accident nowadays are the environment and alcohol or drug influence, but muscle fatigue also counts in but lacking in proper controlled experimental setup of research.
- During prolonged riding, it may cause to feel uncomfortable such as tired and feel numb. These symptoms somehow do not have a proper indication or indexing system that can tell motorcyclist that they are experiencing muscle fatigue.

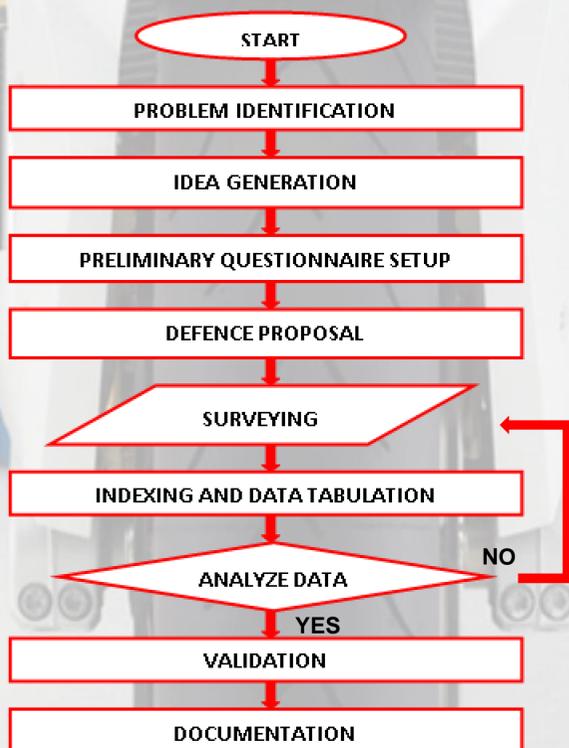
OBJECTIVES

- To evaluate different types of fatigue affected on motorcyclist during prolonged riding.
- To define motorcyclist's perception towards fatigue during prolonged riding.
- To determine suitable index rating to rate the fatigue experienced by motorcyclist.

SCOPE OF PROJECT

- In a way to prevent muscle fatigue during prolonged riding, a motorcyclist muscle fatigue index has been developed.
- Areas of potential muscles being affected and the causes of such muscle fatigue have been thoroughly studied.
- Sets of questionnaire to investigate physical or physiological preparations that motorcyclists perform before a prolonged ride is the part of the tools to acquire the data.
- The data obtained have been combined with another Final Year Project (FYP) student that studied on the risk level that a motorcyclist might experience if the muscle fatigue index shows a severe rating.

PROJECT FLOW CHART

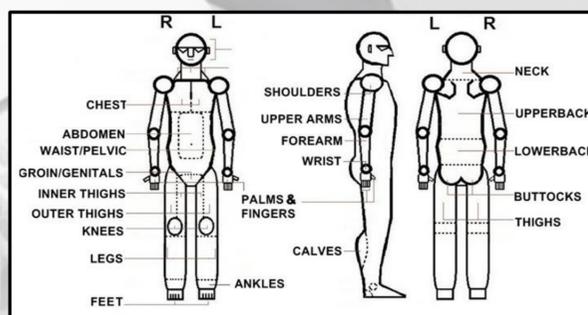


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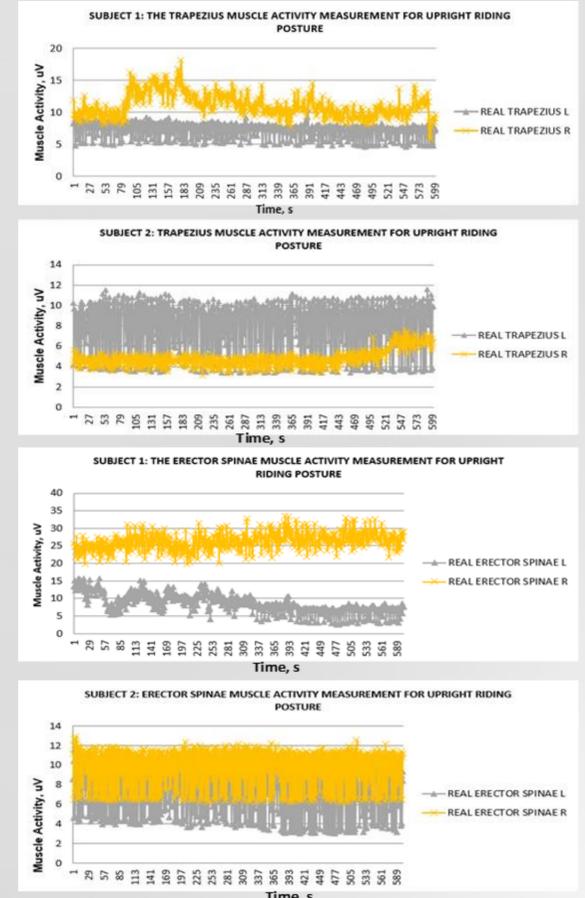
RESULTS

Questionnaire & Analysis



Type of Body	Rating		Moment	
	%	Result	%	Result
1. Face & Neck	62%	No Pain	57.7%	No occurrences
2. Chest	94.2%	No Pain	92.7%	No occurrences
3. Shoulders & Upper Arms	35.8%	Mild Pain, Tolerable Without Medication	38%	During The Ride
4. Forearm	46.7%	No Pain	46.7%	No occurrences
5. Wrist	38%	No Pain	38%	No occurrences
6. Hands	56.2%	No Pain	54%	No occurrences
7. Abdomen	86.1%	No Pain	84.7%	No occurrences
8. Upper back	40.9%	Mild Pain, Tolerable Without Medication	42.3%	During The Ride
9. Lower back	35.8%	Mild Pain, Tolerable Without Medication	39.4%	During The Ride
10. Groin/genitals	65%	No Pain	63.5%	No occurrences
11. Buttock	40.9%	Mild Pain, Tolerable Without Medication	43.1%	During The Ride
12. Thigh region	73.7%	No Pain	73%	No occurrences
13. Legs, ankles and feet	54%	No Pain	52.6%	No occurrences

Validation from sEMG



Motorcycle Fatigue Hazard Indexing Scale (MoFaHS)

MOTORCYCLING FATIGUE RISK FACTORS	0-1st hour	1st-2nd hour	2nd-3rd hour	3rd-4th hour	4th hour and beyond
(A) Riding posture practiced					
RIPOC Types					
i) Type 1	1	3	4	4	5
ii) Type 2	1	1	2	3	4
iii) Type 3	1	1	1	2	2
iv) Type 4	2	3	4	5	5
(B) Motorcyclist body mass index					
BMI Categories					
i) Underweight	1	1	1	2	2
ii) Ideal	1	1	2	2	3
iii) Overweight	1	2	2	4	5
iv) Obese	2	3	4	5	5
(C) Fitness Level					
Lifestyle Categories					
i) Rarely/never exercise	2	3	4	5	5
ii) Regularly exercise	1	1	2	2	3
iii) Athletic	1	1	2	2	2
(D) Sleeping Patterns					
Sleeping Pattern Categories					
i) Sleep deprived	4	5	5	5	5
ii) Sufficient sleep	1	1	1	2	3
iii) Oversleeping	1	1	1	2	3
LEGEND					
1	Negligible hazard level				
2	Low hazard level, rest session is encouraged				
3	Medium hazard level, rest session is encouraged				
4	High hazard level, rest session is a must				
5	Very high hazard level, rest immediately				

ACHIEVEMENTS

1. Bronze winning medalist of the Invention, Innovation and Design Exposition 2014 (IIDEX2014) at Dewan Agung Tuanku Canselor (DATC), UiTM on April 27-30, 2014,
2. The Postura Motergo motorcycle test rig was extensively used. Became one of the team members that helped out to develop the winning test rig that was a great debut for such a designed product
3. Registered as one of the Human Factors and Ergonomics Society Malaysia (HFEM) with a member number 0092 to strengthen networking with professionals in the ergonomics area.
4. Project has been presented at the Ergonomics and Human Factors 2014 (EHF) International Conference, Grand Harbour Hotel, Southampton, United Kingdom on April 10, 2014.
5. The project has been published as a chapter in book with ISBN 781138026353 in the post-conference book for the EHF2014 conference in the 'Contemporary Ergonomics and Human Factors 2014'.
6. It was accepted and to be presented at the 5th International Applied Human Factors and Ergonomics Conference in Krakow, Poland on July 19-23, 2014.

CONCLUSION

- The neck/shoulder, upper back, lower back and buttock were identified as the most severely affected body regions during prolonged riding based on the human riding posture, muscle activity and journey duration.
- All results and data have been recorded and noted based on the feedback from respondents through a set of questionnaire that were validated via the sEMG pilot test in the Motorcycle Engineering Test Lab (METAL).
- The Motorcycling Fatigue Hazard Indexing Scale or MoFaHS was successfully established with suitable index rating to rate the fatigue experienced by the motorcyclist.
- As a conclusion, all objectives had been successfully achieved.