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THE EXPLORATIONS IN DEFINING MOTORCYCLING FATIGUE: A PILOT STUDY

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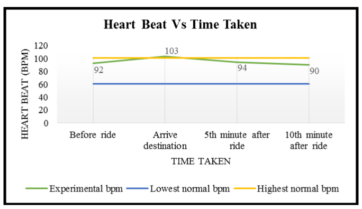
Graphical abstract



Abstract

A renowned motorcycling instructor noted that human error is the main reason for motorcycling road tragedies. Indeed, there are various reasons that could be held responsible in leading towards human error. Even so, it is strongly emphasized that there is a link between motorcycle road accidents with the cases of human error due to motorcycling fatigue. The aim of this study was to explore the physical, physiological and psychological symptoms experienced by motorcyclists during prolonged motorcycling and its relation with motorcycling fatigue. This study assessed motorcycling fatigue generally, without specifying in a single type of fatigue resulting from prolonged motorcycling activity. Literature assessment, real world riding assessment, working posture hazard assessment and a survey study were selected as the research methods for this study. Results showed that collectively, all the physical, physiological and psychological aspects of the motorcyclist could be a variable in leading towards motorcycling fatigue. Nevertheless, all of these variables would only lead to two final outcomes which are: (i) overall decrement in motorcycling performance, and (ii) sleepiness. Both of these outcomes could occur independently or dependently – dependent on individual motorcyclist and the responsible variables that is affecting the particular motorcyclist. In short, motorcycling fatigue could not be simply defined with one single definition. Therefore, it is best to view motorcycling fatigue in various perspectives (physical, physiological and psychological perspectives) of motorcycle ergonomics. Motorcycling fatigue is almost inevitable, thus, further research is warranted in order to gain more accurate information and better understanding on motorcycling fatigue.

Keywords: Motorcycle, ergonomics. fatigue, accident

1.0 INTRODUCTION

Motorcycling: The Norm, Road Accidents Statistics & Fatigue. Globally, the current statistics of motorcycle road accident is distressing. It is noted that regardless of how powerful a motorcycle is (commonly measured in horsepower), the only reason for motorcycling related tragedies will always due to human error [1]. It is strongly emphasized that there is a link between motorcycle road accidents with the cases of human error due to motorcycling fatigue. Davis (2011) associated the prevalence of fatigue with strenuous physical activity [2]. However, it is suggested that from a vehicular operation point of view, it does not necessarily for a physical activity to be strenuous for fatigue to transpire. In linking the statistics from Table 1 and Fig. 1, it is suggested that psychological issue i.e. motorcyclist's concentration level could be one of the cause of road accident. Monotonous motorcycling activity on a straight road could result in careless riding i.e. human error, due to the loss of concentration from motorcycling fatigue. This is especially true if the journey is performed in prolonged session. However, it is still too early to conclude for such occurrences. This study only explores the topic of motorcycling fatigue from a general perspective. More in depth research is warranted with respect to the relation between psychological fatigue and motorcycle road accident.

The aim of this study was to explore the physical, physiological and psychological symptoms experienced by motorcyclists during prolonged motorcycling and its relation with motorcycling fatigue. For only by identifying and understanding the symptoms; motorcycling fatigue could be clearly defined.

Table 1 Analysis of motorcycle accidents [3]

Years	No. of Motorcyclist Accidents by Road Geometry				No. of Motorcycle Accidents by Hours	
	Straight	Bend	Cross Junction	T/Y Junction	Day (0601-1800)	Night (1801-0600)
2000	2415	652	195	490	1752	1589
2001	2107	578	201	458	1553	1503
2002	2123	550	190	483	1662	1492
2003	1994	472	156	422	1592	1517
2004	1939	462	163	385	574	528
2005	2295	544	167	463	1836	1679
2006	2121	468	351	430	1804	1611
2007	2392	528	173	494	1866	1749
2008	2607	591	181	556	2081	1882
2009	2930	558	192	444	1463	2728

Source: PDRM road accident annual statistic reports

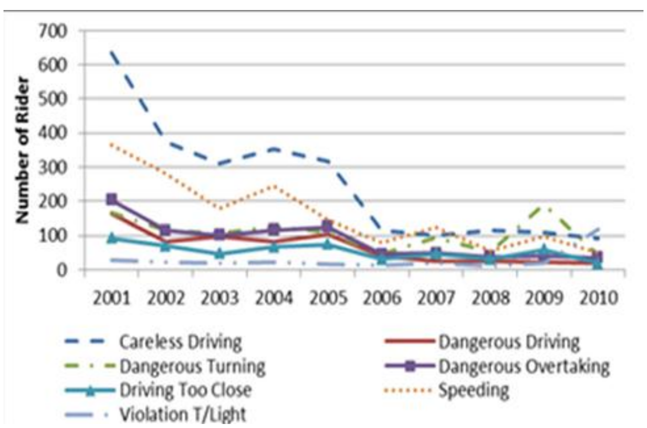


Figure 1 Analysis on fatal motorcycle accidents [4]

Figure 2 Heart beat rate watch used in this research [5]

2.0 RESEARCH METHODOLOGY

Motorcyclist heart beat rate recording during prolonged motorcycling. This assessment was only performed by the main author since it was only a pilot study. The motorcycle ridden for this assessment was a 2012 Kawasaki Ninja 250R. The riding course is a 90 km ride on public road in the state of Selangor and Negeri Sembilan, Malaysia. 19 riding assessments with the total of 25 hours of riding were performed in the course of 3 months. During every ride, the participating author's heart beat rate were measured and recorded.

Fig. 2 shows the heart beat rate pulse counter watch used during the assessment. According to the manual of heart beat rate pulse counter watch used, the heart rate beat is divided in to the following zones:

Table 2 Heart rate zone

Zone	Activity status	Heart beats per minute (bpm)
1	Relaxed	Less than 90 bpm
2	Light	91-120 bpm
3	Moderate	121-140 bpm
4	High	141-160 bpm
5	Extreme	More than 160 bpm

The heart beat was taken in four different time intervals. The time interval was as follow:

i. The moment right before the ride takes place. The reading was taken when the subject (the author) was already on the motorcycle was ready to begin the journey.
ii. The moment when the subject (the author) arrive at destination. The reading was taken as immediate as possible with the subject (the author) was still on the motorcycle.
iii. 5th minute after the ride was completed. The subject (the author) was not allowed to consume any beverages and must be at relaxed.
iv. 10th minute after ride. The subject (the author) was not allowed to consume any beverages and must be at relaxed. Only after this reading

was taken that the subject (the author) was allowed to consume any beverages.

3.0 RESULT

Fig. 3 shows the result of the average heart beat during the four intervals for it the readings were taken. In 25 sessions, it was measured that during the first time interval (the moment right before the ride takes place) the heart rate already increases to 92 bpm as opposed to 60 bpm during resting. The second time interval (the moment of the author arrived at the destination, thus, ending the motorcycling activity) showed the highest reading of 103 bpm before being followed by the third interval (5 minutes after motorcycling is completed). After 10 minutes of motorcycling, the author's heart rate had decreases to 90 bpm.

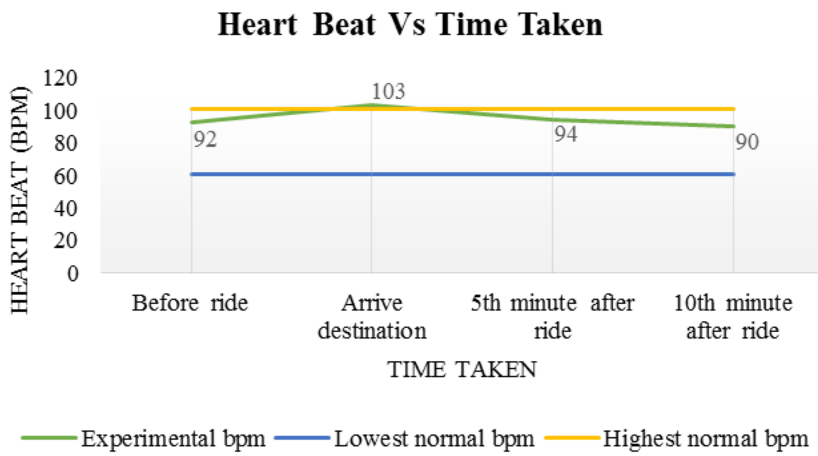


Figure 3 Heart beat against time taken

4.0 DISCUSSION

Firstly, with regards to the heart rate recorded for motorcycling activity, the following interesting findings were recorded (i) the heart rate showed 58% increment the moment before motorcycling activity takes place, (ii) the heart rate showed 71.6% increment at the moment motorcycling activity was completed, (iii) the heart rate dropped by 8.7% five minutes after motorcycling activity was completed, and (iv) the heart rate further dropped an additional 4.3% at the 10th minutes after motorcycling was completed. It was evidence during the assessment that the heart rate started to increase as immediate as before motorcycling takes place. During motorcycling, the heart rate would increases further before settling in on a certain value (in this assessment, it was at the average of 103 bpm). Furthermore, it was observed that it requires more than 10 minutes of resting period before the heart rate decreases to the resting limit. This was in line with the recommendation given by the manual of the heart beat rate watch used in this study. From these recordings, it could be strongly suggested that in order to prepare the human body to participate in motorcycling, the physiological system would spontaneously increases the heart rate. This would aid in preparing the whole body in performing the motorcycling activity (the work). As noted from previous studies, motorcycling activity is complex and requires the use of the whole body to perform efficiently, effectively and safely [6, 7]. Indeed, all of the recorded heart rates during motorcycling were still within the light activity zone. Even so, if such heart rate is maintained for prolonged sessions, for example, beyond 2 hours of continuous motorcycling, the physiological effects are probably inevitable.

Secondly, after prolonged motorcycling sessions (beyond 2 hours of continuous motorcycling), among the unison symptoms of motorcycling fatigue were as follow: (i) the degrading of concentration during motorcycling, (ii) slow reaction time, (iii) occasional yawning, (iii) rapid blinking of the eyes, (iv) micro-sleep, and (v) physical discomforts. Based on the findings and along with the supporting details provided by the literature, it was that collectively, all the physical, physiological and psychological aspects of the motorcyclist could be a variable in leading towards motorcycling fatigue. Factors such as dehydration, sleeping patterns and nutritional intakes were the factors found in this study. Indeed, suggestively, other factors such as fitness level, motorcycling experience (years of motorcycling), motorcycle setup and even the weather could all be a contributing variable as well. Nevertheless, all of these variables would only lead to two final outcomes which are: (i) overall decrement in motorcycling performance, and (ii) sleepiness.

The overall decrement in motorcycling performance was rapidly experienced during the prolonged motorcycling. Symptoms such as the degrading of concentration, slow reaction time and physical discomfort are among the clear evidence in the overall decrement in motorcycling performance. Suggestively, this might just be associated with the motorcyclist's heart rate. Thus, when the motorcyclist's is interrupted at the physiological level, the capability in performing the motorcycling activity (the work) may gradually declines. It is emphasized that the overall decrement in motorcycling performance would ultimately lead to sleepiness during motorcycling. Occasional yawning and rapid blinking of the eyes are among the best indicators for sleepiness. Sleepiness is the riskiest outcome of motorcycling fatigue. This is because sleepiness could lead to micro-sleeping and finally, macro-sleeping during motorcycling. The latter is the most hazardous and dreaded occurrence to could happened while motorcycling.

Conclusively, both of these outcomes of motorcycling fatigue (overall decrement in motorcycling performance and sleepiness) could occur independently or dependently. The occurrences are dependent on individual motorcyclist and the responsible variables that are affecting the particular motorcyclist. From the findings, it was clear that motorcycling fatigue is made up of several types of fatigues, thus, could not be simply defined with one single definition.

There are various independent and dependent factors that could contribute to the development of motorcycling fatigue. Motorcycling fatigue is almost inevitable, thus, further research is warranted in order to gain more accurate information and better understanding on motorcycling fatigue.

5.0 CONCLUSION

Conclusively, motorcycling fatigue is a type of fatigue which results from performing the complex and demanding motorcycling activity. Motorcycling fatigue is also a cumulative form of fatigue. Even so, all of these variables or fatigues would only lead to two final outcomes which may be experienced by the motorcyclist: (i) overall decrement in motorcycling performance, and (ii) sleepiness. The severity or significant level of these outcomes is dependent on individual motorcyclist. Motorcycling fatigue is almost inevitable, thus, further research is warranted in order to gain more accurate information and better understanding on motorcycling fatigue.

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