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To Identify Different Critical Factors Contributing to Motorcycle Crashes in Peshawar through Questionnaire Survey

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Abstract: ***A Road Traffic Accident (RTAs) is a major social and economic concern in many countries especially in a developing country like Pakistan. As almost all motorcycle riders in Pakistan are self-taught and a lack of proper driving education, trainings and a rider gain his riding experience through trial and error basis. Since the early 60s, attempts have been made to model rider behavior, improve rider safety, enhance training sessions and to provide basic education about traffic rules and regulations. In pursuance to that, understanding of a rider's behavior and finding the factors contributing to a motorcycle accident, a questionnaire comprising of 31 demographic and accident analysis questions were asked from 1400 respondents in Peshawar, Pakistan and their responses were statistically analyzed using a statistical analysis software namely Stata (Version 12). This research mainly focuses on the study of a rider's behavior and the identification of important variables that leads to a motorcycle accident. Based on the statistically analyzed results, recommendations to the concern department(s) on the mitigation of motorcycle crash accidents was made. Analysis shows that less experience riders, teen aged riders and high speed of a motorcycle contributes the most in occurrence of an accident.***

Keywords: Transportation Engineering, Generalized Linear Model, Motorcycle Safety, Questionnaire Survey, Accident Analysis.

I. INTRODUCTION

Motorcycle is the most used mean of transport in all developing countries such as Pakistan and other Asian countries in particular [1]. The increased use of a motorcycle is due to the saturated road traffic conditions, easy to park, low cost of its spare parts and economic utilization of fuel. The rise in the frequency of road traffic accidents involving motorcycles has become a distressing and growing concern in recent years. Availability of motorcycles on monthly installment basis with zero initial payment has increased the number of motorcycles in the city. The transportation industry has developed quickly in Pakistan because of the rapid increase in population and construction of new roads. The transport industry has become the major component of the country's source of revenue generation and is contributing a significant importance in people's lifestyle, still we know very little about the behavior of the riders and their daily circumstances. Increase in the price of a vehicle will surely reduce its buying capacity, thus traffic reduces but the lesser the price of a motorcycle encourages people to buy it [2]. People of Peshawar, Pakistan are facing a prime issue of not having the basic knowhow of traffic rules and regulations and the importance of a standard helmet use, which will be helpful in the mitigation of fatal accidents while riding a motorcycle. Speed limit higher than 50kmph is dangerous and cause serious injury after an accident [3]. At present, considerable research efforts has been made to monitor driver's behavior so as to acquire desirable road safety. The literature appraises the use of questionnaire that helps to indicate driver's behaviors and the key factors contributing to a motorcycle crash event.

II. LITERATURE REVIEW

A report of a cross sectional study carried in Washington DC states that those USA states which follows the helmet laws have a significant reduction of a fatal crash than those which do not have any such law [4]. There is no responsible agency or regulator to promote road safety, especially in terms of monitoring driver behavior and reporting aggressive driving. Most of the RTAs are due to human behavior and 65% of violations are caused by speeding and overtaking which are the main factor of a road traffic accident and contributes more than 90% to it [5]. People's injury due to a road accident is a discomfort situation nowadays and in the developing countries it is among the first three causes of an injury [6]. Statistical data reveals that the fatality due to an accident on the road is greater than 1.3 million worldwide [7]. In Malaysia, more than 50% of road crashes involves a motorcycle [8].

Numerous studies have been conducted recently and found that driving behavior is largely dependent on the driver's perceptual characteristics and self-assessment. Research conducted in this area has typically focused on responses of self-report questionnaires, surveying riders to assess their riding tendencies, behaviors, and acuity, such as risk-taking and compliance with laws and reporting for their prior safety records (e.g., collisions, criminal crime) [9]. Motorcycle is the principal source of a road accident [10]. This haphazard enhancement in the road traffic will leads to obstructions in the traffic flow and frequently occurring of collisions, making it a global pandemic [11] [12] [13] [14]. Because of the rapid increase in the number of motorcycles on the road, the increase of motorcycle crashes had also increased producing serious threats to people lives [15]. If we compare all fatalities occur on the road, fatality due to a motorcycle accident is more [16] [17]. Accidents on the road is going to be the seventh leading source of the fatality as the 2030 ends [18]. Being in a good health is an important element in everyone's life to ensure proper thinking and to take efficient decisions while riding a motorcycle therefore, good mental health is plays an important role in the mitigation of an accident [19]. Riding the most vulnerable transportation mean, motorcycle, which is easily affected by the outside environment, weather plays a crucial role among factors contributing to a road crash [20] [21]. This study has highlighted very important issues and establish some of the most common behavioral factors associated with motorcycle accident.

III. METHODOLOGY

A. *Subjects*

Questions of the designed questionnaire were asked from 1400 motorcycle riders in Peshawar, Pakistan. Study area selected was the metropolitan area of the province capital i.e. Peshawar. According to the official report of "Population Stat", from year 2019 to 2021 there is greater than 3% increase in the metropolitan population of Peshawar, Pakistan leading towards the increase in the use of a motorcycle due to its versatile nature [22] and due to its lower cost, people are more encouraged to buy it to meet their daily transportation demands [2].

B. *Questionnaire*

The questionnaire was split into two parts, first part have demographic data of a respondent and the second part contains the accident history data which mainly contributes to the modelling concept. Initially before conducting the main survey, a pilot survey was conducted to find the shortcoming in the survey and to remove or add the shortcomings in the questionnaire accordingly. Pilot survey was conducted from 300 respondents and after fulfilling the shortcomings, main survey was conducted from 1400 respondents.

C. *Software Used*

The software which was used in this research is "Stata version 12". "Stata" is a short form of Statistical Analysis and is used by different type of researchers for their research purposes and mainly for the use of a more advanced data analysis including statistical measures. The level of significance used was 5%.

IV. RESULTS AND DISCUSSION

A. *Modelling Results*

1) *Multicollinearity*

Prior to do modelling, the multicollinearity was checked in the research data keeping the fact in mind that no two variables can correlated with each other so that the results are robust. It is usually the concept that with age the experience of a rider also increases but it may not be the usual case because a respondent can start riding his motorcycle at an old age therefore, check for multicollinearity was required. Stata Software provide efficient space for multicollinearity checking, "Variance Inflation Factor (VIF)" is the term used in the software to familiar a researcher about the multicollinearity in the data. VIF value lesser than 10 is a desired value.

Table 1 VIF of independent variables.

Variable	VIF
Age	1.25
Experience	1.24
Speed	1.08
Weather	1.06
Yearly milage	1.02
Mean VIF	1.25

Since all the values are in the desired limit hence no multicollinearity/correlation exists in the data.

2) Generalized Linear Model (GLM)

The model selected for this research work was GLM. For GLM modelling, the family selected was "Poisson" and link "Log". The results coming from "Poisson Regression" gave more robust results than other families usage [23]. GLM need the response variable to be a rare event and also needs the response variable to be a count data in a specified time interval hence the response variable which was selected for this research was number of accidents in the last calendar year and the occurrence of a motorcycle is a rare event itself. The explanatory variables taken were "Age in Years", "Experience in Years", "Speed of Motorcycle (Low Speed and High Speed)", "Weather Condition (Wet Weather and Dry Weather)" and "Yearly Milage in kilometers". Table 2 represents the model output.

Table 2 GLM output.

Accidents in last calendar year	Coefficient	P > |z|
Age in years	-0.0020644	0.732
Experience in years	-0.0453671	0.000
Speed	0.335093	0.000
Weather	0.0988594	0.031
Yearly milage	0.0000949	0.000
Constant	0.027781	0.850

Except for "Age" variable, all other independent variables and significant with 95% confidence Interval threshold value. The negative coefficients of the "Age" and "Experience" variables shows that the increase of "Age" and "Experience" is associated with the decrease in the occurrence of an accident in the last calendar year while the positive coefficients of "Speed", "Weather" and "Yearly Milage" variables shows that the increase in "Speed", "Wet Weather condition" and more "Yearly Exposure" of a rider is associated with increase in the occurrence of an accident in the last calendar year.

3) Poisson Regression Model Equation

The poisson regression equation the coefficients results becomes,

$$\hat{y} = \exp(0.027781 - 0.0020644x_1 - 0.0453671x_2 + 0.335093x_3 + 0.0988594x_4 + 0.0000949x_5)$$

Where

$$x_1 = Age\ in\ years$$
$$x_2 = Experience\ in\ years$$
$$x_3 = Speed$$
$$x_4 = Weather$$
$$x_5 = Yearly\ milage$$

V. CONCLUSION AND RECOMMEDNATIONS

Same like in other countries, teen aged riding of a motorcycle is a problem in Peshawar, Pakistan also. Parents are requested not to allow their teen aged son/daughter to ride a motorcycle without having a valid motorcycle license. Control of a motorcycle (Two-wheeler) is a challenging task by itself, people with less experience of riding a motorcycle are recommended to gain their initial experience in a safe closed proximity rather than on a busy highway. "Wet Weather" condition after rain is associated with the pounding of water on roads and riding of a motorcycle gets even more difficult and chances of slipping of tires and occurrence of an accident gets high. Proper drainage of the road for rain water is necessary. High speed of a motorcycle will need more time and distance to come to rest and in high speed a minute error will lead to a serious injury. Proper speed limit signs should be installed after every fair distance. High ticket price needs to be implemented for speed limit violators.

Other factors that contribute the most to a motorcycle accident includes deteriorated road condition, excessive speed brakers, unpredictable environmental conditions and motorbike related factor such as not using of side mirror, not working of motorcycle lights at night and inadequate road control system. Moreover, factor like more than two passengers on one motorcycle, improper intersections design and use of mobile phone while riding are also the potential factors.

This study witnessed a sharp rise in congestion on road and increased violent riding of a motorcyclist alongside with no expansion of the existing road network and the scarcity of an effective traffic management in the city. An important reason for the accidents is the haphazard increase in the number of private vehicles, especially motorcycles. In General, the major issue in Peshawar, Pakistan is riders having insufficient knowledge about traffic rules and absence of a standard helmet while riding a motorcycle. Such recurrent incidents throughout the city are the major concern for the stake holders and there is a need that such injuries and their increased occurrence must be investigated and risk factors identified could improve the safety of motorcyclists in Peshawar and the whole country.

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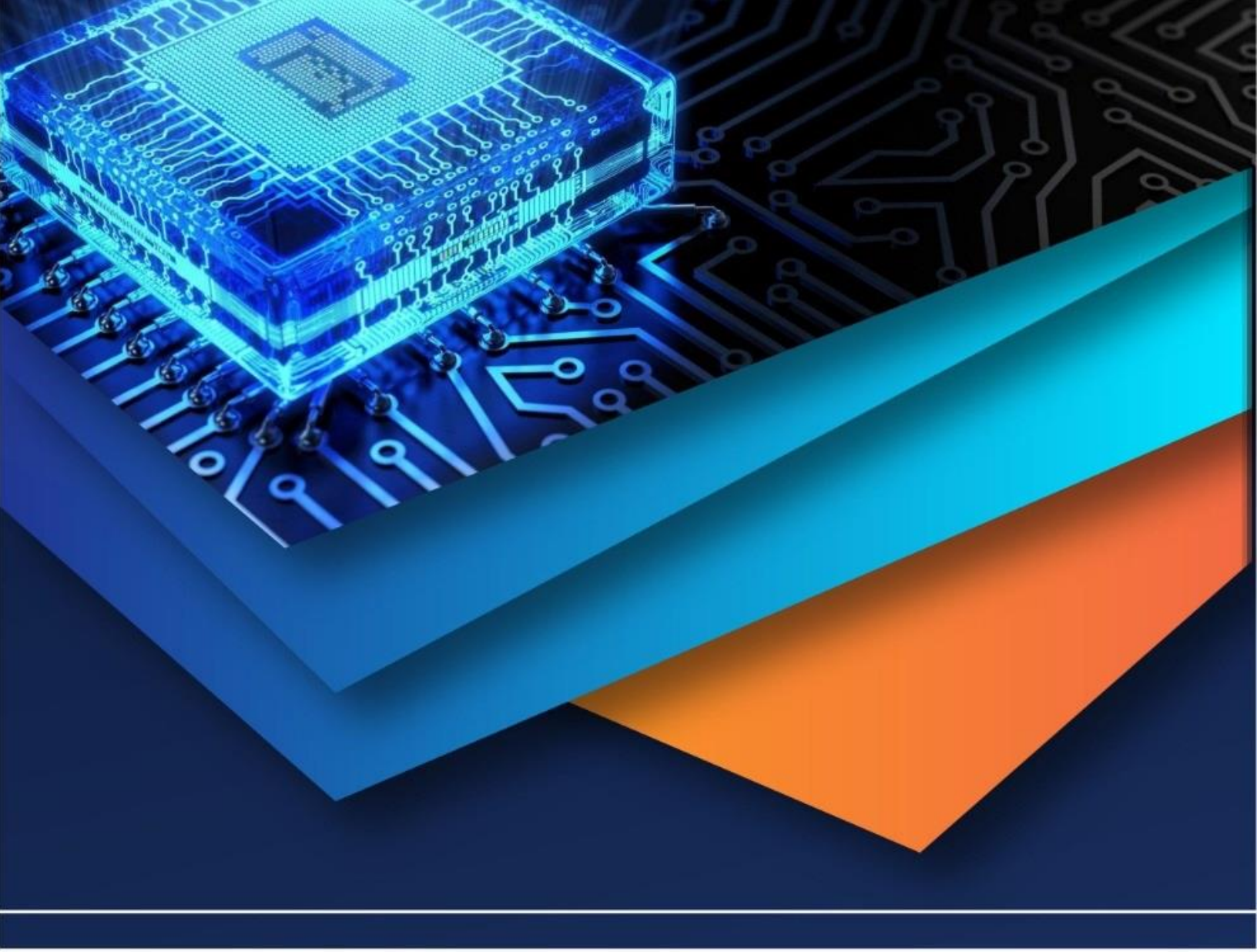

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