Characteristics and Prediction of Traffic Accident Casualties In Sudan Using Statistical Modeling and Artificial Neural Networks

Galal A. Ali[1] and Awadalla Tayfour[2]

[1]Professor & Consultant Engineer, School of Civil Engineering, College of Engineering, Sudan University of Science & Technology, P.O Box 12881, Khartoum 11111, Sudan
ga03ali@yahoo.com (Corresponding Author)

[2]School of Electrical Engineering, College of Engineering, Sudan University of Science & Technology, P.O. Box 72, Eastern Daim, Khartoum, Sudan 1.

ABSTRACT

Road traffic accident (RTA) casualties in Sudan are among the major causes of death in the age group of 21 to 60.with 61% fatalities. The fatality rate of 35 per 10,000 vehicles is among the highest in the world despite the low car ownership of 1 vehicle to 100 persons. This paper presents accident characteristics and considers road safety management. Crucial issues discussed in the paper include prediction and safety measures. The paper applies Artificial Neural Network (ANN) and regression techniques to comparatively predict traffic accident casualties. Both approaches modeled accident casualties using historical data on population, number of registered cars and other related factors from 1991 to 2009. Comparison of predictions with recorded data was very favorable. Predictions during 2010 – 2014 were determined using projected values for the same predictor variables. ANN forecasts provided the best fit for the data with a maximum difference of 1.84% between predictions and observed data. The study demonstrated that ANNs provide a powerful tool for analysis and prediction of accident casualties. The major causes of accidents were attributed to driver behaviour, vehicle fleet and conditions, road network defects, speed-limit violation, negligence of seat-belt usage and lack of traffic-law enforcement.

1. INTRODUCTION

There is great concern worldwide about the increasimg traffic accidents and casualties (fatalities and injuries) particularly in developing countries. Annually, over three-quarter million people are killed while injured and disabled victims in road traffic accidents

(RTAs) exceed 40 million [1]. Developing countries alone represent 70% of RTA fatalities although they own only 12% of the vehicle fleet. Fatality rates per 10^4 vehicles in some African and Asian countries range between 15 and 65 [2]. In contrast, accident records in many industrial countries indicate that there was decrease in recent annual fatalities. In USA, the fatality rate per 100 million vehicle-miles-traveled (MVMT) decreased by 10 % [3]. However, due to lack of MVMT data in developimg countries, fatality rate per 10^4 vehicles closely estimates the equivalent best measure of fatality rate according to Ali et al. [4]. The importance of continually updating and improving accident and casualty records as well as methods of analyzing such data cannot be overemphasized. Better analysis and evaluation of traffic accident and casualty data will assist policy makers device improved traffic regulations and safety measures to enhance road safety.

An overview of the situation on road traffic accidents in some Arab countries and the Middle East generally attributed the main causes of accidents to speeding, driver negligence and violation of traffic regulations [5,6]. In many cases, the majority of these accidents occur in urban areas, while in some countries about 40% of the casualties involve pedestrians. In Kuwait, a reduction of up to 15% in total fatalities was observed after installation of traffic cameras [7].

2. TRAFFIC ACCIDENT AND CASUALTY CHARACTERISTICS IN SUDAN

In Sudan, casualties are about 10 times more than in many developed countries in spite of the current low car ownership of one vehicle per 100 population. About 60% of the casualties are in the age group of 21-60 years as shown in Table 1, the major cause of death for about 50% of this age group being RTAs. The high rate of population growth, the large percetage of young drivers, the dramatic and uncontrolled increase in the number of vehicles over recent years compounded with the absence of strict law enforcement and the poor road conditions have all contributed to the high accident rates. In general, drivers have been the main cause in 90 % of the accidents primarily in terms of negligence, high speed and poor driving as illustrated in Table 2, computed from the data provided by Ali [1]. Poor driving reflects carelessly changing lanes or making turns without signaling their move, etc. Negligence is intended for being indifferent and not concerned with safe driving such as eating, talking to a rider or on phone or playing with radio, etc while driving. This value of 90% is less than the global record of 95 – 98 %. It is also asserted that vehicle age, mechanical defects, tyre failures do have impact on safety. Poor road and vehicle conditions contribute to the remaining 10% (or 2 – 5 % in the latter case) which includes mechanical defects, tyre failure and weather conditions. The corresponding value in Oman, for example, averaged only 3.5 % due to good road and vehicle conditions [8]. However, it cannot be confirmed that analysis of the causes of traffic accidents have been undertaken to investigate the roles of some of these factors on traffic crashes. Such in depth and detailed studies of the causes of accidents could help develop policies to reverse the existing trends and grave situation. Nevertheless, there are indications and various studies in the Arab world and Africa that the main contributors to RTAs are high speeds and the pedestrians.