



Brake Failure and its Effect on Road Traffic Accident in Kumasi Metropolis, Ghana

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ABSTRACT

Ghana in recent years has seen dramatic increase in vehicular growth. Vehicular transport in Ghana is growing with increased socio economic activities. With so many cars on our roads, the rate of vehicular accident has also increased with many people died or sustained serious injuries in traffic accidents. This study reports on the brake failure and its effect on road traffic accident in the Kumasi Metropolis, Ghana. The research design used for this study was survey which relied on questionnaire to generate data for analysis and discussion.

The results indicate that, 195 (40%) of the vehicle users agreed that brake failure is cause by low or shortage of brake fluid whiles, 158 (33%) of the respondent said it was due to brake overheating. For brake servicing periods only, 69 (14%) of the drivers will service their vehicle on the 5000 km servicing period with majority 189 (39%) of the drivers sending their vehicle for brakes repairs only when the brakes develop a fault a situation which is more worrying. A total of 402(83%) of the respondents agreed that brake failure could result in vehicle accident and vehicle should be service regularly to reduce brake failure.

The study recommends that law enforcing agencies should ensure vehicle users maintained their vehicles most especially the brakes and the National Road Safety Commission (NRSC) and the Driver and Vehicle Licensing Authority (DVLA) should intensify their campaign on regular brake servicing checks in the country.

Keywords: Brake failure, Disc brake, Drum brake, Drivers, Vehicle accident

1. INTRODUCTION

Road traffic injuries and deaths are a growing public health concern worldwide (Agnithotri, 2006). Studies have shown that road traffic injuries are a major cause of death and disability globally, with a disproportionate number occurring in developing countries (Banthia, *et al* 2006). Road crashes are the second leading cause of death globally among young people (WHO, 2004). The annual costs of road traffic crashes in low income and middle-income countries are estimated to be between US\$65-100 billion, more than the total annual amount received in development aid (UNGA, 2008). The estimated costs as a percentage of the Gross National Product (GNP) in most African countries range from about 0.8% in Ethiopia and 1% in South Africa to 2.3% in Zambia and 2.7% in Botswana to almost 5% in Kenya (Odero *et al*, 2003). In 2007, the National Road Safety Commission of Ghana estimated road traffic accidents to cost 1.6% of Gross Domestic Product (GDP) which translated to US\$ 165 million (NRSR, 2007). The major contributing factor of this road traffic accident is the motor vehicle that plies on our roads.

Ghana in recent years has seen a dramatic increase in vehicular growth. The total vehicle population has increased more than 12% from 1.03 to 1.2 million from 2009 to 2010 (NRSR, 2011). Vehicular transport in Ghana is growing with increased socio economic activities. With so many cars on our roads, the motor vehicle has become a fact of life for Ghanaians but our reliance on them comes at a cost. Many have died or sustained serious injuries in traffic accidents. By their sheer numbers, commercial road transport operations are involved in multiple vehicle accidents, which cause high rates of deaths and injuries to other road users. Road traffic crashes have become a major socioeconomic problem facing most developing countries including Ghana.

The World Health Organization (WHO) has estimated that nearly 85% of fatalities due to road traffic crashes occur in low- and medium-income countries (Murray & Lopez, 1996; Peden *et al*, 2004). Available crash data in Ghana suggests that about 1,900 persons are killed

annually in road traffic crashes while 15,000 are seriously injured, robbing the nation of some precious lives, thereby dwindling our scarce labour force in the country (Afukaar *et al*, 2008) and that more than 40% of the road traffic fatalities are occupants of cars, buses, and trucks which are used for commercial purposes.

According to the National Road Safety Commission (2011) reports, there are 19 fatalities per 10,000 vehicles in Ghana, 43% of the fatalities involved pedestrians with about 23% representing children below the age of 16 years. The reports also state that, among other things the most common known causes of road traffic accidents in Ghana include gross indiscipline on our roads, overloading, fatigue driving, drunk driving and over-speeding, lack of vehicle maintenance, brake failure and many others. The poor nature of some of our roads also contributes to mechanical failure of vehicle components such as engine, steering, suspension, transmission, brakes and tyres which is noted for causing motor accidents in the country. This work seeks to asses brake failure and its effect on road traffic accident in the Kumasi metropolis, Ghana.

2. BRAKE PRINCIPLE

Of all the systems that make car, the brake system might just be the most important. Its function is to retard or stop the motion of the vehicle which determine the safety of the driver, passenger and also pedestrian. The average driver uses the brakes about 75,000 times a year, making the brakes one of the most important (and overworked) parts of the car (McPhee, 2007). In the olden days it was also one of the simplest mechanisms in the vehicle. Over the years as improvements have been made, the system that has evolved is not simple anymore. When the brakes

are applied, the pads or shoes that press against the brake drum or rotor convert kinetic energy into thermal energy via friction. The cooling of the brakes dissipates the heat and the vehicle slows down. This is all to do with The First Law of Thermodynamics, sometimes known as the law of conservation of energy (Zammit, 1987). This law states that energy cannot be created nor destroyed; it can only be converted from one form to another. In the case of brakes, it is converted from kinetic energy to thermal energy.

Typically, there are two types of brake that are implemented in today's car; Drum brake and disc brake. The brake is a device for slowing or stopping the rotation of a wheel of vehicles. To stop the wheel, friction material in the form of brake pads or shoe is forced mechanically, hydraulically, pneumatically or electromagnetically against both sides of the disc or drum which cause the wheel to slow or stop (Heinz, 2001).

When the brakes are used rapidly, the complete brake assembly will stay hot and get no chance to cool off. The brake cannot absorb much more heat because the brake components are already so hot. The braking efficiency is reduced thereby causing brake failure which could result in road accident. When the brake pedal is depressed, the vehicle's braking system transmits the force from the driver's foot to its brakes through a fluid. Since the actual brakes require a much greater force than the leg could apply with, vehicle must also multiply the force of foot. It does this in two ways; mechanical advantage (leverage) and hydraulic force multiplication. The brakes transmit the force to the tires using friction, and the tires transmit that force to the road using friction. The modern automotive brake system has been refined for over 100 years and has become extremely dependable and efficient.

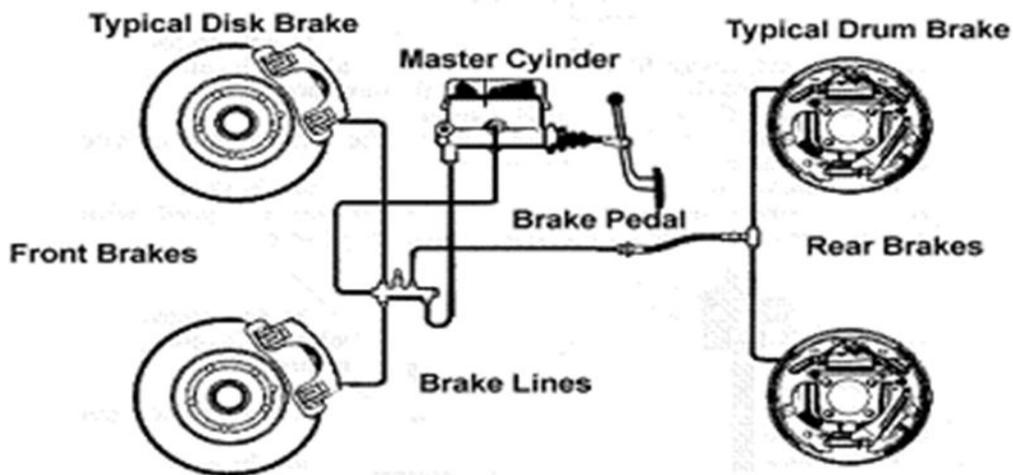


Fig.1: Hydraulic braking system
Source: (Hesiler, 2001)

Fig. 1 shows a typical hydraulic braking system circuit which consists of disc brakes in front and drums brake in the rear connected by a system of tubes and hoses that link the brake at each wheel to the master cylinder.

Other systems that are connected with the brake system include the parking brakes, power brake booster and the anti-lock system. When the brake pedal is pressed, it pushed against a plunger in the master cylinder which forces hydraulic fluid (brake fluid) through a series of tubes and hoses to the braking unit at each wheel. Since hydraulic fluid (or any fluid for that matter) cannot be compressed, pushing fluid through a pipe is just like pushing a steel bar through a pipe. Unlike a steel bar, however, fluid can be directed through many twists and turns on its way to its destination, arriving with the exact same motion and pressure that it started with. It is very important that the fluid is pure liquid and that there is no air bubbles in it or leakages in the system. Air can compress which causes sponginess to the pedal and severely reduced braking efficiency which can lead to failure.

The braking system which is very important component in the motor vehicle, without which the vehicle could possible result in road accident (Leeming and Hartley, 2001) has not been given the needed attention by driver. Most of the vehicle users pay little attention to its operations, maintenance and the causes of brake failure. There is therefore the need to conduct research to find out from the drivers the possible causes of frequent brake failure in Ghana. The main objective of this work is to assess the perception of drivers about the causes of brake failure and its effect on vehicle accident and make recommendation for policy makers when formulation policies on road safety management.

3. RESEARCH METHODOLOGY

3.1. Research Design

The design used for this study was that of survey which relied on questionnaire to generate data for the analysis. The study was to find out the perception of drivers and vehicle users about the causes of brake failure and its effect on road accident among vehicle users in the Kumasi Metropolis.

3.2 Study Area: Kumasi Metropolis was selected for the study because it is the second largest city in Ghana. The city has a population greater than 1,500,000 inhabitants and in recent years it has expanded beyond its original boundaries to form a major conurbation of settlements with a radius of approximately 10km from the city center. Main mobility in the Metropolis is by vehicle and the street of Kumasi is usually full of vehicle especially during the peak hours in the morning and evening with heavy vehicular traffic.

3.2 Study Population and Sample used

The study populations were: (a) taxi drivers (b) private car users (c) minibus (trotro) drivers (d) heavy commercial vehicle drivers (e) trucks users. The populations included people with valid driving license and have at least two (2) years driving experience. A simple random sampling technique was used for the study.

3.3. Instrument and Data Collection

The data used in this study were collected during a survey mounted by the researcher between January and June 2012. By means of structure questionnaires, data were obtained from a total of 485 respondents. The 485 respondents which include 97 taxi drivers, 99 private drivers, 96 minibus drivers, 98 heavy commercial vehicle drives and 95 truck drivers. For the purposes of the study, the city was zoned into four major divisions to form four concentric areas made up of drivers at Adum, Suame, Bantema and Asafo all within Kumasi metropolis.

The questionnaire were personally administered by the researcher that gave him the opportunity to interact with the respondents, explained in details the rationale for the research and gave explanation where necessary. Enough time was giving to the respondents to answer the questionnaire of which some were collected on the same day and others after a few days. 500 questionnaires were distributed out of which 485 were returned (Table 1), representing 97% response rate.

Vehicle users	No. of questionnaires Distributed	No. of questionnaires returned	Responses rate (%)
Taxi drivers	100	97	19.4
Private car users	100	99	19.8
Minibus (trotro) drivers	100	96	19.2
Heavy vehicle drivers	100	98	19.6
Trucks users	100	95	19
Total	500	485	97

4. RESULTS AND DISCUSSION

4.1 Causes of Brake Failure

The respondents were asked to state the frequent causes of brake failure in motor vehicle. Fig. 2 presents the summary of the responses on the causes of brake failure.

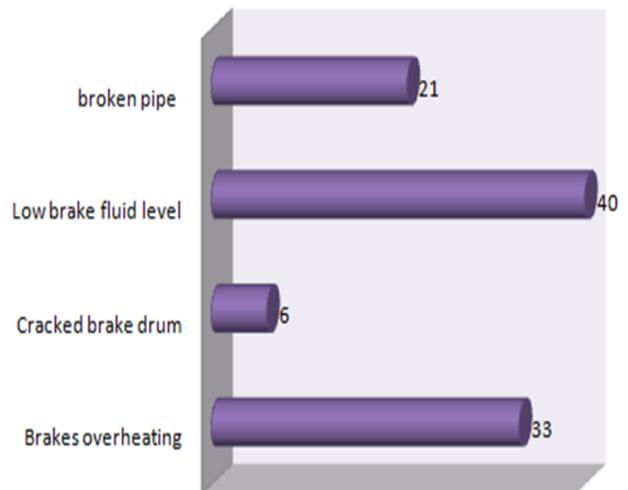


Fig.2: Causes of Brake Failure

The results indicate that, 195 representing 40% of the vehicle users agreed that brake failure is caused by low or shortage of brake fluid in the master cylinder. According to Hesiler (2001) hydraulic braking system is being pressurized by brake fluid and the brake system is fully compensated; i.e. automatically divide the available braking force equally between each brake wheel so shortage or low brake fluid level will render the braking system ineffective and therefore cause brake fault known as no braking which could possibly result in vehicle accident. Also, 158 respondents representing 33% suggested that brake overheating is a major cause of brake failure. From the point of view of Mudd (1972) brake fade occurs as a result of heat in the brake system causing the brake assembly to become heated. On application of the

brakes, the brake pedal becomes spongy and the pedal travel increases. This particular fault is unpleasant experience, especially when descending a longer hill. However, only 21% and 6% of the respondents respectively suggest that brake pipe broken and cracked brake drum could be the cause of brake failure, perhaps the reason being that these components are made of metal and it is difficult for it to fail easily.

4.1 Causes of Brake Ineffectiveness

The respondents’ responses on the causes of brake ineffectiveness are presented in Table 2.

Table 2: Cause of Brake Ineffectiveness

Causes of brake ineffectiveness	Number of respondents	Percentage (%)
Air in the braking system	195	40
Grease or brake fluid on lining	45	9
Incorrect brake adjustment	60	12
Uneven tyre pressure	52	11
Automatic brake adjuster not working	22	5
Vehicle overloading	111	23
Total	485	100

Invariably, 195 of the respondents representing 40% suggest that the major causes of brake ineffectiveness is the presence of air in the braking system. Hesiler (2001) who conducted study on the hydraulic braking system concluded that, the presence of air in the hydraulic braking system makes the system become ineffective because much of the drivers’ effort will be used to compress the air leaving very little to pressurize the brake fluid thereby causing brake failure. Again, 111 (23%) of the respondents indicate that vehicle overloading could possibly make the brake become ineffective. According to Mudd (1972), under normal load condition, when brakes are applied about 60% of the vehicle weight are transferred to the front wheels so when the vehicle exceeds its normal load (overloading) the possibility of excessive load being transferred to the front wheels could force the vehicle to move forward even though the brakes are fully applied. However, only 22(5%) of the respondents suggested that automatic brake adjuster malfunction could cause brake ineffectiveness.

4.2 Vehicle pulling to one side when brakes applied

The respondents were asked to indicate the causes of vehicle pull to one side when brakes are applied. The summary of their response is given in Fig. 3.

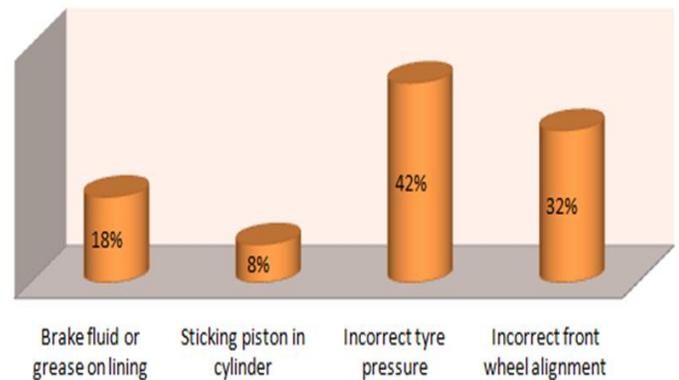


Fig. 3: Vehicle pulling to one side when Brake applied

The data shows clearly that 42% of the respondents suggested that incorrect tyre pressure result in the vehicle pulling to one side when brakes are applied. From Leeming and Hartley (2001) incorrect tyre pressure on the front wheels could lead to poor handle on the vehicle, increased rolling resistance and prolong braking causing the vehicle to move to one side. Also, 32% of the respondents agreed with Nunney *et al*, (1998) that incorrect wheel alignment could result in the vehicle pulling to one side. Invariably, only 18% and 8% respectively suggested that grease or oil on lining and piston sticking in the cylinder could cause the brake to pull to one side during braking.

4.3 Brake Service Period

The respondents were asked to indicate at what time they serviced their brake when running the vehicle. The summary of the data are presented in Fig. 4

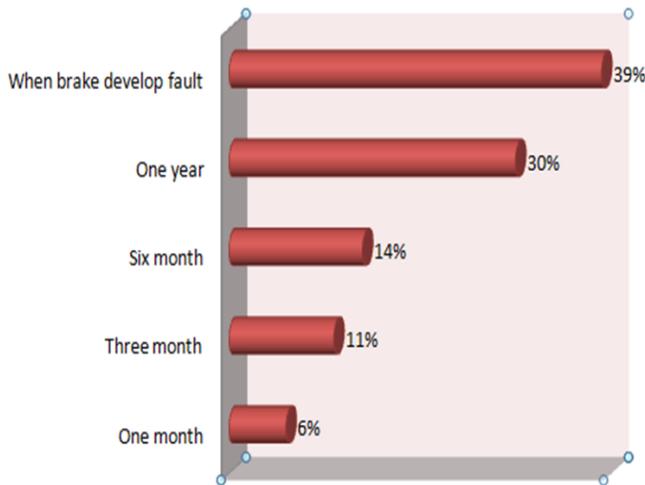


Fig.4: Brake Service Period

According to McPhee (2007) of all the systems that make car, the brake system might just be the most important because the average driver uses the brakes about 75,000 times a year, making the brakes one of the most overworked parts of the car. The servicing of the brakes should be given the needed attention that is required. However, the outcome of the study as presented in Fig.4 shows the opposite. The results indicated that, 189 (39%) of the respondents will visit a workshop for their brake repairs only when their brake develop fault. This situation is worrying and could perhaps contribute to a lot of brake failure which result in vehicle accident. Leeming and Hartley (2001) was of the view in their studies on braking system that, drivers are supposed to send their vehicle to workshop for inspection and service at every 5000km or six (6) months period. The data suggested that 30% of the respondents prefer sending their vehicle for service at one year while only 14% will service their vehicle in six months time. The results suggest that 11% of the respondents service their vehicle at every three (3) months and only 6% check their brakes at regular intervals of one month.

4.4 Brake Failure Result in Accident

The drivers were asked whether brake failure could result in accident. The summary of their response are presented in Fig. 5.

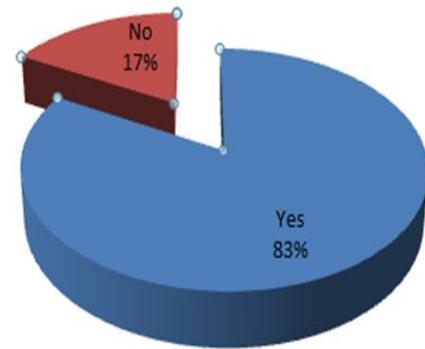


Fig.5: Brake Failure Result in Accident

From the result of the study, 402 (83%) agreed that brake failure could possible result in accident and proper precaution needs to be taken to avoid such situation. However, 83(17%) of the respondents did disagreed and said brake failure could be handling without necessary causing accident. Mudd (1972) stated that brake failure is a fault where the brake fails to response effectively during brake application and this fault makes the vehicle very difficult to handle.

4.5 Frequent Brake Defects

The respondents were asked to indicate the frequent brake failure defects. The results of the respondents are given in Table 3.

Table 3: Frequent Brake Defects

Frequent brake defects	Number of respondents	Percentage (%)
Brake pedal hard	190	39
Back plate loose or broken	35	7
Excessive brake pedal travel	102	21
Brake pedal soft	133	28
Brake drag	25	5
Total	485	100

From the results presented, 190 respondents representing 39% suggest that the most frequent brake defects are brake pedal becoming hard. According to Hesiler (2001) hard brakes is a possible fault of seize piston in the wheel cylinder or faulty master cylinder and it become common when the rubber sealing in the cylinder is defective.

Again 133(28%) of the respondents suggest pedal becoming soft is the most frequent brake defects whiles 102 (21%) consider excessive brake pedal travel. From Nunney *et al.*, (1998) point of view, excessive pedal travel

is possible when there is low brake fluid in the reservoir, when the brake pads or shoes worn beyond acceptable limits or air in the hydraulic braking system. This will in effect make the pedal feel soft and also cause the pedal to travel more what is required. However, 25(5%) of the respondent said brake drag is the most frequent fault.

5. CONCLUSION AND RECOMMENDATION

In conclusion, motor vehicle accident can be fatal and constitute a high economic burden. Accident also imposed high intangible cost (i.e. pain, grief and suffering). The study recommends that law enforcing agencies should ensure vehicle users maintained their vehicles most especially the brakes. Also, the National Road Safety Commission (NRSC) and the Driver and Vehicle Licensing Authority (DVLA) should intensify their campaign on regular brake servicing checks in the country. Additionally, the Motor Traffic and Transport Union (MTTU) division of the Ghana Police Service should introduce brake servicing cards which qualified workshops should be given to drivers after servicing their brake and this law should be enforced by the police.

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