

## Tyre related risk assessment in the middle belt region in Nigeria: Information for Policymakers

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### Abstract

**Objective:** It has been reported that defective, worn-out and under-inflated tyres were responsible for many road crashes. The objective of this study was to assess the safety profiles of tyres used by inter-city commercial vehicle drivers in Ilorin Kwara State, Nigeria.

**Methods:** It was a descriptive cross-sectional study in which simple random sampling technique by ballot method was adopted to select 300 commercial vehicles. Two tests were performed on each vehicular tyre viz: visual inspection of tyres for tread wear indicator (TWI), manufacturing date to determine the expiry date and the depth of tread of vehicle tyres by one penny US coin. Data analysis was done using SPSS data analysis package.

**Results:** Ninety-two vehicles (30.7%) had all the four tyres expired and 80 (26.7%) did not have extra tyre. Of all the 300 vehicles inspected, 120 (40.0%) had all the four tyres worn-out. Additionally, 104 (34.7%) of the vehicles failed the coin test. Only four vehicles (1.3%) had all their four tyres pass all the three tests conducted on them.

**Conclusion:** There is need to scale up the study so that the magnitude and contribution of tyre safety to road crashes can be determined in the country to provide basis for informed and evidence-based interventions.

**Keywords:** Tyres, risk, assessment

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Received: June 25, 2018

Accepted: July 29, 2018

Published: September 30, 2018

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<http://dx.doi.org/10.4314/rejhs.v6i3.6>

## Évaluation des risques liés aux pneumatiques dans la région de la ceinture moyenne au Nigéria: Informations à l'intention des décideurs

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### Resume

**Objectif:** Il a été signalé que des pneus défectueux, usés et sous-gonflés étaient à l'origine de nombreux accidents de la route. L'objectif de cette étude était d'évaluer les profils de sécurité des pneumatiques utilisés par les conducteurs de véhicules utilitaires interurbains dans l'État d'Ilorin Kwara, au Nigéria.

**Méthodes:** Il s'agissait d'une étude transversale descriptive dans laquelle une technique d'échantillonnage aléatoire simple par la méthode du scrutin a été adoptée pour sélectionner 300 véhicules commerciaux. Deux tests ont été effectués sur chaque pneu de véhicule: inspection visuelle des pneus pour l'indicateur d'usure de la bande de roulement (TWI), date de fabrication pour déterminer la date de péremption et profondeur de la bande de roulement des pneus du véhicule. L'analyse des données a été effectuée à l'aide du package d'analyse de données SPSS.

**Résultats:** Quatre-vingt-douze véhicules (30,7%) avaient tous les quatre pneus expirés et 80 (26,7%) n'avaient pas de pneus supplémentaires. Sur les 300 véhicules inspectés, 120 (40,0%) avaient tous les quatre pneus usés. De plus, 104 (34,7%) des véhicules ont échoué au test de pièces. Seuls quatre véhicules (1,3%) avaient tous leurs quatre pneus réussis les trois tests effectués sur eux.

**Conclusion:** Il est nécessaire d'intensifier l'étude de manière à ce que l'ampleur et la contribution de la sécurité des pneumatiques aux accidents de la route puissent être déterminées dans le pays pour servir de base à des interventions éclairées et fondées sur des preuves.

**Mots-clés:** Pneus, risque, évaluation

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## INTRODUCTION

Tyres are undoubtedly the most critical safety component on a vehicle (1). Where the rubber meets the road affects traction, handling, steering, stability and braking. A sudden **tyre failure** can have serious consequences particularly if it occurs at highway speeds in a vehicle with a high center of gravity. Many tyres today can be used to cover 60,000 to 80,000 miles (1) or more provided they are properly installed, maintained, aligned and inspected regularly. With proper care and normal use, most tyres will go the distance without a problem. Tyres are a vehicle's only contact with the road; therefore the condition of a vehicle's tyres is crucial to its safe use. Over-speeding and tyre burst are frequently being reported as the commonest twin causes of road accidents in Nigeria (2). This is as a result of vehicle cruising on worn-out tyres that are susceptible to bursting. The chances for survival in this situation, are slim, because the vehicle will be difficult for the motorist to control.

National Highway Traffic Safety Administration (NHTSA) in US estimates that tyre failure causes approximately 11,000 crashes a year. The most common cause of failure includes tread separations, blowouts, bald tyres and under-inflated tyres (3). A tyre-related risk is involved in every seventh fatal crash (4). The Department for Transport revealed that illegal, defective and under-inflated tyres were responsible for more than 1,210 road casualties in Great Britain in 2010. Road Casualties in Great Britain report shows that 18 motorists were killed during the year from defective tyres bringing the number of tyre related deaths in the United Kingdom (U.K.) to 164 between 2005 to 2010 (5).

**Also**, vehicles of drivers found to be at fault in high-speed accidents were found to be six times more likely to have worn tyres than those of the other drivers involved. During the period 2000–2005 there were a total of 1,292 accidents; of these 198 were incidents relating to the tyres of the party responsible for the accident. A total of 248 people died in tyre-related accidents and 73 were severely injured (6).

Vehicle tyres must have a minimum tread depth of 1.6mm to be roadworthy. Driving on anything less is extremely dangerous especially in wet weather; low tread depth cannot disperse the water quickly enough allowing water build-up between the tyre and the road surface. When this occurs the car loses grip with the surface of the road and may easily and unexpectedly slide (aquaplane). Loss of grip from poor performing

tyres is most dangerous in an emergency situation when a car needs to stop quickly, or change direction quickly. Adherence to the specification according to the respective vehicles provides safety, comfort, grip as well as ability to carry load, last long and save cost for the users. The lettering signs which are inscribed on every tyre by the manufacturers, determine if the tyres are authentic and fit for the vehicle. Every tyre has its life cycle. However, tyres can expire even when not in use. The various conditions that could lead to tyre damage to include overloading, speeds, inflation pressure, driving method, road damage, and vehicle body as well as system conditions. Wheel balancing and alignment, should also be checked at intervals of about six months or 20,000 kilometers not ignoring the need to rotate the tyres periodically. Tyre rotation should be done at every 12,000 kilometers.

A survey by the Federal Road Safety Corps (FRSC) in Nigeria shows that tyre-related crashes have been responsible for the destruction of 5,288 vehicles between 2011 and 2015 (2). The survey showed that there were more expired than non-expired tyres used by motorists on the Nigerian roads, with the expired ones constituting about 61 percent. The survey also showed that 35 percent of vehicles in that period drove on fairly-used tyres and 15 percent on re-bored tyres. Also, it was discovered that nine percent of tyres used were completely worn out tyres while 91 percent were expired. The Federal Road Safety Corps in Nigeria reported that in 2015, 772 of the 9000 road traffic crashes were caused by burst tyres (7). The objective of this study therefore, was to assess the safety status of tyres used by inter-city commercial vehicles in Ilorin, Kwara State, Nigeria.

## MATERIALS AND METHODS

The study was conducted in Kwara State, middle belt region of Nigeria, located at the geographical and cultural confluence of the North and South of Nigeria. It was a descriptive cross-sectional study to assess the safety profile of tyres used by inter-city commercial motorists in the State. Prior to the commencement of the study, advocacy visits were paid to Executives of the National Union of Road Transport Workers (NURTW) Kwara State branch where the purpose and significance of the study were communicated. The study was carried out in the three senatorial districts of Kwara State. Simple random sampling technique by ballot method was adopted to select four major inter-city commercial motor parks in each of the three

senatorial districts. A total of twelve motor parks were used for the study. In each of the parks, all vehicles that were perceived to be in good condition by the drivers, scheduled to travel and on queue for passenger-loading during the survey were used for the study. A total of three hundred commercial vehicles were selected. The study was carried out in August 2017. For each of the vehicle selected, two tests were performed on each of the tyre viz: The first test was visual inspection of tyres for tread wear indicator (TWI) and manufacturing date in order to determine the expiry date of the vehicle tyres. The second test was the determination of the depth of tread of vehicle tyres by a coin test (one penny US coin). The procedures for the assessment are described as follows:

#### **i. Treadwear indicator**

Every tyre is designed with a tread wear indicator (TWI) which is a raised section moulded into the grooves of a tyre. In passenger car tyres, the TWI is around 1.6 mm and the tyre shoulder is labelled with TWI or the symbol. TWI indicates the tread wear limit and helps vehicle owners understand the tread wear so they know when to replace the tyres. When the tread is levelled with the TWI, the tread pattern will be separated and the tyres need to be replaced immediately. When tread wear limit is reached, vehicle handling, control and braking are significantly affected (5, 8). On inspection, the tyre shoulder by the sidewall of a tyre was searched for a TWI label or symbol. The tread wear indicator is usually labelled round the tyre at about 15 inches interval.

#### **ii. Expiry date**

Every tyre is designed with a four digits number written in a rounded rectangular shape on the sidewall. The number represents the date when the tyre was manufactured, where the first two digits indicate the week and the last two digits the year of manufacture. The lifespan of a newly manufactured tyre is four years (8). The manufacturing date of the vehicle tyres was inspected and used to calculate the expiry date of the tyre. This was done by adding 4 years to the manufacture date of the tyre and compare with the date of assessment. It can also be done by estimating the age of the tyre in week/year from the date of manufacture and then subtract the current age of the tyre from 4 years. However, a tyre can still be road unsafe before its expiry date if it has travelled a distance of 30,000km or more; sidewall has multiple bulges, cracks and cuts and has tread wears at TWI limit (5, 8).

#### **iii. Penny/Coin test**

In the United States, tyre tread depth is measured in 32nds of an inch. New tyres typically come with 10/32" or 11/32" tread depths, and some truck, Sport Utility Vehicle (SUV) and winter tires may have deeper tread depths than other models. The U.S. Department of Transportation recommends replacing tyres when they reach 2/32", and many states legally require tyres to be replaced at this depth (5, 8). The idea of the penny test is to check whether the 2/32" threshold is reached. This penny test is carried out as follows:

1. A penny is placed between the tread ribs on a tyre. A "rib" refers to the raised portion of tread that spans the circumference of a tyre. Tyre tread is composed of several ribs.
2. The penny is turned so that Lincoln's head points down into the tread.
3. If you can see all of Lincoln's head, the tyre needs to be replaced

When performing the penny tyre test, each tyre is checked and various places around each tyre. Special attention is paid to areas that look the most worn. Even if parts of tread are deeper than 2/32", the tyre is replaced when any areas fail the penny test.

Consistent wear around the whole tyre is normal, but uneven tread wear could be a sign of improper inflation, wheel misalignment, or a variety of other things. If uneven tread wear is observed, a technician should inspect the vehicle.

**Data collection and analyses:** Four research assistants were recruited and trained on how to conduct the assessment of the safety status of vehicular tyres. Data was collected using the checklist and edited manually to detect omission and to ensure uniform coding, after which data was entered into the computer. Data analysis was done using SPSS version 23 software package. The analysis was presented in simple percentages. Ethical approval for the study was obtained from the Ethical Review Committee, University of Ilorin. Permission was sought from the different motor parks chairmen. Written consent was obtained from the respective drivers of the vehicle before inspection and assessment.

## **RESULTS**

Of the 300 vehicles inspected, 140 (46.7%) had expired front tyres on the right and on the left while 128 (42.7%) and 136 (45.3%) vehicles had expired right and left rear tyres respectively. Nearly one-quarter 72 (24.0%) of the vehicles inspected had expired spare tyres,

and 80 (26.7%) did not have a spare tyre. The tread wear indicator revealed that 164 (54.7%) and 172 (57.3%) tyres were worn on the front right and left sides respectively, and 156 (52.0%) and 168 (56.0%) on right and left rear tyres respectively. Of the 220 extra tyres, 156 (70.9%) were worn-out. The results of the tyre coin test revealed 132 (44.0%) of the right and 144 (48.0%) of the left front tyres passed. Of the rear tyres, 172 (57.3%) on right and 164 (54.7%) on the left passed the coin test. One hundred and forty (63.6%) extra tyres passed the coin test (table 1).

About a third 112 (37.3%) of the vehicles inspected had all the four tyres not yet expired, 32 (10.7%) had one tyre expired, while 48 (16.0%) and 16 (5.3%) had two and three of their tyres expired respectively. Ninety-two vehicles (30.7%) had all four tyres expired. Of all the vehicles inspected, 120 (40.0%) had all four tyres worn-out and tread wear had been reached; 92 (30.7%) had the four tyres in which tread wear safety limit had not been reached. Additionally, 104 (34.7%) of the vehicles failed the coin test and equal number passed the coin test.

Of the 220 vehicles inspected which had spare tyres, 96 (43.6%) had expired tyres, 124 (56.4%) had worn-out tyres as the tread wear indicator had been reached and 116 (52.7%) failed the coin test. Twelve of the spare tyres (5.5%) passed all the three tests, while 104 (47.3%) passed 2 tests and 24 (10.9%) did not pass any test (table 3). The overall assessment revealed that only four vehicles (1.3%) had four tyres that passed all the three tests, while 268 (89.3%) vehicles had four tyres that could not pass any of the tests (table 4).

## DISCUSSION

Out of the vehicles inspected, a little more than one-half (53.3%) of them had their front tyres expired while the rear tyres had expired in 57.3% and 54.7% of right and left side of the vehicles respectively. About one-quarter 24.0% of the vehicles inspected had expired extra tyres. This implied that motorists did not observe the expiry date of vehicular tyres and thereby exposing passengers to risk as they travel on the road. These findings are similar to that of a study conducted nationwide in Australia where 44% of tyres were expired (9).

Similarly, more than half of the vehicles had worn out tyres as the tread wear indicator was reached in 54.7% and 57.3% on right and left front tyres respectively, and 52.0% and 56.0% on right and left rear tyres respectively. Of the spare

tyres inspected, 56.4% were worn-out. This clearly demonstrated that tyre safety was not given priority by the commercial motorists in the study area. It has been reported from the previous study that burst tyre is said to have been responsible for 6.7% of road traffic crashes in 2015 in Nigeria (10).

The assessment of the status of the tyres by the coin test indicated that more than half (52.0%) of all vehicles did not pass and 36.4% of spare tyres failed the coin test. There is consistency in the findings of the status of tyres assessed by coin test, thread wear indicator and expiration date. However, this is in contrast to a nationwide road safety study where 18% of tyre were worn-out (9). The implications of these findings pose serious threats to road travel and increase the risk of road crashes. It has been reported that tyre-related risk factor has been implicated in one of every seven road traffic crashes in Nigeria (4).

This study further revealed that 30.7% of vehicles assessed had all four tyres expired. It can be deduced that the regulatory agencies of government have not enforced the rules on motorists guiding vehicular tyres use. This might have contributed significantly to the endemicity of road crashes in the country. Also, two in every five vehicles in this study had all the four tyres worn out. It cannot be overemphasized that commuters in Nigeria particularly those involved with commercial vehicles at risk of road crashes. This is one of the preventable risk factors for road traffic crashes if appropriate enforcement is implemented.

One in every three vehicles assessed had all four tyres fail the coin test. This point to insensitive and uncaring attitude on the part of commercial motorists in Nigeria toward tyre safety. The implication of this is that policy shift and its implementation by relevant stakeholders is desirable to address the challenges of use of safe tyres.

About one in every ten of the vehicles (89.7%) inspected passed all the three tests. Therefore, this implied that only one in every ten commercial vehicles had safety-compliant and road worthy tyre. Similar findings were reported by the Nigerian Road Safety Corps where 91% of the vehicular tyres were expired (2), however, 14.3% was reported in the United States of America (4).

## CONCLUSION

Critical appraisal is required to identify the magnitude and contribution of tyre safety to

road crashes in Nigeria. These findings clearly portray the fact that tyres used by commercial motorists could not support high speed which they are known for.

Re-orientation, education and continuous sensitization of commercial motorists are required on the importance of the use of safe tyres. It is important that regular tyre inspection by the appropriate vehicle safety enforcement agencies should be done. Policy environment for affordable tyre production should be supported by the government.

**Acknowledgement:** The secretariat support provided in the development of this manuscript by Dr T. Oloyede is appreciated.

**Conflict of Interest:** The authors declare no conflicts of interest.

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**Table 1: Assessment of safety status of tyres of the vehicles by location (N=300)**

<b>Variable</b>	<b>Frequency (%)</b>	<b>Frequency (%)</b>
<b>Expiration status of tyre</b>	<b>Expired</b>	<b>Not expired</b>
Front		
Right	140 (46.7)	160 (53.3)
Left	140 (46.7)	160 (53.3)
Rear		
Right	128 (42.7)	172 (57.3)
Left	136 (45.3)	164 (54.7)
Extra (n=220)	72 (32.7)	148 (67.3)
<b>Tread Wear Indicator</b>	<b>Reached</b>	<b>Not Reached</b>
Front		
Right	164 (54.7)	136 (45.3)
Left	172 (57.3)	128 (42.7)
Rear		
Right	156 (52.0)	144 (48.0)
Left	168 (56.0)	132 (44.0)
Extra tyre (n=220)	156 (70.9)	64 (29.1)
<b>Tyre Coin Test</b>	<b>Passed</b>	<b>Failed</b>
Front		
Right	132 (44.0)	168 (56.0)
Left	144 (48.0)	156 (52.0)
Rear		
Right	172 (57.3)	128 (42.7)
Left	164 (54.7)	136 (45.3)
Extra tyre (n=220)	140 (63.6)	80 (36.4)

**Table 2: Pattern of safety status of the assessed vehicle tyres by expiry date, tread wear indicator and coin test (N=300)**

<b>Variable</b>	<b>Frequency</b>	<b>Percent</b>
<b>Expired Tyre</b>		
0	112	37.3
1	32	10.7
2	48	16.0
3	16	5.3
4	92	30.7
<b>TWI reached (worn out)</b>		
0	92	30.7
1	24	8.0
2	36	12.0
3	28	9.3
4	120	40.0
<b>Tyre passed coin test</b>		
0	104	34.7
1	28	9.3
2	24	8.0
3	40	13.3
4	104	34.7

TWI = Tread Wear Indicator

**Table 3: Pattern of safety status the assessed vehicle spare tyre by expiry date, tread wear indicator and coin test (N = 220)**

<b>Variable</b>	<b>Frequency</b>	<b>Percent</b>
<b>Expiry date</b>		
Expired	96	43.6
Not Expired	124	56.4
<b>Treadwear indicator</b>		
Reached	124	56.4
Not reached	96	43.6
<b>Coin test</b>		
Passed	104	47.3
Failed	116	52.7
<b>Number of test passed</b>		
3	12	5.4
2	104	47.3
1	80	36.4
0	24	10.9

**Table 4: Summary of total number of test(s) passed by the inspected vehicular tyres (N = 300)**

<b>Number of test passed</b>	<b>Frequency</b>	<b>Percent</b>
3	4	1.3
2	8	2.7
1	20	6.7
0	268	89.3

\*Tyres were tested using Expiry date, Coin test and Treadwear