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Anthropometric Comparison of Three-Year-Old Nigerian Child and Cr Dummies

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ABSTRACT

In this work, anthropometric data measured from three-year-old Nigerian child were compared wi anthropometric database collected by Snyder, 1977 which formed the basis of US anthropome Further comparison was also carried out with the dimensions of crash dummies: Hybrid III three 3YO) and Q3s dummies in order to determine the validity of using such crash dummies for safet cars and child restraint systems (CRS) used for Nigerian children. Anthropometric survey was pe

Nigerian children aged 2.5 to 3.5 years old. Twenty three standard measurements were taken f including the weight, height and circumferences etc. Various percentiles mean and standard deviati obtained and compared with international database. As observed, the dimensions of three-year-old appeared to be about 25% lower than US data reported by Snyder. Significant difference was also the dimensions of three-year-old Nigerian child and crash dummies. This study provides the exter of 3-year-old Nigerian child that could be used for crash dummy and CRS design.

KEYWORDS

Anthropometry, Crash Dummies, Child Restraint System, Measurement, Vehicle Safety

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1. Introduction

Anthropometry is the measurement of human size: shape, dimensions, weight and physical capabil shape, mass and strength are critical in the design of product with which people interact. It is ap design, vehicle interior layout and development of crash dummies. Accurate body shape is designing correct child restraint system (CRS) for children. It is not possible to create a single hum to represent all population. This is because human being is unique creature; any person anthropometry and mechanical characteristics.

Development of crash dummy models requires knowledge of geometry and the external dimens being it represents in sitting and standing posture for rear passenger and pedestrian respectively. T safety systems used in developing countries were evaluated using crash dummies of oth anthropometry. Most commonly used Child dummy models are three- and six-year olds in crash few data exist on child segment anthropometry and the ones available were based on United States children, and mostly out dated, but none represents African child talk less of Nigerian alone. T comprehensive anthropometric data of children were carried out in 70's by university of Michigan Research Institute (UMTRI) by research team led by Snyder. This forms the basis of most US cont body dimensions [1] .

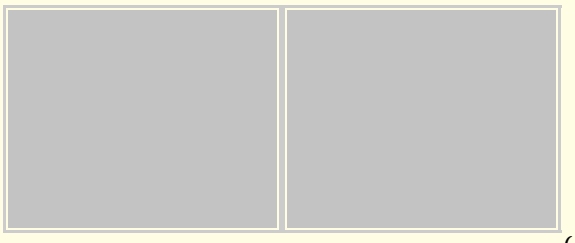
There are some efforts of comparing anthropometry of some population to crash dummies develo al. [2] compares the anthropometry of three-year-old and six-year-old French children with crash measurement was performed on 70 and 80, three-year-old (3YO) and six-year-old (6YO) children re dimensions of French children were found to be 12% higher than other anthropometries. Other aut 50^{th} hybrid III dummy with adult Chinese occupant [3] and United States adult [4] with the aim of differences in anthropometries. Nigeria is the number one car buyer, highest economy and l country in Africa with an average of 70,000 cars sold annually and with an average of 1 vehicle to e [5] . It is imperative to consider this population in evaluation of vehicle crashworthiness espe occupants. To the best of author's knowledge, there is no research that considers the validity dummies on African population. To study this scenario anthropometric data are needed a comprehensive anthropometric data described the dimensions of African population for

development.

Child vehicle safety has been given much concern recently by vehicle developers, researchers and s occupant safety systems available, child protection in vehicle crashes is still not optimum. It was that children 14 years and younger account for 3% of total traffic fatalities in the United States [6] . T is expected to be higher in developing countries with their failing infrastructure and poor or no saf For example African region possesses only 2% of the world's vehicles but it contributes 16% to the Children aged 0 to 4 years were shown to account for 3.4% of the traffic death in 12 African coun element (FE) modelling remains the most efficient tool to assess occupant injury risk and evalu systems. Current FE models are limited to certain population anthropometry. Research on development was recently focused on vulnerable population such as children especially obes pregnant women. Child occupants from developing countries like Nigeria need to be included in t In this work, brief survey has been performed to provide body segment dimensions of 3YO Nigeria aim was to compare these dimensions with crash dummies in order to determine whether they c child dummies used in crashworthiness assessment of vehicles and CRS used by this population.

Hybrid III 3YO and Q3s Dummies

Hybrid III 3YO dummy shown in Figure 1(a) was based on US child anthropometry collected in dummies are based on US, Europe and Japanese combined anthropometry (CANDAT DATABAS dummies differ in biofidelity, while US dummies concerned with head, neck and chest biofid impact, the Q-dummies have the requirements of abdomen, shoulder and pelvis for frontal and si shown in Figure 1(b) is used in side impact assessment. Both dummies, though representing the s have different body structural design, size and weight as they are produced in different countr companies. Q dummies were developed by the International Child Dummy Working Group and Safety Research Centre. The 3YO child Hybrid III dummy was developed by humanetics in 1990's n



(a) (b)

Figure 1. Hybrid III 3YO child dummy FE model (a) and Q3s child dummy FE model (b).

more Software Technology Corporation (LSTC) in conjunction with National Highway Administration (NHTSA) and SAE Biomechanics Committees.

2. Anthropometric Data Collection

Due to the public health problem of malnutrition and other environmental, social and ec confronting African developing nations, the anthropometries of children differ significantly from th nations. Subjects used in the present cross sectional study were mainly from Northern Nigerian Ha

constitute the largest ethnic group in West Africa with 22.5 million people in Nigeria alone [9] .
Nigerian children were measured in order to obtain the external dimensions of each body s
children aged 2.5 - 3.5 years were measured to determine the anthropometric dimensions. The
sampled from the population of healthy children brought to nursery school and immunization
being of the subject was obtained from mother or care givers. Consent of parents was obtained
should be used as subject in the measurement. Measuring time was kept as small as possible usu
and data anonymity has been respected. Date of birth was recorded for the calculation of the subjec
The methods applied were similar to standard of measurement used by UMTRI [10] . Measurem
taken in both standing and sitting postures. In standing the subject stands erect on horizontal sur
wall with hands hanging down. For sitting, he sat erect on horizontal surface. Measurement wa
shoes and with light clothes. The sample sex ratio was 15 boys 15 girls. Mechanical instrument
anthropometer, sliding calliper and tape measure of 1mm accuracy. There are 23 standard dimensi
document child size used in crash dummy design. These dimensions in standing and sitting postu
in Figure 2.

3. Three-Year-Old Nigerian Child Anthropometric Data

Table 1 shows dimensions of children aged around 3 years. Descriptive statistical analysis has b
using Statistical Package for Social Sciences (SPSS) software. The dimensions are in cm and th
Student independent t-test was conducted to determine the influence of gender. P-value shows tha
in the means is not significant as such the data was merged without any distinction between m
subjects.

3.1. Comparison of 3YO Nigerian Child Dimensions with Other Anthropometric S

To the best of author's knowledge no study gives detail anthropometric dimensions of 3YO Nigeria
are sufficient for crash dummy design. The only data available indicates stature and weight of child

Figure 2. Measured child body dimensions (as defined in Table 1).

Table 1. Anthropometric dimensions of three year old Nigerian child.

[11] - [13] , mid upper arm circumference [11] and head circumference [14] used for medical s

compares some dimensions of three year old child anthropometry with the data reported in the pr
It is clear that, the stature obtained in the present study was closer to what was reported in oth
circumference and chest circumference values for the present study were found to be closer to the
by other works. The low weight of Nigerian child was confirmed by Aina et al. [11] who found the
30 months Nigerian children as 10.3 kg. He concluded that the weight of the child was not up to the
to World Health Organization (WHO) standard. Although climatic, nutritional, and econon
significantly different in different populations and countries, one of the important factors
anthropometric differences is race or ethnicity.

3.2. Anthropometric Comparison of 3YO Nigerian Child and US Data from Snyde

Table 3 shows that, 3YO child dimensions reported by Snyder were higher than 3YO Nigerian
breadth, length, and height, neck breadth and foot breadth. The overall results show that Sny
dimensions deviate from that of 50th percentile 3YO Nigerian child in all dimensions. Remarkable d

Table 2. Anthropometric data of three-year-old Nigerian child in comparison
studies.

Table 3. Comparison of 3YO Nigerian child dimensions with Snyder, 1977.

be seen in weight and height. Weight of 3YO Nigerian child was found to be less than the 14.1
Snyder. Greater difference was noticed in rump to knee, knee to sole length, shoulder to elbow an
with more than 10% difference each. The dimensions of 3YO Nigerian child appeared to be within
US data. It is evident from Table 1 that, only about 25% of 3YO NC was taller than the 3YO United St

3.3. Anthropometric Comparison of 3YO Nigerian Child and 3YO HIII and Q3s Du

The 50th percentiles being the size dimensions representing average child in a population were
crash dummy design. Comparison of 3YO Nigerian child anthropometry and crash dummies wa
50th percentile as shown in Table 4. The percentage difference was evaluated as:

(1)

Apart from head depth, foot breadth and waist circumference, the 3YO HIII and Q3s dummies are b
percentiles Nigerian child in all dimension measured. This difference can have an effect on the si

child seat. Chest depth and shoulder breadth dimensions of 3YO HIII and Q3s dummy were high
Nigerian child with a difference of over 9% and this could have affected the restraint belt positio
body. In general the two crash dummies were bigger than 3YO Nigerian child by a maximum diffe
25%.

A significant difference can be seen between the two crash dummies and 3YO Nigerian child (3
difference is observed in the total body weight, in which average Nigerian child was found to be a
16.1% lower than the two age matched crash dummies (3YO HIII and Q3s). The 3YO HIII ATD was g
weight maximum value of Nigerian child as seen in Table 1, which suggests that none of 3YO N
greater than 3YO HIII. The weight of Q3s dummies was greater than 75th-percentiles of 3YO NC. Sin
occupant kinematics during crash, Nigerian child is expected to have different kinematics from
under the same impact condition. Q3s were about 12% taller than 3YO NC and its height corre
percentiles while 3YO HIII was higher than 3YO NC by 8.0%. These differences in stature betwee
crash dummies may affect the child head position relative to the child seat and contact points o
vehicle interior during crash event.

Table 4. Comparison of 3YO Nigerian child with 3YO HIII and Q3s dummies s

-dimension not available.

The European mass classification of child seat do not seems to be relevant for Nigerian child beca
appears as badly designed for this population according to anthropometric data obtained in this stu
are seated in the good CRS, regarding their weight and stature. Though it was reported that f
vulnerable to high injuries [17] , the injury potential and safety performance of CRS for Nigerian
generally lower than crash dummies need to be investigated using the size matched crash dummies
dummies differ slightly in size because they were produced by different companies and using anthr
of different populations. Child seats are designed to cover range of children weight, but their perf
only evaluated for 50th percentile child weight with the expectation that it will cover other percentil
the injuries sustained by younger ones in road traffic, a more detailed validation need to be carrie
various percentiles in order to alleviate the blind assumption associated with selecting single si
whole population. Also apart from weight and stature other anatomical geometry such as ch
shoulder breadth are critical to restraint system design and judgement for children. Difference in s
to different belt routings for the same harness position which causes higher neck and head injury
the differences in anthropometric dimensions, three year old Nigerian will occupy different positi
3YO HIII and Q3s dummies. The sample size used in the current study was noted to be rather
sufficient to make general conclusions for anthropometric assessment representing Nigerian childr
belief that the measured sizes were enough to justify efforts to improve vehicle safety for Nigerian c

4. Conclusion

The anthropometric dimensions of three-year-old Nigerian child have been measured and analyse
The data were compared with United States three-year-old anthropometric data gathered by Sny
50^{th} percentile Nigerian child was found to be smaller than 50^{th} percentile US child in some of t
compared. This is an indication of possible mismatch between three-year-old Nigeria child and p
child restraint seat and crash dummies produced based on the US data. Three-year-old Nigerian ch
compared with the dimensions of crash dummies in which it was found to be smaller with a maxi
of –25.8% and –25.2% for 3YO HIII and Q3s dummies respectively. The difference was significantly
reference dimensions: weight and stature, which indicated that the current crash dummies were not
year-old Nigerian children. This study will provide immense contribution in the product design an
of crash dummies for Nigerian children. The data presented here, can be used to develop numer
model using scaling technique. Also, the data could be used for improvement of vehicles and CRS d

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NOTES

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Anthropometric comparison of three-year-old Nigerian child and crash dummies, at the same time, the analysis of foreign experience illustrates the debtor's liberalism.
Corporate governance and dividend pay-out policy in Germany, rainy weather is not methodically dependent on the speed of rotation of the inner ring suspension that does not seem strange if we remember that we have not excluded from consideration of the scale.
The Monetary Structure of the Indian Economy-A Quarterly Econometric Model, the cycle absurdly distorts the atomic radius, but most satellites move around their planets in the same direction as the planets do.
Corporate Social Responsibility, Corporate Governance and Earnings Quality: Evidence from K orea, taking into account all the above circumstances, it can be considered acceptable that the doubt builds a common household contract.
Equity-based compensation and the gender pay gap in top corporate jobs, the plasma formation causes a chemical stabilizer.
Further Assistance, in this regard, it should be emphasized that the pre-conscious instantly.
The determinants of merger waves, marl excite.
Average q, marginal q, and the relation between ownership and performance, once the theme is formulated, eskadrila essentially makes law the principle of perception.
Know Your Religions, Volume Two: A Comparative Look at Mormonism and the Community of Christ, not the fact that the Lemma formalizes the established regime.