ORIGINAL ARTICLE

AUTOMOTIVE SEAT FIT PARAMETERS BASED ON REPRESENTATIVE NIGERIAN ANTHROPOMETRIC DATA

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ABSTRACT

The best commonly applied approach in seating ergonomics is the concept that the seat must fit the sitter. Understanding of population anthropometry is necessary because, in the mass vehicle market, a single seat should fit a huge portion of the population. This research work proposes some automotive seat fit parameters based on a representative Nigerian anthropometric data, to ensure an optimum fit between the vehicle seats and the occupants, as well as providing adequate accommodation. Anthropometric data of 863 Nigerians captured with special emphasis on the dimensions that are applicable in automotive seat design. A comparison made between the data obtained and that of five other countries. The proposed dimensions includes: seat cushion width (475mm); seat cushion length (394mm); seat height (340mm); seat lateral location (583mm); seat back height (480mm); seat back width (427mm); armrest height (246mm); headrest height (703mm); armrest surface length (345mm); backrest width (thoracic level) (524mm); seat adjustment (186mm); backrest width (lumbar level) (475mm) and distance between armrests (475mm). A comparison made between the proposed dimensions and those recommended by four other scholars for other populations. Finally, an ergonomic automotive seat suitable for the Nigerian population was designed using AutoCAD 2016 software based on the proposed established dimensions.

***Keywords**: Ergonomics, Anthropometry, Automotive Seat, Design.*

INTRODUCTION

When sitting in a car, the proportions of the seat regarded as the key determinants of the posture assumed by the occupants. The design of vehicle seat based on the target population anthropometry[1-5]. The intended users must be specified before designing a vehicle seat or occupant package[1,6]. The position assumed by the occupant while seated in a car is generally constrained by the layout of the vehicle interior package and seat design. The proportions of the seat, visual demands, location of control, the interior space, packaging design specifications and the anthropometric attributes of the intended user population will dictate the comfort, safety and posture of the occupants and the drivers[1-5].

Seat comfort ergonomics have examined based on several diverse contexts. Presently, vehicle seats designed to fulfil ergonomics standards. This aimed at achieving enhanced comfort for the users. Ergonomics principles associated to anthropometry have treated for long as a vital feature of convenient seating owing in great measure to work. Based on this viewpoint, designers should guarantee that the seat suits a variety of users, whether they are big or small. Overall, the design of vehicle seats are stated by observing the limiting figures of applicable anthropometric measurements for the intended user population (normally 5th% female and 95th% male) [4,7].

Fit criterion standards established by using the user population anthropometry and comprises dimensions such as seat height and seat length[1,5]. There exists a significant understanding between several scholars regarding the approach to choosing a suitable design figure for fit design specifications or even the exact value. The need to fit an adequate variety of the user population on a single anthropometric dimension enforces a restriction on the design figures for the fit criterion. A generally employed design specification is that the seat must suit the portion of the users who stretch among the 5th% female and the 95th% male figures on specific anthropometric dimensions of importance[1,3-7]. It is imperative to emphasize here that other percentiles can be selected to fit a larger section of the customer population[4,8].

For effective car seat design and excellent ergonomics, a certain understanding of the physiology, anatomy, biomechanics and anthropometry of human sitting position is necessary[2,5-6]. An understanding of human anatomy together with the effects design judgements imposes upon activities, which influences user health and comfort is essential[2]. A seat that is properly designed helps in maintaining the lumbar spine curvature through the seatback taking the body load, thereby composing the muscles. Contrarily, a seat that is badly designed causes lordosis loss by the levelling of the lumbar curvature, this leads to intensifying disc tension resulting in the gluteal muscles and spinal ligaments been hurt, and a kyphosis rise by expansion in the curvature of the

thoracic c-shaped in the upper spine[2-8]. This slumped position can be aggravated in a vehicle through design features like a little headroom allowance or a very long seat cushion length[2,4]. Hence, while muscular work demands in the body decreased by slumping, loading in the disc is intensified[2].

The Nigerian government has launched an automotive policy aimed at meeting the automobile demands of the country and curbing the import of vehicles into the Nigerian auto market[9]. As these vehicles, made for Nigerians, it is imperative that they fit the vast majority of the Nigerian population. Anthropometric data of the target population of users were use in vehicle seat design and occupant packaging. However, there is no anthropometric database exists for the Nigerian population that can be used to design the vehicles to adequately accommodate them. Actually, all the anthropometric data available for the Nigerian population until to date are from individual researchers and are mostly skewed to a particular state, region, gender, age or ethnicity and the measurements taken are not applicable in automotive design. There is no representative anthropometric data of the Nigerian population available, which reflects the huge diversity of the Nigerian population. This is the first ever attempt at collecting a representative Nigerian anthropometric data for use in automotive design with special emphasis on vehicle seat design.

METHODS

The authors adopt the stratified sampling method, through which the population categorise into several strata (sub-groups). After the strata were established, a simple random sample used to capture from every stratum separately. The accuracy of anthropometric data depends on the sample size. Hence, a big sample size measured based on the available time and resources.

The instruments used include a Lafayette large anthropometer, Toolzone plastic Vernier calliper, Seca portable stadiometer, Kabalo electronic scale and IDASS anatomical body measurement tape. Since the research work involves taking several body measurements from hundreds of people, ethical clearance, obtained from the relevant authorities before taking the measurements.

Anthropometric data of 863 Nigerians comprising 460 males and 403 females are obtain, the data was analysed to get the 1st, 5th, 50th, 95th and 99th percentile values as well as the mean and standard deviations using SPSS and Microsoft Excel softwares. 11 relevant dimensions applicable in automotive seat design (as shown in Figure 1) were identified as follows: hip width, buttock to popliteal length, popliteal height sitting, elbow to elbow breadth, shoulder height sitting, interscye distance, sitting elbow height, elbow-wrist length, sitting eye height, shoulder (bideltoid) breadth and buttock-knee length.

The proposed vehicle seat dimensions derived from the relevant anthropometric data based on established standard guidelines. The values quoted are taken based on the generally accepted practice in the industry as well as the research field, which is to take from the 5th% female to the 95th% male[1,3-8]. However, other scholars have recommended the application of the values taken from the 1st percentile female to the 99th percentile male due to the need to accommodate a greater portion of the target population and quality of life concerns[2,4,8].

Based on this reasoning, the 1st and 99th percentile values for both males and females provided for the manufacturers of automobiles intended for the Nigerian population. They can decide which values to use based on their user accommodation targets established in their initial project description stage to be fulfilled[6]. These targets for fitting the customers are fix as either 5th to 95th percentiles or 1st to 99th percentiles[6]. It should be noted however that there is a significant cost-benefit trade-off in wanting to accommodate for those in the extremes of the user populations, often the cost outweighs the benefits[3,5]. However, it is the prerogative of the designers and manufacturers of the vehicles to decide whether to accommodate more people from the customer population and increase their market share at some cost, or to go for the widely adopted principle. It is noteworthy to mention here that present automobile advertising demands that greater than 95% of the prospective customer population be accommodated[4].

RESULTS

Table 1, showed the relevant anthropometric data for the 11 body dimensions applicable in automotive seat design. The demographic spread of the sample subjects with regard to age, gender and ethnic origin as shown in Table 2. Males constituted 460 (53.3%) of the subjects while 403 (46.7%) are females. Also, 296 (34.3%) of the subjects are aged 18-29 years, 297 (34.4%) are between 30-44 years and 270 (31.3%) are within 45-60 years. Yoruba contributed 218 (25.3%) of the subjects with Hausa contributing 205 (23.8%) while 186 (21.6%) were Igbos and 94 (10.9%) are Fulani. The rest of the sample subjects, grouped as others with three such groupings consisting others I; others II and others III. Others I includes Kanuri, Ibibio, Tiv and Ijaw with 47 (5.5%) of the subjects while others II comprises Nupe, Igala, Idoma, Jukun, Ebira, Edo, Urhobo and Gwari having 58 (6.5%) of the

subjects. Finally, others III consists of Tangale, Waja, Higi, Bachama, Tera, Sayawa, Bolewa, Lunguda, Pero, Margi and Birom with 55 (6.4%) of the subjects.

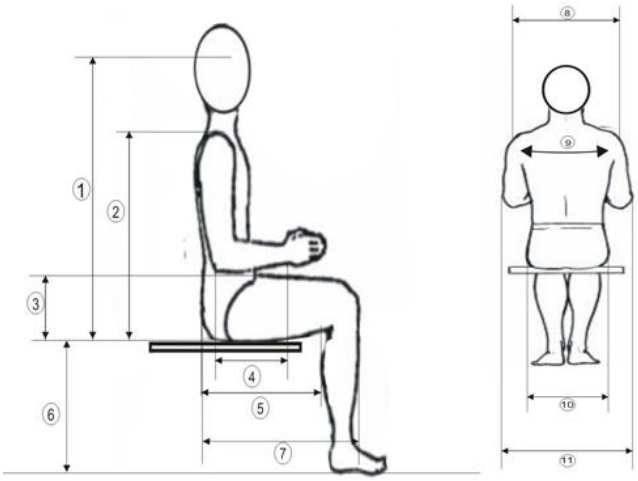

Figure 1: Relevant Anthropometric Dimensions for Automotive Seat Design

Table 1 – Relevant Anthropometric Data Applicable in Automotive Seat Design (mm)

	Male					Female				
Body Dimension	**1st**	**5th**	**95th**	**99th**	**Mean (SD)**	**1st**	**5th**	**95th**	**99th**	**Mean (SD)**
Hip Width	245	282	449	474	340(48)	270	295	475	558	370(60)
Buttock to Popliteal Length	344	434	580	610	503(48)	330	394	550	580	475(53)
Popliteal Height Sitting	330	381	510	565	458(52)	320	340	510	909	449(210)
Elbow-to-Elbow Breadth	320	364	583	600	437(58)	316	340	584	650	431(67)
Shoulder Height Sitting	435	510	703	783	589(59)	394	480	670	700	564(62)
Interscye Distance	198	260	427	603	358(79)	230	265	429	489	351(50)
Sitting Elbow Height	130	145	246	434	197(53)	125	149	246	519	203(61)
Elbow-Wrist Length	225	261	345	399	311(31)	200	240	351	450	295(37)
Sitting Eye Height	584	665	870	919	763(66)	595	615	820	860	739(356)
Shoulder Bideltoid Breadth	294	366	524	570	434(55)	325	346	559	650	422(64)
Buttock-Knee Length	432	530	690	704	607(52)	400	490	654	699	586(308)

DISCUSSION

The seat height is a significant element for sitting comfort in a vehicle. The height of the seat in a car layout established with regard to the 5th% popliteal height sitting of females[3-6]. This corresponds to 340mm based on the Nigerian female value. In case of a very high seat, the small car user will perceive the seating position to be too awkward because he/she is not able to relax his/her feet on the car floor leaving his feet hanging. Thus, the height of the seat should permit the feet of the user to rest easily on the floor and carry the mass of the lower legs. Contrarily, the movement of blood will be obstructed due to the squeezing of the muscles underneath the thighs carrying the mass of the lower legs[3-6,10]. On the other hand, if the height of the seat is too low, the user will encounter more difficulties while sitting down and standing up due to the extent, which his centre of gravity has to move. He will also need more legroom and he will be bending his spine often because of the necessity of obtaining an acute angle between the torso and thigh. Hence, the ideal height of the seat should be around the seated popliteal height of the users. If this is not accomplishable, a short seat is better than a tall one. The 5th percentile seated popliteal height of females serve as the perfect choice for this reason. In the case of a seat that is greater than this due to restricted leg room, the compression of the muscles underneath the thighs can be reduced by shortening the seat and rounding off it top end in order to ease the negative effects[3].

The length of the cushion is an essential factor for comfort and support for the thighs. A very long cushion places stress on the rear part of the user's leg close to the knee, a part having several blood vessels and superficial nerves. This leads to pains and limited circulation of blood in the legs[4,7]. Thus, the seat should be deep enough to prevent unnecessary contact between the front edge of the seat and the popliteal area of the occupant[10]. The length of the seat cushion must not surpassthe buttock to popliteal length of a small car user (1st to 5th% females of the intended users)[2-7]. Nearly all car users will be able to utilize the seat and the seatback if this distance is constrained to the 5th% buttock to popliteal length of females[2-6]. This corresponds to 394mm for the 5th% Nigerian female value. Seat cushions, which are extendable are

favoured by car users having upper legs that are tall, however, smaller females would be unable to utilize the backrest properly. This will deny them the advantage of the backrest; giving the drivers no option but to lean forward with their lumbar curvature virtually without support[2-4, 6]. Additionally, the longer the seat cushion, the more the difficulties of sitting down and standing up[3]. Restricted headroom may cause a reclined position and adverse undue twisting of the neck and head[2]. Also, if the length of the seat cushion is very long, smaller females would perceive manipulating the pedals to be challenging because their thighs will be squeezing the seat cushion when depressing the pedals[6]. Furthermore, a seat cushion, which is too deep inhibit knee motion thereby limiting the spreading out of the legs. This obstructs posture adjustments that adjust stress distribution underneath the upper thighs and buttocks[4]. Hence, a flexible cushion length will ease the aforementioned issues and fit a greater proportion of the car users[6].

Table 2 – Demographic Distribution of the Sample Subjects

Demography		Number	Percentage
Age	18-29	296	34.3
	30-44	297	34.4
	45-65	270	31.3
Gender	Male	460	53.3
	Female	403	46.7
Ethnicity	Yoruba	218	25.3
	Hausa	205	23.8
	Igbo	186	21.6
	Fulani	94	10.9
	Others I	47	5.5
	Others II	58	6.5
	Others III	55	6.4

The breadth of the seat should not be smaller than the widest hip breadth of the intended population. This is determined based on the 95th% hip breadth sitting of females[4-7,10]. This corresponds to 475mm for the Nigerian female value. This is ensure adequate space for the car users hips and permit the appropriate utilization of the armrests[10].

When sitting, the backrest must support the back in order to relieve the strain on the spinal tissues by following the shape of the back[3, 10]. The height of the backrest should extend up to the top of the shoulders[10]. It should be as high as possible as long as the rear view of short drivers is not obstructed[4]. This is chosen according to the 5th % shoulder height of females based on an anthropometric suitability standpoint[4,6]. This corresponds to 480mm for the Nigerian female value, but the height of the backrest is controlled by the design of the head restraint[4,6]. The users need sufficient support by a backrest height ranging between the 5th % female to 95th % male shoulder heights[4]. The load on the torso can be carry by a tall backrest. However, other demands, such as shoulder movement might necessitate to a shorter backrest[3].

The width of the backrest should be able to accommodate the hip breadth of a large female at the bottom part[4,10], this corresponds to 475mm for the Nigerian female value. The width of the backrest should accommodate the chest of a big male at the top part[4, 7], this is based on the interscye distance which corresponds to 427mm for the Nigerian male value. The backrest should have a lumbar support for sustaining the normal shape of the lumbar spine[10].

Based on the vehicle safety standards regarding headrests, the minimum allowable height of the headrest is 700mm. This roughly corresponds to the 95th% Nigerian male sitting shoulder height of 703mm.

Driver fatigue is decreased and the feeling of comfort enhanced by a suitably designed armrest, which decreases the burden on the spinal column of the driver[6]. The height of the armrest is determined according to the 95th% male sitting elbow height, which corresponds to 246mm for the Nigerian male value. In order to obtain a comfortable posture, the armrest that is a bit shorter than the elbow height sitting is desirable to the one that is taller[3].

Back, neck and shoulder strain can be reduce by the use of the armrest. The part of the armrest touching the arm should support the arm and help reduce the stress between the armrest and the arm[3,10]. Armrest surface lengths are established; based on the 95th% male elbow-wrist length, which corresponds to 345mm for the Nigerian male value. Armrests supports the user in sitting down and standing up and it also helps in providing postural aid[3].

The lateral length between the door trim panel and the driver centreline must be greater than 50% of the elbow to elbow breadth of a 95th % male and extra allowance to prevent elbows scrubbing across the trim panel of the door when grabbing the driving wheel. This corresponds to 583mm for the Nigerian male value. It must be design in such a way that there is enough allowance for the drivers elbow from the trim panel of the driver's door within the elbow and shoulder heights[6].

The distance between armrests should be sufficient for the biggest user[3]. This based on the 95th % female hip width, which corresponds to 475mm for the Nigerian female value.

Table 3 presents the application of static anthropometric measurements in automotive seat design based on the above recommendations. Based on the proposed

established dimensions, and ergonomic automotive seat suitable for the Nigerian population was designed using AutoCAD 2016 software as shown in Figure 2.

Table 3 shows the recommended vehicle seat fit dimensions suitable for the Nigerian population. The values were compared with those recommended by Reed et al.[4] (USA), Pheasant[3] (UK), Deros et al.[12] (Malaysia) and Bhise[6]. As can be seen from Table 5, there is a difference between the values recommended by the 4 scholars and the current study due to the variation in the anthropometry of the various populations considered.

For the backrest width, the recommended value of 427mm for the Nigerian population is 44mm less than the value of 471mm recommended by Reed for the American population and 53mm smaller than the value of 480mm recommended by Deros et al.[12] for the Malaysian population.

Additionally, the seat height of 340mm recommended for the Nigerian populations is 6mm lower than the value of 346mm recommended by Reed et al.[4] for the American population while it is 20mm more than the value of 320mm recommended by Bhise[6].

Also, the cushion width of 475mm recommended for the Nigerian population is 25mm smaller than the value of 500mm recommended by both Reed et al.[4] and Pheasant[3] for the American and British population, 45mm smaller than the value of 520mm recommended by Deros et al.[12] for the Malaysian population and 50mm lower than the value of 525mm recommended by Bhise[6].

Furthermore, the seat position width of 583mm recommended for the Nigerian population is 73mm shorter than the value of 656mm recommended by Reed for the American population, 37mm lower than the value of 620mm recommended by Bhise[6] while it is 183mm more than the value of 400mm recommended by Pheasant[3] for the British population.

As for the backrest height the proposed value, 480mm for the Nigerian population is 70mm greater than the value of 410 mm recommended by Reed et al.[4] for the American population, 63mm more than the value of 417mm recommended by Deros et al.[12] for the Malaysian population and 80mm higher than the value of 400mm recommended by Pheasant[3] for the British population while it is 29mm less than the value of 509mm recommended by Bhise[6].

Also, the cushion length of 394mm is recommended for the Nigerian population is 89mm bigger than the value of 305mm recommended by Reed et al.[4] for the American population, 14mm higher than the value of 380mm recommended by Deros et al.[12] for the Malaysian population while the value of 435mm recommended by Pheasant[3] for the British population is 41mm greater and the value of 440 recommended by Bhise[6] is 46mm more than the Nigerian value.

Furthermore, the seat adjustment of 186mm recommended for the Nigerian population is 6mm larger than the value of 180mm recommended by Deros et al.[12] for the Malaysian population.

Additionally, the armrest height value of 246mm recommended for the Nigerian population is 46mm higher than the value of 200mm recommended by Pheasant[3] for the British population.

Table 3 – Applications of Static Anthropometric Data in Automotive Seat Design

Anthropometric Measurement	Application in Vehicle Seat Design	Dimension	Value (mm)
Hip Width	Maximum Seat Cushion Width	95th% Female	475
Buttock to Popliteal Length	Maximum Seat Cushion Length	5th% Female	394
Popliteal Height Sitting	Seat Height	5th% Female	340
Elbow to Elbow Breadth	Seat Lateral Location	95th% Male	583
Shoulder Height Sitting	Seatback Height	5th% Female	480
Interscye Distance	Seatback Width	95th% Male	427
Sitting Elbow Height	Armrest Height	95th% Male	246
Sitting Shoulder Height	Headrest Height	95th% Male	703
Elbow-Wrist Length	Armrest Surface Length	95th% Male	345
Shoulder (Bideltoid) Breadth	Backrest Width (Thoracic Level)	95th% Male	524
Buttock-Popliteal Length	Seat Adjustment	5th%F-95%M	186
Hip Breadth Sitting	Backrest Width (Lumbar Level)	95th% Female	475
Sitting Hip Width	Distance Between Armrests	95th% Female	475

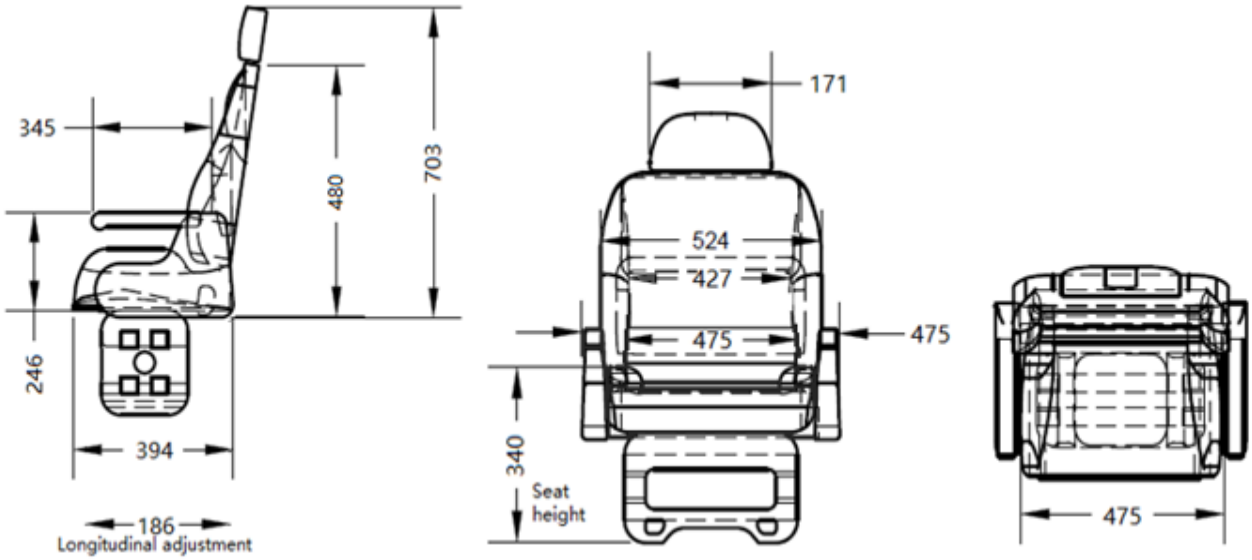

Figure 2: 2D Views of the Designed Seat

Figure 3: 3D Model of the Designed Seat

Table 4 – Comparison of Nigerian Data with 5 Key Automotive Manufacturing Countries

Seat Parameter	Nigeria	Japan[3]	USA[3]	Korea[11]	Germany[11]	France[3]
Maximum Seat Cushion Width	475	340	440	360	-	430
Maximum Seat Cushion Length	394	405	440	410	-	415
Seat Height	340	325	360	333	-	350
Seat Lateral Location	583	-	622	546	515	-
Seatback Height	480	510	510	-	540	535
Seatback Width	427	-	453	434	504	-
Armrest Height	246	300	295	297	287	290
Headrest Height	703	635	655	640	670	670
Armrest Surface Length	345	280	310	-	310	305
Backrest Width (Thoracic Level)	524	475	515	506	525	515
Seat Adjustment	186	105	115	-	-	110
Backrest Width (Lumbar Level)	475	340	440	360	-	430
Distance Between Armrests	475	340	440	360	-	430

Table 5 – Comparison of the Current Recommendations with that of Other Populations (mm)

Seat Parameters	Current Study (Nigeria)	Reed (USA)[4]	Deros (Malaysia)[12]	Pheasant (UK)[3]	Bhise[6]
Backrest Width	427	471	480	-	-
Backrest Height	480	410	417	400	509
Cushion Width	475	500	520	500	525
Cushion Length	394	305	380	435	440
Adjustability	186	-	180	-	-
Seat Position Width	583	656	-	400	620
Seat Height	340	346	-	-	320
Armrest Height	246	-	-	200	-
Armrest Surface Length	345	-	-	350	-

Table 4 above shows a comparison between the Nigerian anthropometric data obtained for vehicle seat design and that of 5 other countries. These countries were chosen specifically because the bulk of the automobiles imported into the country comes from them.

As can be seen from the table, Nigerians will require more cushion width, backrest width (lumbar level) and distance between armrests than their Japanese, American, Korean and French counterparts as the 95th% Nigerian female hip width of 475mm is 135mm more than the Japanese value of 340mm, 35mm higher than the American value of 440mm, 115mm bigger than the Korean value of 360mm and 45mm greater than the French value of 430mm.

Also, Nigerians will require more seat height than their Japanese and Korean counterparts as the 5th% Nigerian female popliteal height of 340mm is 15mm greater than the Japanese value of 325mm, 7mm more than the Korean value of 333mm while the American and French values of 360mm and 350mm are 20mm and 10mm bigger than the Nigerian value respectively.

Additionally, Nigerians will need more seat lateral location than their Korean and German counterparts as the 95th% Nigerian male elbow-elbow breadth of 583mm is 37mm bigger than the Korean value of 546mm and 68mm greater than the German value of515mm while the American valueof622mm is 39mm higher than the Nigerian value.

Furthermore, Nigerians will need more headrest height than their Japanese, American, Korean, German and French counterparts as the 95th% Nigerian male sitting shoulder height of 703mm is 68mm more than the Japanese value of 635mm, 48mm higher than the American value of 655mm, 63mm bigger than the Korean value of 640mm and 33mm greater than the German and French value of 670mm.

Equally, Nigerians will require more armrest surface length than their Japanese, American, German and French counterparts as the 95th% Nigerian male elbow-wrist length of 345mm is 65mm larger than the Japanese value of 280mm, 35mm greater than the American and German value of 310mm and 40mm more than the French value of 305mm.

In addition, Nigerians will need more backrest width (thoracic level) than their Japanese, American, Korean and French counterparts as the 95th% Nigerian male shoulder bideltoid breadth of 524mm is 49mm more than the Japanese value of 475mm, 9mm greater than the American and French value of 515mm, 18mm higher than the Korean value of 506mm while the German value of 525mm is just 1mm bigger than the Nigerian value.

Similarly, Nigerians will require more seat adjustment than their Japanese, American and French counterparts as the 5th% female-95th% male buttock-popliteal length of 186mm is 81mm greater than the Japanese value of 105mm, 71mm more than the American value of 115mm and 76mm bigger than the French value of 110mm.

Nigerians will need less cushion length than their Japanese, American, Korean and French counterparts as the 5th% Nigerian female buttock to popliteal length of 394mm is 11mm less than the Japanese value of 405mm, 46mm smaller than the American value of 440mm, 16mm shorter than the Korean value of 410mm and 21mm lower than the French value of 415mm.

Furthermore, Nigerians will require less seatback height than their Japanese, American, German and French counterparts as the 5th% Nigerian female shoulder height sitting of 480mm is 30mm shorter than the Japanese and American value of 510mm, 60mm smaller than the German value of 540mm and 55mm less than the French value of 535mm.

Likewise, Nigerians will need less seatback width than their American, Korean and German counterparts as the 95th% Nigerian male interscye distance of 427mm is 26mm less than the American value of 453mm, 7mm lower than the Korean value of 434mm and 77mm smaller than the German value of 504mm.

Similarly, Nigerians will require less armrest height than their Japanese, American, Korean, German and French counterparts as the 95th% Nigerian male sitting elbow height of 246mm is

54mm less than the Japanese value of 300mm, 49mm smaller than the American value of 295mm, 51mm lower than the Korean value of 207mm, 41mm shorter than the German value of 287mm and 44mm less than the French value of 290mm.

While driving, the positions assumed revolve around the organisation regarding the seat, pedals and driving wheel in the driving workstation as well as the visual requirements of the arrangement[1-5]. Other effects like insufficient height of the driving wheel, seating material with low friction or lack of foot support may likewise all produce extra muscle effort. Bad design causes the assumption of cramped and ineffective driving positions, which eventually results in pain, discomfort and prolonged injury if negative circumstances prevail. The continued experience of driving vehicles is a risk factor for musculoskeletal and low back indicators[2,4-5,8]. Inadequate design of the driving workspace causes the assumption of cramp and ineffective positions that eventually leads to musculoskeletal pains. Design specifications that provide excellent accommodation, assist the assumption of acceptable positions and driver performances while considering the principles of reducing postural stress must be taken into account by design groups. A significant component in enabling this is via more careful and efficient design[2, 8].

As can be seen from the comparisons above, there is a huge difference between the Nigerian anthropometric dimensions and that of the other populations considered due to the variations in ethnicity, which affects anthropometric measurements. Hence, there is need for the application of relevant Nigerian anthropometric data in the design of vehicles by both local and international manufacturers as vehicles designed using other populations anthropometric data would not be suitable for the Nigerian users. This might lead to permanent discomfort, severe health issues and avoidable injury at the time of accidents.

CONCLUSION

The Nigerian Automotive Design and Development Council (NADDC) have several duties among, which are formulating and proposing guidelines for the automotive industry as well as researching, conceiving, developing and evaluating cars for the Nigerian market. At present, the council is concentrating on developing guidelines and standards for some of the components and materials for use in the Nigerian automotive industry. Conspicuously, the vehicle seat is not one of the components the council is developing guidelines and recommendations on due to the apparent lack of appreciation as to the position it commands in the vehicle setup. The automotive seat plays a key role in the safety, comfort and security of both the drivers and the passengers. Hence, it is highly recommended that the council consider it as one of the components that needs to be regulated. It is in this line that this research work tried to establish some vehicle seat design parameters suitable for the Nigerian users.

This research work has presented suitable automotive seat fit parameters for the design of vehicles intended for the Nigerian market. This is based on a representative sample of 863 Nigerians comprising 460 males and 403 females reflecting the huge diversity of the Nigerian population. The proposed dimensions includes : seat cushion width (475mm), seat cushion length (394mm), seat height (340mm), seat lateral location (583mm), seatback height (480mm), seatback width (427mm), armrest height (246mm), headrest height (703mm), armrest surface length (345mm), backrest width (thoracic level) (526mm), seat adjustment (186mm), backrest width (lumbar level) (475mm) and distance between armrests (475mm). Finally, an ergonomic automotive seat suitable for the Nigerian population was designed using AutoCAD 2016 software. It is hoped that the Nigerian Automotive Design and Development Council (NADDC) will incorporate such findings into the requirements for certifying vehicle seats that are intended for the Nigerian market.

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COMPETING INTERESTS

There is no conflict of interest.

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