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REDUCING STRESS-RELATED ISSUES FOR LOCAL WEAVERS IN ILORIN, NIGERIA: AN ANTHROPOMETRIC APPROACH

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ABSTRACT

Local weaving is an occupation of making a local type of clothing in the South Western and some part of North-central Nigeria called "aso-òkè" using local methods of weaving. This method is an age-long one, which persist until today. Data were obtained from 80 male local weavers in Ilorin, Nigeria and analyzed statistically. Standard dimensions of an ergonomic chair that will help ease the disorder and stress-related injuries and illnesses experienced by these workers were obtained using a traditional method. The 95th percentile values of the Popliteal Height (HP), Heap Breath (HB) and Sitting Shoulder Height (SSH) of the local weavers used in the study were 46.17 cm, 41.8 cm and 60.2 cm respectively, and their respective mean age, mean weight and mean height were 25.8 years, 60.4 kg and 168.94 cm.

Keywords: *Ergonomics, anthropometric data, Ilorin, Nigeria, Weavers*

Introduction

Ergonomics which deal with the design of machines, tools and work environments that can best accommodate human performance and behaviour can be partly achieved from anthropometric studies due to the variability of human body dimensions across races, cultures, and geographical location. Anthropometry is a research area in ergonomics that deals with the measurement of human body dimensions and certain physical characteristics (Bridger 1995, Chou *et al.* 2005). Anthropometric data varies considerably between regional populations (Openshaw and Taylor, 2006) and these variations must be considered,when designing for a particular population (Ashby, 1978). Hence, the need for a reliable anthropometric data from a target population that would be useful in designing products for such population. Anthropometric data has been considered in the designs of several worktables in nearly all industrialized nations (Parcells *et al.* 1999). There are very limited anthropometric studies in the Nigeria (Ismaila, 2009), and this has led to the discomfort of many workers, and subsequent health disorders due to the unsuitable engineering designs for the populace. Ismaila (2009), himself, presented a limited anthropometric data, which includes hand, foot, and ear dimensions; he compared the foot breadth and foot length and reported the former is larger in females than males and vice-versa for the latter. Studies by Ismaila *et al.* (2010) revealed a mismatch between the furniture in use by some one hundred (100) pupils and their anthropometric data, which could lead to discomfort and distraction in class. Due to the inherent cost and resources involved in gathering anthropometric data, Ismaila (2012) presented a model that could help provide the popliteal height from the standing height, using about four hundred and eighty (480) students (aged 10 to 18 years) in public secondary schools in South Western Nigeria. Biomechanics, which is the study of body movements and of the forces acting on the musculoskeletal system, deals with determining the dimension of several moveable parts of the body and their range of movement and it closely relates to anthropometry (McCormick, 1976).

Weaving is the act of making materials such as clothing materials by interlacing strands or strips of the materials in repeated patterns and this involves rapid and seemingly unending simultaneous movement of the hands, legs, neck and eyes of the weaver. It also involves sitting with the back nearly perpendicular to the buttocks for long hours, this

could bring great discomfort since the best shape of the vertebrae column at a sitting position should be an elongated-S shape (Openshaw and Taylor, 2006). Therefore, an unsuitable workstation could led to several ageing characteristics due to the stress-related health disorders even in the young weaving population.

There are three (3) well-adopted methods of taking anthropometric data at present. These are the tailor's method, the traditional method and the 3-Dimensional surface anthropometry method. Robinette *et al.* (1999) adopted the last of the three because it is the easiest, cheapest and the most accurate method of obtaining anthropometric data however, the equipment for the measurement unlike for the traditional method is not moveable; it has to be installed in a fixed point and then subject volunteers brought to the equipment to be measured. At present in Nigeria, the use of 3-Dimensional method surface has not been employed because it is impossible to make volunteers come to a fixed point just to be measured..

This study was designed to help cater for the shortage of anthropometric data for the Nigerian population, to help in the ergonomic design of adjustable chairs for local weavers of various physical dimensions as well as to design environmentally safer and more user-friendly workstations. The aim of the work is to drastically reduce the painful experience these local workers encounter in their daily means of livelihood. In addition, this study would help increase the number of their active and productive years as well as help increase their profit margins and increase.

Methodology and Data Analyses

Participants

This study covers eighty (80) male local weavers that volunteered. The age range of the volunteers is 16–35 years old. This range of the participants for the collection of the anthropometric data comes from all the ages fitting into the 95th percentile of the weavers.

Measured Dimensions

From each of the volunteering participants, twenty (20) dimensions from different body parts were taken. These are the stature, shoulder breadth, chest depth, sitting height, sitting eye height, sitting shoulder height, popliteal height, sitting knee height, forearm hand length, sitting elbow height, thigh clearance, head length, hand length, hand depth, hip breadth, foot length, foot breadth, elbow to elbow breadth, elbow height and malleolus height with the weight, age and sex of each individual. Table 1. presents the definition of the terminologies used for different measured part of the volunteer's body. These terminologies are the standard. All these dimensions are very important for an ergonomic chair design and good user-friendly environment.

Equipment

We adopted the traditional method. This method involves the use of simple moveable instruments such as a chair, a mechanical mass-measuring scale, a wooden divider, a wooden meter rule, a steel tape rule, measurement data form (to capture the individual dimension measurement), a set of writing materials, and a vernier caliper. This method was adopted because the instruments used are easily carried about to the work place of the weavers.

Results and Discussion

The descriptive statistical analysis of the collected anthropometric data is presented in Table 2. The statistical parameter used are the mean, standard deviation, and the 5th, 50th, 95th percentile of each of the variables listed in Table 1. as well as the age and weight of the subjects (see Table 2). The mean age of the local weavers was found to be 25.8 years, which implies that able-bodied men are very much involved in the local weaving. The 95th percentile of the weight of the local weavers is an indication that when the ergonomic chair is designed, it should be able to accommodate such a kind of weight as close to 70 ± 5.97 kg.

Table 1: Anthropometric terminologies used in this work, their symbol (as used) and their respective definitions

S/N	Anthropometric dimension	Symbol	Definition
1	Stature	ST	Vertical distance of the subject in a standing position
2	Shoulder Breadth	SB	Distance between the two shoulders of the subject
3	Chest Depth	CD	Distance between the posterior chest and the dorsal
4	Sitting Height	SH	Vertical distance between a sitting surface and the subject's head
5	Sitting Eye Height	SHE	Vertical distance between a sitting surface and the subject's nasion
6	Sitting Shoulder Height	SSH	Vertical distance between a sitting surface and the subject's highest bone at the shoulder
7	Popliteal Height	PH	Vertical distance from the floor to the underside of the thigh immediately behind the knee
8	Sitting Knee Height	SKH	Vertical distance between the highest bone at the elbow and the middle finger
9	Forearm Hand Length	FHL	Horizontal distance between the highest bone at the elbow and the middle finger
10	Sitting Elbow Height	SHE	Vertical distance between the elbow and the horizontal surface of the subject
11	Thigh Clearance	TC	Vertical distance between the seating surface and the tail bone (coccyx) of the subject
12	Head Length	HL	Distancce from the glabella landmark and the posterior of the head
13	Hand Length	HNL	Length of the hand between the stylon landmark on the wrist and the tip of the middle finger
14	Hand Depth	HND	Length of the hand measured at distal end of the metacarpal
15	Hip Breadth	HB	Distance between both hips while sitting
16	Foot Length	FL	Distance between the tip of the longest toe and vertical line that intersects malleolus landmark
17	Foot Breadth	FB	Distance between the biggest and the smallest toes
18	Elbow to Elbow Breadth	EEB	Distance between the elbow on the right and that on the left
19	Elbow Height	EH	Distance between the elbow and the horizontal surface
20	Malleolus Height	MH	Vertical distance between the ankle bones to the horizontal surface.

Table 2: Statistical Analysis of Anthropometric Dimensions of Male Local Weavers

S/N	Anthropometric Dimension (unit)	Mean	5th Percentile	50th Percentile	95th percentile	Std. Dev.
1	Age, A (yrs)	25.8	18.95	26	33.1	5.11
2	Weight, W (kg)	60.46	53	60	70	5.97
3	ST (cm)	168.94	160.48	170	179	6.08
4	SB (cm)	46.32	41.95	46	50.22	2.76
5	CD (cm)	20.11	19.09	20.15	21.51	0.89
6	SH (cm)	80.92	77.19	81	86.5	3.4
7	SEH (cm)	72.2	66.2	72.3	77.7	3.22
8	SSH (cm)	54.78	49.6	55	60.2	3.61
9	PH (cm)	43.61	40.29	44	46.17	2.4
10	SKH (cm)	52.13	48.19	52.1	55.54	2.62
11	FHL (cm)	48.77	44.99	49	51.61	2.29
12	SE (cm)	52.78	49	52.6	56.59	2.64
13	TC (cm)	17.82	16.88	17.9	19	0.68
14	HL (cm)	21.2	19.6	21.1	23.15	1.11
15	HNL (cm)	19.96	18.95	20	21.01	0.76
16	HND (cm)	8.03	7.5	8	8.5	0.31
17	HB (cm)	38.41	36.5	38	41.8	1.58
18	FL (cm)	27.17	25.39	27	29.32	1.35
19	FB (cm)	10.46	9.3	10.5	11.62	0.73
20	EEB (cm)	40.08	34	40.2	47.5	4.07
21	EH (cm)	106.67	98.31	108.5	114.28	6.47
22	MH (cm)	7	6.8	7	7.3	0.15

The average height of the local weavers used for this study is 168.94cm. The 5th, 50th and 95th percentiles of the height were also recorded. Though the anthropometric data varies for considerably for the weavers, we observe that the chair they use for their work has almost the same dimensions, which implies that they are ignorant of the magnitude of the disorders they can bring to their health and body. A sample of former design for the same local weavers presented in Table 3. showed that the designer did not put the anthropometric data of these workers into consideration. Many of them reported backache since the design underestimated the SSH and overestimated the PH. These contrasting estimations revealed that there are mismatches and will bring about great discomfort to the weavers. Hence, they reverted to using their old chairs.

Table 3. shows the comparison of the dimensions of the existing ergonomic chair designed for the weavers and with the anthropometric data obtained from the measurements of these people.

Table 3: Comparison of the dimensions of existing ergonomic chair and the anthropometrically designed chair

Features	Dimension (Former Design) (cm)	Dimension (Anthropometric) (cm)
PH	47.6 – 56.7	43.3 – 46.2
HB	39	36.5 – 41.8
SSH	45	49.6 – 60.2

Therefore based on this study, in designing ergonomic chair for weavers in North Central Nigeria, it is suggested that the Popliteal Height (PH) be in the range 40 and 46 cm. Seats that are too high will not be comfortable for a short weaver and vice-versa. A prolong usage of such seats would pose pain to the weavers. This is the main essence for the adjustability of the seat to different convenient height of the user.

The Heap Breadth (HB) for the existing seat was found to be 39 cm. Based on this study; the HB should be given allowance up to 42cm to accommodate all weavers no matter their size. This allows their hipbone to rest, thus preventing dislocation or fracture of this bone.

As stated earlier, stature varies from one geographical region to another. In lieu of this, the stature of the subjects takes a vital role when designing any workstation. For example, our analysis in Table 2. included the Sitting Height (SH) and the Sitting Shoulder Height (SSH) which could be considerably useful for determining the height of certain tools or equipment that could make the workplace less stressful and help them perform their tasks with minimal or no health issues.

The weaving profession requires a good vision and rapid eye movement. Therefore, the Sitting Eye Height (SEH) analysis can help determine the proper height of the local weaving stand. Although, the weaving art does not allow armrest due to the constant pendulum movement of the hand, the analysis of the elbow-to-elbow breadth can be useful for other designs targeted at populations from this part of Nigeria. Other data obtained could be used in designing some tools used by the local weavers in local weaving industries; involve gripping such as shuttle.

Conclusions

The results of this study showed that the anthropometric data of male weavers were not considered by local furniture designers used when designing the existing ergonomic chair available for the weavers. Some of the dimensions indicate a mismatch of dimensions, which may not be comfortable for the weavers while working. Therefore, it is very paramount that anthropometric data of the user population are taken into consideration in designing and to reduce some musculo-skeletal disorders that may occur while sitting. This study also gave a propose ergonomic chair dimension for the Nigeria local weavers to minimize shoulder pains, back pains, neck pains. It therefore serves as a contribution to alleviating the disorders and stress-related issues encountered on a daily basis by these weavers.

Finally, the work also presented some additional data that may be useful in the design of other products for local weavers and similar professions in the locality of Ilorin, Nigeria. In an era where, local manufacturing companies are being encourage to take-up the challenge of producing for local consumption, this type of study is timely and it is recommended that it is extended to the female weavers and other professions.

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