TEHRAN UNIVERSITY OF MEDICAL SCIENCES

IJOH INTERNATIONAL JOURNAL OF OCCUPATIONAL HYGIENE

2008-5435/14/63-1-8

IRANIAN OCCUPATIONAL HEALTH ASSOCIATION IOHA

ORIGINAL ARTICLE

Anthropometry and Health Status of Public Administrative Staff in the Kumasi Metropolis in Ghana

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Received May 26, 2020; Revised July 19, 2020; Accepted August 03, 202

This paper is available on-line at http://ijoh.tums.ac.ir

ABSTRACT

Anthropometry is the study that takes human body measurements in a population. Patronised furniture that fails to utilize the users body measurements impact on their health negatively. Therefore, mismatch between anthropometric dimensions and consumer products may cause health problems in human body. Eight static anthropometric measures were considered. In the administrative block, mean age of the male and female populations were 39.97±8.87 years and 39.56±8.62 years respectively; mean±SD weight were 74.39±11.31kg and 72.57±11.17kg in males and females respectively; and mean±SD stature were 1729.20±64.01mm and 1628.90±56.48mm in males and females respectively. In the results, stature, popliteal height and knee height measured were significantly different between male and female administrative staff members in public institutions. Also, the study reported that lower back pain and neck pain had the highest prevalence among the male and female administrative staff respectively. The study is applicable to the design of furniture to cut down on workers' absenteeism and increase productivity.

KEYWORDS: *Anthropometry, Furniture Design, Health Issues, Public Administrative Staff*

INTRODUCTION

Anthropometry is the study that takes human body measurements in a population [1]. The design of appropriate furniture is based on the right anthropometry of workers. Patronised furniture that fails to utilise the users body measurements impact on their health negatively. When the use of a product does not fit the body measurements of a user, the result is health problems [2]. The study was to establish whether the design of product is dependent on workers' anthropometric measurements and health issues associated with the use of office furniture. The methods to address the issues included the amassing of anthropometric data and health challenges in public institutions in workplace assessment survey.

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This study has come at the right time since there is not enough information about the differences in male and female anthropometric data and health standing of adult office workers in public institutions in Ghana.

For good design of workstation, equipment and furniture to avoid bad positioning and forces on the human body, anthropometric data is of essence [3-6]. It is an acceptable fact that, anthropometric data has to be modified from time to time to ensure the wellbeing of people who patronise furniture (chairs and desks). Anthropometric data of users define the standards and functional dimensions of furniture [7-9]. People of various ages, sexes, races and backgrounds have different anthropometric dimensions [10]. These dimensions may temporally differ by changes in nutritional status, socioeconomic situation and geographical factors. The integration of body measurement into furniture design bring about suitable furniture [11].

Poorly manufactured sitting items bring about discomfort, body pains, inefficiencies, delays, and wastage [12]. Accident, injury, ill health and reduction of productivity are the result of inappropriately designed furniture [13-14]. Working efficiently is dependent on using the right furniture. When human body measurements do not fit the product they use, the end result is increase in accidents and health problems [15-19]. The volume of work and the length of time a worker sits can result in pain at the lower back and neck of the individual [20-21]. Back pain is the highest reported case of ill health among people in the working group [22]. Neck pain is prevalent among office staff [23]. Also, [24] reported that, maximum established musculoskeletal disorders signs among workers (such as office and operational workers) of Iranian petrochemical industries were lower back (41.5%) and neck (36.5%).

Pains that result from office work include lower back pain, neck pain, shoulder pain, wrist pain and hand pain [25-28]. In literature, two-thirds of men from the working population suffers lower back pain at some point. In fact, office workers who have suffered LBP continuously for one-year ranged from 23% to 38% [31-33]. For people under 45 years-old, lower back pain is the most common cause of disease associated with work and the highest contributor to workers' compensation and medical costs [34].

Many researchers from certain parts of the world have carried out work on measuring anthropometric dimensions in different populations (primary students, university students, and workers) and their area of study. The results of a study on "An analysis of anthropometric data on Iranian primary school children" showed that there was some difference in anthropometric data between two genders aged 6 and 11 years [35]. "An analysis of biomechanical and anthropometric parameters on classroom furniture design" reported that there was a mismatch in Turkish students between their popliteal height and seat height, knee height and desk clearance, buttock to popliteal length and seat depth[8]. In a study titled [2] "An assessment of the anthropometric data of Iranian university students", the major finding was that apart from buttock to popliteal length, other dimensions differ among the age bracket 18 – 25 years. Furthermore, "Anthropometry dimensions of older Malaysians:

Comparison of age, gender and ethnicity" showed that age, gender and ethnicity influence the differences in some anthropometric dimensions [36]. Therefore, bad furniture is a result of wrong use of body data and can lead to negative influence on their health. Further authors who reported on health problems associated with administrative workers and their study areas are as follows: 37. Ivelic et al,. [37] in "Office furniture design according to a human anthropometric data" said that, administrative work is the main cause of the spine deformation. They said that, wrong sitting because of poor furniture design has the probability of registering 14% in headaches, 24% in neck and shoulder pain, 57% in back pain, 16% in backside, 19% in lower leg pain and 2% in knee and feet pain; Green et al., investigated [38] "A

literature review of neck pain associated with computer use: public health implications", the results showed that long use of computers for daily office work and recreation bring about neck pain; Ranasinghe et al., [39] in their study "Work related complaints of neck, shoulder and arm among computer office workers: a cross-sectional evaluation of prevalence and risk factors in a developing

country" documented that workers who use computers as their job description suffer health levels of 42.6% forearm/hand pain, 36.7% neck pain and 32.0% shoulder/arm pain.

This study was to ensure that the design of an ergonomic furniture is based on the application of anthropometric measurements of the users. Secondly, to establish musculoskeletal disorders when office furniture is used for a longer period. In fact, furniture that is not ergonomically designed, affect the health status of both male and female adult workers. Finally, to record negative health levels of male and female participants' who patronized seating furniture in public institutions in Ghana.

MATERIALS AND METHODS

Before the data collection on anthropometric data and health problems, authors assembled twenty-five public institutions (made up of twenty-one ministries and four tertiary institutions). Each of the institutional elements was assigned a number on pieces of paper and recorded the names and their respective numbers in a notebook. These numbers were mixed in a big paper envelop. Authors went ahead and randomly selected three institutions, notably Kumasi Technical University (KsTU), Ministry of Land, Forestry and Mines (MLRM) and Kwame Nkrumah University of Science and Technology (KNUST) as study areas for the study. In fact, the selected institutions according to the authors could be managed successfully due to the period of the research. The period was approaching the end of the year (i.e. between October and December). Authors were made to understand that the institutions had little time to spare and wanted to avoid distractions in their scheme of work.

The selected institutions in total were made up of 186 offices (47 from KsTU, 44 from MLFM and 95 from KNUST). In these offices were

office workers. Workers who qualified to participate in the exercise had to satisfy two criteria: that the workers were the sole occupants of the offices and have used the seating furniture for at least three months to do office work. In all, 310 administrative staff were gathered (84 from KsTU, 70 from MLFM and 156 from KNUST).

Considering the kind of data collected, each staff provided information on their body measurements and health challenges. Adjustable office chair, steel measuring tape, weighing scale and dataset sheet assisted in the collection of the eight anthropometric data (popliteal length, elbow to seat height, sitting shoulder height, knee height, width of bitrochanter, stature and weight). In respect of the health challenges (such as, lower back pain, upper back pain, leg pain, arm pain, wrist pain, shoulder pain, neck pain and hand pain) authors used perceived health problems dataset sheet.

It is important to note that, the data gathered became possible due to some ethics followed by the authors. Firstly, authors were given approval by Heads of those selected institutions to use their premises as study areas. Secondly, participants were assured of confidentiality of their data. The assurance boosted their confidence, made them comfortable and relaxed during the exercise. Finally, the participants were not forced and therefore freely gave their total support for the success of the whole research.

Definitions of anthropometric dimensions according to the measurement developed by Kaya et al.,[7] are provided (Table 1). According to the outcomes of Rahman and Syed studies [40-41], key percentile classifications of some anthropometric variables are reported in Table 2 for determining furniture variables which are fixed or not adjustable.

Published online: Septenber 30, 2020

Table 1. Anthropometric dimensions with their definitions

Anthropometric dimensions	Definition
Weight	Body weight
Stature	Is the straight up direction between floor and head top
Popliteal height	Is the straight up direction between floor and knee back
Buttock to popliteal length	Distance between buttocks back and the back of the knee
Elbow to seat height	Is the straight up direction between seat surface and elbow under
Sitting shoulder height	Is the straight up direction between seat surface and the top most part of the shoulder
Knee height	Is the straight up direction between the floor and the top most part of the knee
Width of bitrochanter	Maximum distance between the two ends of the hips when seated

Table 2. Percentile values of relevant dimensions in anthropometric design of office chair

Anthropometric variable	Furniture variable	Key percentile classifications
Popliteal height	Seat height	50^{th}
Buttock to popliteal length	Seat depth	5^{th}
Elbow to seat height	Armrest height	50^{th}
Sitting shoulder height	Backrest height	50^{th}
Knee height	Desk clearance	95^{th}
Width of bitrochanter	Seat width	95^{th}

An independent t-test was carried out to find out gender differences in anthropometric data within the institutions. The two groups which did not depend on each other were male and female. The results of statistical analyses showed differences in male and female in the institution (Table 3). The analysis depicted that there were significant differences in three anthropometric dimensions (stature, popliteal height and knee height).

Table 3. Independent t-test of Males and Females anthropometric data

Dimension (mm)	T	*p*-value
Weight(kg)	1.370	0.172
Stature	13.848	0.000
Popliteal height	4.221	0.000
Buttock to popliteal length	-0.725	0.469
Elbow to seat height	1.111	0.267
Sitting shoulder height	-1.878	0.061
Knee height	2.547	0.011
Width of bitrochanter	1.370	0.655

Participants were asked questions on whether they had experienced lower back pain, upper back pain, leg pain, arm pain, wrist pain, shoulder pain, neck pain or hand pain as at the time data was collected. A cross-sectional survey (body sizes survey) was conducted in Kumasi metropolis public institutions in Ghana on 310 administrative staff (197 males and 113 females). Their mean age (±standard deviation) was 38.82±8.77 years. There was no major change in age between the two genders (p = 0.69). Mean±SD of weight was 74.39±11.31 kg and 72.57±11.17 kg in males and females, respectively.

The descriptive analyses of the eight body dimensions into mean, standard deviation (SD), 5^{th} and 95^{th} percentiles, and health issues of male and female administrative staff members were made possible with the help of IBM SPSS version 21.

Ethical consideration:

The approval to use the participating institutions for the study was sought from the Heads in those institutions. The Heads are responsible for the staff in the administrative block. The administrative staff members were persuaded to participate in the exercise since the data collection of their body dimensions would benefit everyone but not to affect them or reveal any secrecy. Also, the presence of the researchers in their premises would not disturb their routine work.

Before the use of the data sheet to record the anthropometric dimensions, the researchers explained to respondents individually how to become comfortable with the exercise and the research. The measurements and recordings of the data started when both researchers and administrative staff members arrived at a conscientious. All of the administrative staff members from the public institutions took part in the research out of their own free will.

RESULTS

The proposed furniture sizes in seat height, seat depth, armrest height, sitting shoulder height, desk clearance and seat width for administrative staff members in Kumasi Metropolis has been presented in Table 4.

Table 4. Percentile values of relevant measurements in anthropometric determination of furniture sizes

Anthropometric measurements(mm)	5th percentile	50th percentile	95th percentile	Furniture size
Popliteal height	418	460	515	460 + heel height (32.5mm)
Buttock to popliteal length	430	495	550	430
Elbow to seat height	170	190	220	190
Sitting shoulder height	445	530	1060	530
Knee height	536	600	670	670
Width of bitrochanter	316	360	469	469

Descriptive statistics of the study were collected for male and female administrative staff members (Table 5). Male subjects were higher in three anthropometric dimensions; Stature (S), Popliteal Height (PH) and Knee Height (KH) than

females. However, both male and female subjects have the same anthropometric dimensions in Weight (W), Buttock to Popliteal Length (BPL), Elbow to Seat Height (ESH), Sitting Shoulder Height (SSH) and Width of Bitrochanter (WoB) (Table 6).

Table 5. Anthropometric data for administrative staff members aged 24 – 59 years (dimension in millimetres)

		Males				Females			
	Dimension	Mean	SD	5th	95th	Mean	SD	5th	95th
1	W(kg)	74.39	11.31	55.90	91.30	72.57	11.17	55.70	90.30
2	S	1729	64.01	1590	1820	1629	56.48	1537	1743
3	PH	466	28.74	430	520	451	30.41	397	500
4	BPL	492	38.07	430	550	495	33.45	430	547
5	ESH	192	20.40	170	220	190	19.46	166	220
6	SSH	645	249.85	423	1061	700	243.25	450	1053
7	KH	603	47.05	540	670	589	44.23	517	675
8	WoB	374	54.99	310	480	376	47.10	317	466

Table 6. Comparison for each body dimensions in public institution

		Males		Females			
	Dimension	Mean	SD	Mean	SD	t-Ratio	*p*-value
1	Weight(kg)	74.39	11.31	72.57	11.17	1.370	0.172
2	Stature	1729	64.01	1629	56.48	13.848	0.000
3	Popliteal height	466	28.74	451	30.41	4.221	0.000
4	Buttock to popliteal length	492	38.07	495	33.45	-0.725	0.469
5	Elbow to seat height	192	20.40	190	19.46	1.111	0.267
6	Sitting shoulder height	645	249.85	700	243.25	-1.878	0.061
7	Knee height	603	47.05	589	44.23	2.547	0.011
8	Width of bitrochanter	374	54.99	376	47.10	-0.448	0.655

Published online: Septenber 30, 2020

Table 7 shows summaries of all the perceived health issues: Lower Back Pain (LBP), Upper Back Pain (UBP), Leg Pain (LP), Hand Pain (HP), Wrist Pain (WP), Arm Pain (AP), Shoulder Pain (SP) and Neck Pain (NP). With the exception of lower back pain in both male and female staff plus neck pain in only female staff, the rest of the pains are all below average. Lower back pain and neck pain had the highest prevalence of 52.79% and 54.87% for males and females respectively.

Table 7. gender health issue distributions of administrative staff members

	Male (n=197)				Female (n=113)			
	Yes		No		Yes		No	
Pain	N	%	n	%	N	%	n	%
LBP	104	52.79	93	47.21	59	52.21	54	47.79
UBP	43	21.82	154	78.18	25	22.12	88	77.88
LP	30	15.23	167	84.77	23	20.35	90	79.65
HP	14	7.11	183	92.89	16	14.16	97	85.84
WP	56	28.43	141	71.57	38	33.63	75	66.37
AP	49	24.87	148	75.13	45	39.82	68	60.18
SP	55	27.92	142	72.08	46	40.71	67	59.29
NP	81	41.12	116	58.88	62	54.87	51	45.13

DISCUSSION

The calculated furniture sizes are dependent on the body measurements of the adult workers' population [1]. The furniture sizes are appropriate since they are dependent on the workers' anthropometry, thereby avoiding accidents, injury, not impacting negatively on their health issues and increase production [13-19]. The right furniture will also bring about workers working efficiently. Therefore, one will say that the anthropometric data of the users define the accurate and performing sizes of furniture [7-9]. Secondly, there will not be mismatch between their body measurements and the furniture product they will use [2]. Mismatch results in participants' discomfort; increase pain, inefficiencies, delays and wastage [12].

Spending more hours (such as eight hours) in the office not only lead to body weakness and pains at the lower back and neck [20-21], but also lead to harmful emotional effect. These results are manifestations of higher recordings in lower back pain and neck pain. The search revealed that male and female administrative staff members use their sitting furniture for long periods in doing office work.

In a study conducted by Syed et al., [42] popliteal height, buttock to popliteal length, elbow to seat height, sitting shoulder height, knee height and width of bitrochanter are relevant body dimensions for the design of furniture. Popliteal height is key measure to predict seat height specification [43]. The popliteal height ensures fitness of administrative staff members in sitting position by supporting feet flat on the floor without unnecessary stress behind the knees. Seat height (popliteal height), seat depth (i.e. buttock to popliteal length), desk clearance (knee height), maximum performing elbow height (accurate desk height) are the joint measures applicable for ergonomic furniture [44].

Pain is a term ascribed to a situation experienced and understood by the sufferer. It is the level that has been the concern of people in several methods in pain research [45]. The highest reported case of neck pain in this study conformed to [38] as workers mostly use computers as part of their work. However, this study did not conform to what were reported by Ivelic et al., [37] and Ranasingheet al., [39] which states that both neck pain and shoulder pain, and neck pain are 24% and 36.7% respectively. Secondly, the registered lower back pain in this study was higher than those recorded in Koes et al., research [30]. Thirdly, shoulder pain in females is higher than those registered by both Ivelic et al., [37] and Ranasingheet al., [39] whilst that in males is less than the registered in Ranasingheet's et al., findings. Also, female's leg pain was higher than the one recorded in Koes's et al., study [37]. Furthermore, recorded hand pain in Ranasingheet's et al., study was higher than what was registered in male and female staff in the present study.

CONCLUSION

Eight body measures for public institution staff (male and female) aged 24 – 59 years were collected and summarized. All measurements of the male and female workers were statistically different at three body measurements (stature, popliteal height and knee height). Thus, the body measurements between males and females were not the same. Since anthropometric variables vary between males and females, different furniture designs should be made for males and females within and between institutions.

COMPETING INTERESTS

The authors declare that they have no competing interests.

ACKNOWLEDGEMENTS

The authors are grateful to the various Heads of Departments and participants that permitted us to use their premises as study areas. We thank the administrative staff that supported and willingly provided data for this research study.

ABBREVIATIONS

SD: Standard Deviation
PH: Popliteal Height
BPL: Buttock to Popliteal Length
ESH: Elbow to Seat Height
SSH: Sitting Shoulder Height
KH: Knee Height
WoB: Width of Bitrochanter
S: Stature
W: Body Weight

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Published online: Septenber 30, 2020

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Published online: Septenber 30, 2020