COMPARISON OF OLDER MEXICAN AMERICAN UPPER EXTREMITY REACH CAPABILITIES TO OLDER ANGLO AMERICANS

Odi Mike Ikpe

Department of Industrial Engineering

APPROVED:

Arunkumar Pennathur, Ph.D., Chair

Luis Rene Contreras, Ph.D.

Peter Golding, Ph.D.

Patricia D. Witherspoon, Ph.D.
Dean of the Graduate School

Dedicated to my other half, Lauren.

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By

Odi Mike Ikpe, Bachelor of Science

THESIS

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ABSTRACT

The study aimed to investigate if there are upper extremity reach capability differences in older Mexican Americans and older Anglo Americans. The subjects were recruited and corresponded to the 2000 census track. Upper extremity reach capability was determined by analysis of 20 range of motion variables. A MANOVA analysis utilizing SPSS software was performed with age, gender and ethnicity as independent variables while height and 20 range of motion anthropometric measurements servings as dependent variables (responses). Ethnicity as a function of age was found to be significant in height, horizontal distance from buttock to hand, rotation of head to the right and left, extension and flexion of the head, lateral and medial rotation of shoulder, abduction and adduction of the shoulder, extension of the shoulder and flexion of elbow at 5 % alpha levels.

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Chapter 1

INTRODUCTION

1.1 Definition of Anthropometry

Anthropometry is the measurement of human physical form (Kroemer, 1994) and the art of application that establishes the physical geometry, mass properties, and strength capabilities of the human body (Del Prado-Lu, 2007). Anthropometric data can be measured longitudinally or cross-sectional. Longitudinal data provides consistent measurements of a particular group or individual by making measurements after a lapse of a predefined period for a certain duration. On the other hand, cross sectional data measures a group average at a given point in time. Though the former approach provides the best indication of anthropometric changes, the latter approach is more frequent in the literature most likely due to its economical and feasibility advantages. Some common anthropometric measurements include (1) forward fingertip reach ; (2) overhead fingertip reach; (3) forward grip reach; (4) overhead grip reach; (5) lower hand height; (6) upper hand height; (7) maximum overhead fingertip reach angle; (8) horizontal distance from buttock to hand; (9) vertical reach distance; (10) arm span; (11) extension of head; (12) flexion of head; (13) maximum rotation of the head; (14) flexion and extension of the shoulder; (15) abduction and adduction of the shoulder; (16) lateral and medial rotation of the shoulder.

1.2 Aging

Physical age has served as the most reliable predictor of aging. However, people of the same physical age may age differently due to the various factors that affect aging. Aging is a normal process characterized by typical, functional and morphologic changes indicative of age related changes in the body. The only experience that humans share beside birth and death is aging. Some people have better quality of life than others. The term aging is referred to a process or a group of processes occurring in living organisms that with the passage of time lead to a loss of adaptability, functional impairment, and eventually death (Spirduso, 1995).

Though we all age, the manner rates at which people age differs. Low probability of disease and disease related disability, high cognitive and physical functional capacity and active engagement with life are the three components to successful aging. The three components are further broken down into subsets and the interaction between the various factors is what determines one's aging (Rowe, 1997).

1.3 Older Adult Population

In this research the older adult population will refer to people aged 65 and above. In 2011 the first baby boomers will turn 65, ushering in a new generation of older Americans. The 65-and-older population of the future will be markedly different from previous generations, with higher levels of education, lower levels of poverty, more racial and ethnic diversity, and fewer children. Their most striking characteristic, however, will be their numbers. The aging of the baby boom population (The baby boomer refers to people born in the post-World War II period from 1946 through 1964), combined with an increase in life expectancy and a decrease in the

relative number of younger people, will create a situation where older adults make up a much larger percentage of the U.S. population than has ever before been the case. Between 2005 and 2030 the number of adults aged 65 and older will almost double, from 37 million to over 70 million, accounting for an increase from 12 percent of the U.S. population to almost 20 percent (Retooling, 2008).

In July 2003, 35.9 million people were aged 65 and older in the United States, or 12 percent of the total population. Among the older population, 18.3 million people were aged 65 to 74, 12.9 million were aged 75 to 84, and 4.7 million were 85 and older. In 2003, non-Hispanic Whites accounted for nearly 83 percent of the older population. Blacks, Asians, and Hispanics accounted for 8 percent, 3 percent, and 6 percent, respectively. Projections indicate that by 2030, the composition of the older population will be more diverse: 72 percent non-Hispanic White, 11 percent Hispanic, 10 percent Black, and 5 percent Asian. The older Hispanic population is projected to grow rapidly, from just over 2 million in 2003 to nearly 8 million in 2030 (He, 2005).

1.4 Disability in Older Adults

Disability is a complex phenomenon to define. The 1990 Americans with Disabilities Act defines disability as a physical or mental impairment which substantially limit one or more of an individual's major activities of daily livings such as walking, hearing, speaking, learning and performing manual tasks. The World Health Organization defines disability as any restriction or lack of ability to perform an activity in the manner, or in the range, considered normal. Studies

show that the variations of disability statistics is a result of varying disability definitions (Levine, Zitter, and Ingram, 1990; Gardner- Bonneau, 1990).

According to a National Health Interview Survey, the disability rate among people ages 18 to 59 rose significantly from the 1980s through the 1990s, with the growing prevalence of obesity an important factor in this trend. Obesity and overweight put people at increased risk for potentially disabling chronic diseases such as heart disease, type 2 diabetes, high blood pressure, stroke, osteoarthritis, respiratory problems, and some forms of cancer.

Research demonstrates that disease and disability are not an inevitable part of aging (Fried, 1997). Disability rates can be reduced, as evidenced by data from the National Long Term Care Survey, which found that between 1982 and 1999, the prevalence of physical disability in older Americans decreased from 26 percent to 20 percent. Factors thought to have contributed to this decline in disability rates include improved medical treatment, positive behavioral changes, more widespread use of assistive technologies, rising education levels, and improvements in socioeconomic status(National Institute of Health). Analysis of anthropometric measurements could eventually serve as predictors of future states of disability and provide an early avenue for intervention. Furthermore, anthropometric measurements can be utilized at early design stages in order to produce better products.

1.5 Organization of Thesis

The first chapter introduces gives an overview of anthropometry, aging, older population and disability among older adults. The second chapter is back ground section which reviews the literature on the various topics including the findings of the relationship between Anthropometry and Age, Upper Extremities Anthropometry, Duke OARS, and the validity of Self Reported

Assessments. My research objectives are defined in chapter three. In chapter four, I explain my research methodology while describing the data origin and design of experiment. The fifth chapter compiles the results of my experiment. Chapter 6 concludes with an explanation and analysis of my results.

Chapter 2

LITERATURE REVIEW

2.1 Introduction

Samples of most anthropometric surveys are exceedingly small and the surveys do not distinguish between ethnic origin, region, socioeconomic status, health and other attributes that are codeterminants of anthropometry (Kroemer, 1994).

2.2 Anthropometry and Age

There has been much research done to understand the relationship between age and anthropometry. Perissinotto et al. state that anthropometric measurements serve as an essential tool in geriatric nutritional assessment to evaluate underweight and obesity conditions (2002) which are both important factors for severe diseases and disability in the elderly (Jensen, Roger, 1998; Visser et al. 1998).

The most apparent anthropometric measurement affected by age is height. There is about a 1cm decline in height per decade lived and this may be a result of (a) flattening of the cartilaginous disks between the vertebrae; (b) a flattening of thinning of the bodies of the vertebrae; (c) a general thinning of all weight- carrying cartilages; (d) a change in the S- shape of the spinal column in the side view, particularly an increased kyphosis in the thoracic area (hump back); (e) in some cases, scoliosis, a lateral deviation from the straight line displayed by the

spinal column in the frontal view; and (f) possibly bowing of the legs and flattening of the feet (Barlow, Braid 1990; Stoudt, 1981).

2.3 Upper Extremities Anthropometry

Upper extremities anthropometric measurements are generally used to evaluate reach capabilities. They are good indications of upper body range of motion. Body Measurements are usually defined by two end points of distanced measured (Kroemer, 1994). Anthropometric measurements can be measured statically or functionally. Static anthropometry is the measurement of body dimensions with the body held in standardized, static postures. In contrast, functional anthropometry is the measurement of the limits of movements of the human body.

Findings by James Prichett (1988) suggest that accurate predictions of growth and of growth discrepancy in the upper extremity can be made and the time at which to perform equalization procedures can be determined more precisely. He adds that the human body is generally thought of as a symmetrical structure. Prichett states that while a small difference in the lengths of the extremities is not a functional problem, larger discrepancies may lead to physically disability and emotional distress. Mild inequalities in the length of the upper extremities are well tolerated but larger differences may pose problems. Anthropometric measurements have rarely been used to study growth in the upper extremities (Prichett, 1998).

2.6 Duke OARS and Validity of Self Reported Assessments

The Duke University Center for the Study of Aging and Human Development developed OARS, which includes an assessment of personal functioning in five domains: social, economic, mental health, physical health, and self-care capacity. A summary rating is calculated for each of the domains that ranges from excellent functioning (1) to totally impaired (6) (Fillenbaum & Smyer, 1981). Previously, a test–retest reliability trial showed that 91% of items were identical after a 5-week interval, and an intrarater reliability trial demonstrated that 80% of intrarater correlations were 0.8 or higher (Fillenbaum, 1988). Although other domains in OARS have been previously assessed for validity, the social resource component was not examined, as an external standard of comparison was not identified (Burholt, 2007).

Burholt et al. performed a study to examine data quality, reliability, and construct validity of the Older Americans Resources and Services social resources scale. They assessed the measurement equivalence of the OARS social resources measure by examinining reliability (internal consistency), item–total correlations, and the construct validity of underlying dimensions. They then used confirmatory factor analysis to determine the applicability of the factor structure of the OARS social resources scale. Their study was performed across multiple countries and supports other findings which highlight the complexity of social structure. Varying ethnic group have different social resources and this is particularly the case in Anglo Americans and Mexican Americans. Furthermore, studies do suggest that social resources have multiple dimensions (Hall & Wellman, 1985; Wellman, 1988).

Chapter 3

RESEARCH OBJECTIVES

3.1 Research Objectives

Anthropometric variability can be attributed to ethnicity, gender and age differences (Jurgens et al., 1990). The anthropometric differences between older Mexican Americans and their older Anglo American counterparts are yet to be assessed. Intervention to allow for successful aging is an important issue especially since the near future promises an unforeseen aging population with a significant percentage being older Mexican Americans. An intervention to slow or circumvent effects of aging can occur medically or through engineering. Engineering interventions typically involves redesign of the built environment to support graceful aging (Pennathur, 2007). Before engineering designs can be implemented, it is important to understand the users of the proposed design. In regards to design for an aging population, engineers need to know if the varying ethnic population have different anthropometric measurements and assess how or if that will affect their designs. Incorporating anthropometric data in the design stage would yield more efficient designs, ones that are more user friendly, safer and enable higher performance and productivity (Ali, 2009). Improved design in the built environment will ultimately increase the quality of life especially in older adults.

Reach capabilities determine range of motion and studies have shown that reach capabilities affect older adults' ability to perform activities of daily living (Pennathur, 2003). I aim to investigate whether older Mexican Americans have different reach capabilities than their Anglo American counterparts.

Chapter 4

RESEARCH METHODOLOGY

4.1 Introduction

Though the concept of “quality of life” is complex, subjective and multidimensional (Felce, 1995), I believe it is quantifiable. Quantification of “quality of life” is necessary because nothing can be improved without first measuring it. I define quality of life as one’s ability to successfully perform activities of daily living with minimal or no assistance. There is a correlation between independence and quality of living. Studies suggest that people associate a better quality of life in regards to their ability to perform activities of daily living (Ulander, 1997; Goldstein, 2003; Schoenmakers, 2005).

The data utilized in my experiment were acquired by investigators headed and coordinated by Dr. Arunkumar Pennathur. Below describes the selection criteria and population description. I will measure functional reach capabilities through anthropometric measurements, specifically upper extremity reach capability. Upper extremity reach capability will be measured by height and 20 other range of motion measurements. Self reported responses of the Duke Older American Resources and Service questionnaire filled out by both the older Mexican American and Anglo American sample groups will also be assessed.

4.2 Participants

Study participants: The investigators had established a successful working relationship with the Aging Services of the City of El Paso and the El Paso Housing Authority, through Ms. Winifred

Dowling, Aging Services Administrator for the City of El Paso. Mexican American older adults were recruited from retirement community dwellings in El Paso through the assistance of the Aging Services Administration in El Paso. The El Paso Aging Services Administration coordinated access to participants from the Retired Senior Volunteer Program (RSVP). Based on the 2000 Census data (documenting the distribution of older Mexican American adults living in El Paso), and a map of the census tracts in El Paso, the investigators determined the proportion of older Mexican American men and women to be included in the study from each census tract (to add to a total of 125 men and 125 women in the study). After this determination of desired proportional sample sizes from each census tract, the investigators coordinated with the aging services administration's RSVP list and provided a random list of selected participants from each census tract. The RSVP program coordinators then provided contact information for several potential recruitment points throughout El Paso. The investigators then contacted the recruitment center coordinators by phone, and set up orientation meetings and field data collection meetings for the research. All older adults participating in the study were required to be physically active individuals independent of walkers, wheelchairs, or canes, and must not have had any serious debilitating disease. All older adults signed informed consent forms and were free to withdraw from the study at any time.

Measurement Protocols and Equipment: All functional anthropometric reach dimensions were measured using various anthropometers and scales available at the Ergonomics, Safety and Productivity Applications Laboratory at UTEP.

Below are the anthropometric variables measured;

1. Height: vertical measurement from top of head to floor.

2. O.F.R. - Overhead Fingertip Reach: performed standing and measured vertically from the floor to the tip of the middle finger.
3. O.G.R. Overhead Grip Reach: performed standing and measured horizontally from vertical wall to center of a rod gripped vertically in the hand.
4. Arm Span: fingertip to fingertip, measured horizontally from the tip of the middle finger on one hand to the tip of the middle finger on the other hand.
5. U.H.H. - Upper Hand Height: performed standing and measured as the vertical distance from floor to knuckle of middle finger of left hand at a distance of 360 mm from chest.
6. L.H.H. - Lower Hand Height: performed standing and measured as the vertical distance from floor to knuckle of middle finger of left hand at a distance of 360 mm from chest.
7. V.R.D. - Vertical Reach Distance: maximum overhead fingertip reach angle measured standing with subject standing erect, with weight as evenly balanced as possible, and arm extended vertically above head and hand and fingers held straight.
8. H.D.F.B.H. - Horizontal Distance From Buttock to Hand: horizontal distance from buttock to hand when bending forward and downward measured horizontally from buttocks to tip of middle finger of left hand.
9. F.F.R - Forward Fingertip Reach: performed standing and measured horizontally from a vertical wall to the tip of the middle finger.
10. F.G.R - Forward Grip Reach: vertical reach distance when bending forward and downward measured vertically from floor to tip of middle finger of left hand.
11. R.H.R - Rotation of the Head to the Right: maximum rotation of the head to the right (in degrees) will be measured with the subject sitting upright and rotating the head to the

right while looking forward; the angle from the horizontal reference point (zero start position) to the line from the back of the head through the nose will be measured.

12. R.H.L - Rotation of the Head to the Left: maximum rotation of the head to the left (in degrees) will be measured with the subject sitting upright and rotating the head to the left while looking forward; the angle from horizontal reference point (zero start position) to the line from the back of the head through the nose will be measured.
13. F.H - Flexion of Head: flexion of head (in degrees) will be measured as the maximum forwards bending of the head; the angle from the vertical reference point (zero start position) to the fixed line in front of the ear will be measured.
14. E.H - Extension of Head: extension of head (in degrees) will be measured as the maximum backwards bending of the head (extension).
15. L.R.S - Lateral Rotation of the Shoulder: lateral rotation of the shoulder (in degrees) will be measured as the maximum rotation of the shoulder.
16. M.R.S. - Medial Rotation of the Shoulder: medial rotation of the shoulder (in degrees) will be measured as the maximum rotation of the shoulder.
17. Ab. S. - Abduction of the Shoulder: abduction of the shoulder (in degrees) will be measured as the maximum range of motion of the shoulder in the coronal plane (side to side) of the body.
18. Ad. S - Adduction of the Shoulder: adduction of the shoulder (in degrees) will be measured as the maximum range of motion of the shoulder in the coronal plane (side to side) of the body.

19. F.S - Flexion of the Shoulder: flexion of the shoulder (in degrees) will be measured as the maximum range of motion of the shoulder in the sagittal plane (front to back) of the body.
20. E.S - Extension of the Shoulder: extension of the shoulder (in degrees) will be measured as the maximum range of motion of the shoulder in the sagittal plane (front to back) of the body.
21. F.E - Flexion of the Elbow: flexion of the elbow (in degrees) will be measured as the maximum flexion and extension of the elbow.

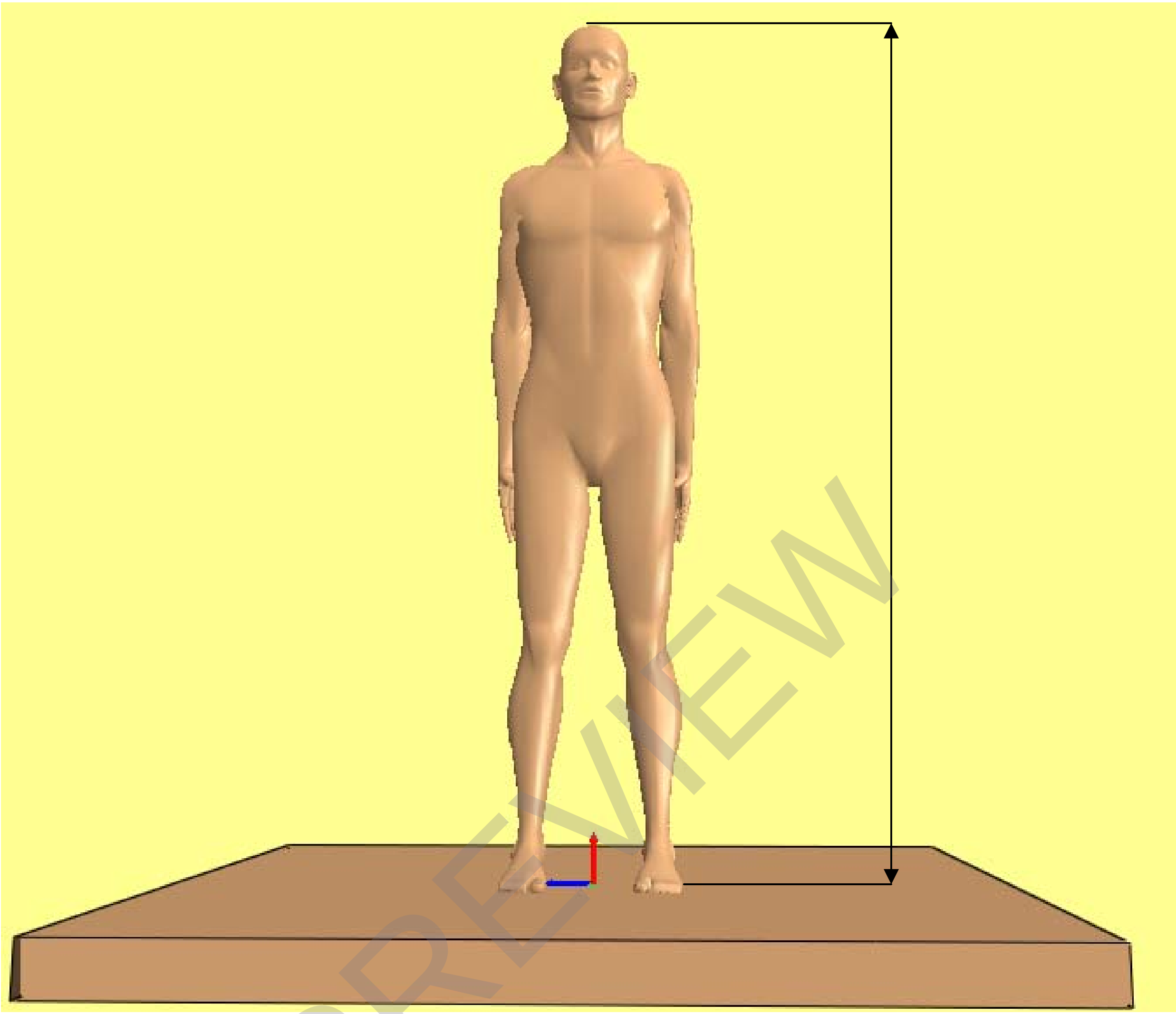

Figure 1: Height

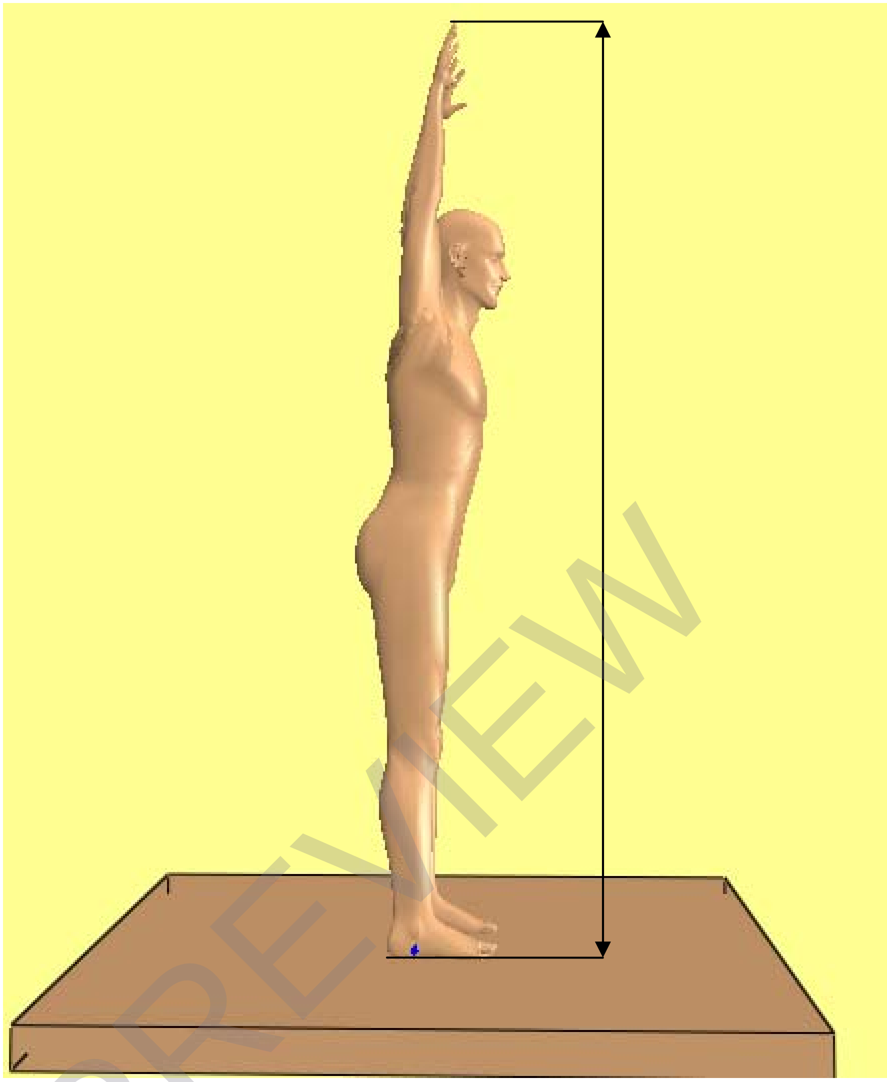

Figure 2: overhead fingertip reach

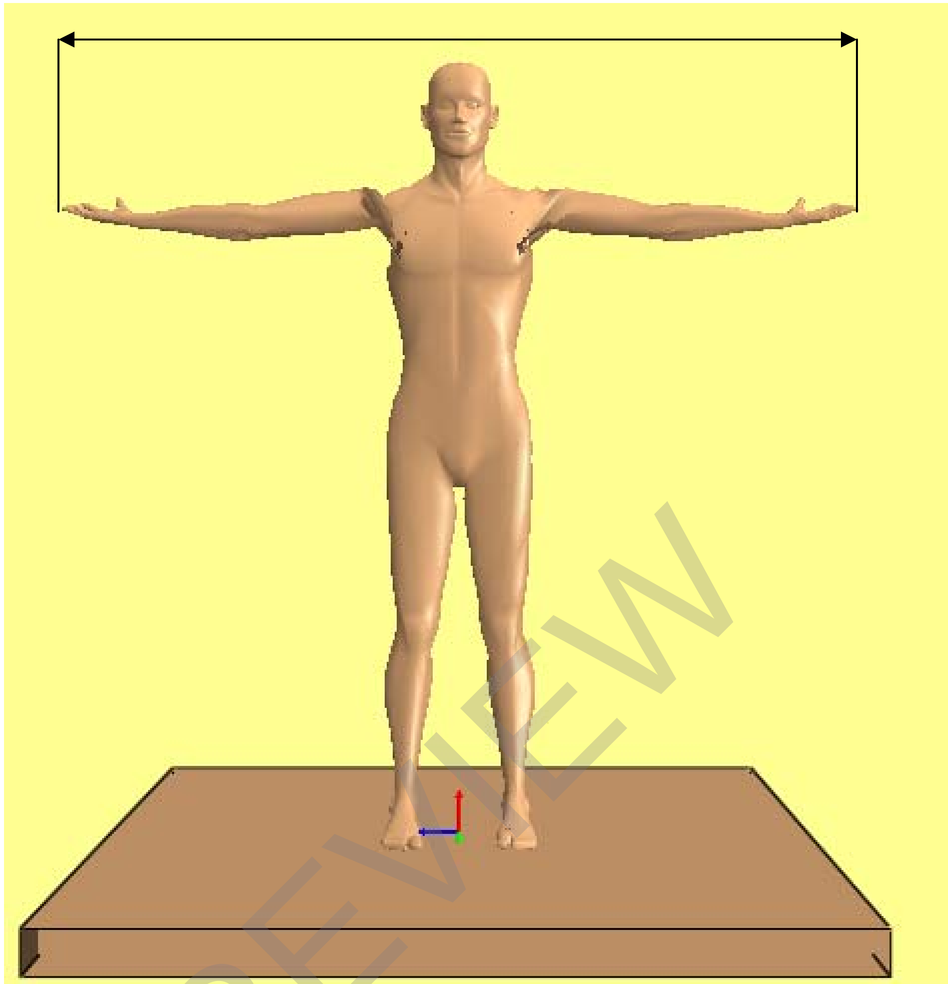

Figure 3: arm span