Tuijin Jishu/Journal of Propulsion Technology
ISSN: 1001-4055
Vol. 45 No. 3 (2024)

Exploring the Precision of Sizing Charts Applying Anthropometric Data in the Bangladeshi Retail Market Concerning Women's Ready-Made Apparel Fit Dilemmas

Most. Naznin Akter [1*], MD. Fahad Bin Nizam [2], Md Ashraful Kabir [3]

[1] *Lecturer, Department of Fashion Design & Apparel Engineering, NITER, Bangladesh*
[2] *Fabric Sourcing Manager (Head of department), Windy Group, Bangladesh*
[3] *AGM, Sales and Marketing, Nice Denim Mills Ltd, Bangladesh*

Abstract:- This article explores the issue of fit and style in women's clothing considering the Bangladesh market, using anthropometric data to reflect proper sizing patterns. Consumers mostly assume garment fit as an ultimate factor when buying readymade garments. The clothing industry in Bangladesh still uses the Western sizing system, modified to fit the ideal body type, as standard sizes are not available. Research shows that most mature women are over the age of 26 and then the body undergoes physical changes due to certain conditions. Therefore, they prefer to wear semi-fit or loose-fit clothes instead of finding a better fit from Bangladeshi brands. The complexity of garment sizing and poor fit leads to dissatisfaction for most consumers. This study leads to an analysis of the anatomy of the female body and provides details used to develop a size chart in terms of anthropometric measurements to present the steps. A total of 135 Bangladeshi women aged 25 to 34 years were measured using manual measurement methods and anthropometric surveys were obtained to target her group from size range, size code, and upper size limit. determined the lower bound. To provide quality clothing for consumer comfort and satisfaction, this study is designed to help consumers by providing detailed, process-based anthropometric data that serves as a guide for creating an appropriate sizing system. It will significantly pay its way to advance our understanding of size charts and provide the groundwork for more research in Bangladesh.

Keywords*:* size chart, anthropometric data, garments fit, womenswear.

1. Introduction

“In ancient civilizations, clothing was primarily used to cover and protect human bodies. Today, most consumers see clothing as more than just a basic necessity. Clothing is not only developed to cover the body but also to enhance the beauty of the individual. Research conducted on clothing behaviour shows that consumers differ in attitudes, values, and expectations of clothing. People use clothing to identify themselves with a social class, project a positive image, and as a means to improve their overall appearance”(Ola-Afolayan et al., n.d.). In the early 18th century, all clothing was hand-stitched for a specific person. The custom-fitting clothing perfectly conforms to the shape and dimensions of the individual wearing it. Artisans and seamstresses throughout that era used to employ numerous sizing techniques, but sizing was not a problem as each item was tailored to individual needs. “But in Today’s world Ready-made clothing, available off-the-rack in retail stores or shipped directly from a warehouse to the customer, is the primary paradigm for clothing production used by the apparel industry”(Chun, 2014). Bangladesh is already a sizeable market for the fashion industry for both domestic and international vendors since it is the world's second-largest apparel manufacturing nation after China. Today, people in Bangladesh are brand-conscious and purchase goods from stores as per their needs. Standardization of garments has become a necessary and important issue in the garment industry. The main problem faced by customers most frequently was the inability to find form-fitting, fashionable clothing that meets their functional, economic, and aesthetic needs.

We are faced with the challenge of satisfying our senses. Research has shown that female body shape can vary across geographic locations due to differences in lifestyle, dietary habits, sociocultural values, geographic location, dietary habits, and ethnic composition of the population. Ultimately, the fit will be a key decision point for consumers. Because someone wearing ill-fitting apparel feels less confident and looks awkward. The most frequently mentioned issue concerning Bangladesh's apparel sector is fit. The reason for this is that there isn't a single, widely accepted standard for size charts across all categories in Bangladesh's garment sector, where manufacturers adopt their own or foreign sizing systems. The result is reconciliation issues, followed by clothing refusals, returns, and exchanges. Manufacturers' brand images have also suffered from this disruption. Consumers are frustrated by the short or no availability of alternatives, especially when shopping for special occasions, and events. we have a lot of disappointment in store purchases when a particular piece of clothing is appropriate but the choice has to be discarded due to fit issues. Consumers often only buy products that provide the highest level of fit and meet their emotional and psychological needs, regardless of price. Apparel companies define their target customers, and need to create a suitable size chart. Size standards play an important role in the ready-to-wear industry, providing guidelines for manufacturers and consumers.

Purpose of Study

The research paves the way to investigate fit and sizing preferences alongside the difficulties related to Bangladeshi womenswear. It additionally intends to present an appropriate sizing chart that would assist designers and producers when developing fashion apparel.

2. Literature Review

“The evolution of the apparel sizing system occurred due to the introduction of ready-to-wear apparel in the apparel industry. During the late part of the nineteenth century, a sizing system for women was developed by professional dressmakers, tailors, and draftsmen. Their techniques for measuring and fitting their clients were unique. When the demand for mass production of garments came into being in the 1920s, the need for a standard sizing system arose, since there was variation in the measurements of the same size among the different brands”(Otieno & Fairhurst, 2000a). A well-made garment may catch the attention of a buyer if it fits poorly, despite the fact it has all the excellent practical and aesthetic features that make a garment appealing. To enhance their appearance and self-image, customers not only keep it in their wardrobes but also style it well with other apparel pieces. People notice and react negatively to ill-fitting clothing, which also causes discomfort.

Conducting anthropometric surveys of indigenous peoples and developing national standard size charts for each category are two ways that the United States, the UK, Germany, France, Italy, Sweden, Japan, Finland, and other countries have handled the issue. Useful information has been gathered through anthropometric surveys, such as precise measurements for garment fit and size. To guarantee maximum suitability, the manufacturer must take the intended customer into account when developing specifications. Few people in Bangladesh have taken this journey. “Though researchers have studied satisfaction/dissatisfaction with fit, little research has been done concerning consumer preferences for a fit of apparel concerning body shape and body cathexis, and fit problems identified by the consumer”(4). “Because of that, they often prefer grading their garments according to their target bust, waist, and hip measurements instead of a prescribed size chart”(Faust & Carrier, 2009).“To get a good fit, RTW clothing should be evaluated from the individual self and body angle. The self-evaluation is called body cathexis. Body cathexis is the evaluative dimension of body image and is defined as positive and negative feelings towards one’s body. The dissatisfaction with body cathexis will result in dissatisfaction with clothing fit”(Beazley, 1997).

2.1. Anthropometry

Anthropometry, which is extremely valuable in many fields like anthropology, designing, feasible clothing, ergonomics, etc., is a study of the anatomy of humans in a variety of static and dynamic positions to extract data from body measurements. “Anthropometric protocols demonstrate how a manual anthropometric survey can be conducted. The measurement process starts with the subject changing into a tight-fitting garment for better and more accurate body measurements”(Ashdown, 2014).

"Sizing systems used in the design and distribution of ready-to-wear clothing are generally based on a selection of dimensions from an anthropometric study of the population for which the sizing system is designed. Key body dimensions are chosen to divide the population into size groups. The goal of any sizing system is to choose these size groups in such a way that a limited number of sizes will provide clothing that fits most individuals in the population"(Otieno & Fairhurst, 2000b). Because standard size charts are widely available, creating size charts based on anthropometric measurements will expedite mass production, save manufacturing time and costs, minimize material waste, and improve product comfort, affordability, and accessibility for fashion consumers. Bangladesh also conducted an effort to gather historical anthropometric data on its population, but this was not done to generate a size chart for the clothing sector.

"In the 1970s the women's apparel industry considered an average figure as someone who had a difference of 7 to 8 inches between the bust measure and waist measure, and hips about 3 inches larger than the bust. Recently, consumers' body shapes have significantly changed. More consumers nowadays have a larger waist size than consumers of the 1970s"(Pisut & Connell, 2007). Women's ready-to-wear apparel in Bangladesh is derived from overseas sizing methods and, in contrast to Bangladeshi clothing, emphasizes equilibrium at the upper and lower torso. This sort of woman finds it difficult to locate clothes that fit; in suits or coordinated styles, they typically need to buy two sizes for the upper part and lower torso. "This problem of a mismatch between apparel available in the market and existing body types is exacerbated by the fact that South Africa does not have its anthropometric database in the public domain"(Chun, 2014).

In Bangladesh, body measurements of a person are done by tailors, unlike Western manufacturers. Therefore, there is a need for large-scale, updated, and accurate anthropometric measurements of specific groups. Today, people prefer ready-made clothes because of the easy availability of different types of clothes and at cheaper prices.

3. Methodology

This is the most common and conventional method of collecting anthropometric information. With the body kept still in predetermined, standard positions, measures of body circumference, body portion lengths, and volume are taken.

Sampling

Between June 2023 and December 2023, an anthropometric survey was carried out in Bangladesh. A total of 135 women in the 26–34 age range were assessed. A total of 26 body measures are obtained for each participant using ISO 8559:1989 Garment construction and anthropometric surveys, as well as body dimension recommendations. These measurements begin with weight and go up to 650 body measurements, consisting of 12 length measurements, 13 width measurements, and girth measurements. The body weight scale, meter, and flexible plastic measuring tape were among the tools used to take and record the measures of the body. To ensure precision and uniformity when taking body measurements, specially designed skin-clinging clothing is supplied.

Data Analysis

The information foundation for the analysis was provided by anthropometric data from this study. The value of anthropometric surveys will depend on how well these body measurements are converted into critical dimensions and used to solve design problems. Everything except weight (in kilograms) is expressed in inches. An extensive statistical analysis of the raw data was carried out using the Statistical Package for the Social Sciences (SPSS). "Descriptive statistics including mean, mode, median, and standard deviation were calculated and used for correlation analysis. The correlation coefficient is used to determine the relationship between body sizes. Multiple coefficients have analysis measured the linear association between two measures. The values used to determine the correlation between dimensions and determine the key parameters are based on BS 7231 (BSI, 1990)" (Beazley, 1999). The standard states that:(10)"Firstly, a correlation coefficient of less than 0.5 shows no relationship; Secondly, a correlation coefficient between 0.6 and 0.75 shows an intermediate relationship; and thirdly, a correlation coefficient greater than 0.76 shows a significant or high relationship".

4. Result and Discussion

4.1. Determination of the size chart

Given that, the population size (P) and error margin (e), the sample size (p) is determined using Slovin's methodology.

The calculation is as follows:

p = P / (1+P*.052), with a 5% margin of error and a 95% confidence level, n = 135

Table.1. Percentile from original dimension

Body dimension	Mean	50th Percentile	Minimum	Maximum
Body weight	58.08	58	52	68
Full length	56.21	56.20	49	61
Waist	34.75	34	28	40
bust	38.92	40	32	48
neck	15.24	15.25	12	18
Full length				
Front	16.89	17.90	13	20
back	16.48	16.50	13	20
Centre length				
Centre front	13.95	14	11	17
Centre back	14.77	14.70	11	17.5
Shoulder length	7.69	7.70	5.50	9
Bust radius	5.78	5.80	3	8
Side length	7.84	7.90	6	8
Shoulder Slope				
Front	15.54	15.60	13	17
back	15.23	15.25	13	17
Across shoulder				
front	8.364	8.35	6	11
back	8.65	8.60	6	11
Across chest	8.457	8.50	4	12
Bust arc	8.31	8.30	4	12
Across back	8.353	8.30	5	11
Bust span	6.77	6.70	4	8
Back neck	4.965	5	3	7
Waist arc				
front	9.83	9.80	7	11
back	8.59	8.60	6	13
Lower torso				
Abdomen circumference	33.33	33	28	38

Body dimension	Mean	50th Percentile	Minimum	Maximum
Hip circumference	40.22	40	34	46
Side hip length	10.354	10	7	14
Waist to ankle	39.15	40	34	47
Hip arc				
front	9.31	9.30	6	12
back	10.59	10.5	7	13
sleeve				
Bicep circumference	13.83	13.80	8	16
elbow	11.54	11.50	8	14
Forearm circumference	10.28	10.25	8	14
wrist	7.46	7.50	4	9
Sleeve length	21.51	21.50	18	24.5
Under arm length	19.03	19	15	23

4.2. Determination of size range and size interval

"To get 5 steps for 5 height categories, add 1 standard deviation (1SD) and 2 standard deviations (2SD) to the mean to get the 2 values above the mean. Sequentially subtract one standard deviation (-1SD) and two standard deviations (-2SD) from the mean to get the two values that were less than the mean"(Beazley, 1999). According to BS EN 13402-3 (2004), a woman's 4 cm or 8 cm spacing between her is standardized to accommodate height differences through national and corporate systems. The same standard also recommends a chest-to-waist distance of 4 cm or 6 cm1 and a hip distance of 4 cm or 5 cm to have a flexible connection between the chest, waist, and hips. There are variations in size spacing some as low as 3 cm, others as high as 8 cm, but the most logical is her 6 cm spacing, which is used in most countries.

Table .2. Size ranges from original data

Body dimension	S(-2SD)	XS(-1SD)	M	L(+1SD)	XL(+2SD)	SD
Body weight	52	55	58	61	64	3
Full length	50.20	53.20	56.20	59.20	62.20	3
Waist	28	31	34	37	40	3
bust	36	38	Chest-to-waist40	42	44	2
neck	9.25	12.25	15.25	18.25	21.25	3
Full length						
Front	11.90	14.90	17.90	20.90	23.90	3
back	10.5	13.5	16.50	19.50	22.50	3
Centre length						
Centre front	10	12	14	16	18	2
Centre back	8.70	11.70	14.70	17.70	20.70	3
Shoulder length	1.70	4.70	7.70	10.70	13.70	3
Bust radius	1.80	3.80	5.80	7.80	9.80	2
Side length	1.90	4.90	7.90	10.90	13.90	3
Shoulder Slope						
Front	13.60	14.60	15.60	16.60	17.60	1
back	13.25	14.25	15.25	16.25	17.25	1
Across shoulder						

Body dimension	S(-2SD)	XS(-1SD)	M	L(+1SD)	XL(+2SD)	SD
front	6.35	7.35	8.35	9.35	10.35	1
back	6.60	7.60	8.60	9.60	10.60	1
Across chest	6.50	7.50	8.50	9.50	10.50	1
Bust arc	6.30	7.30	8.30	9.30	10.30	1
Across back	6.30	7.30	8.30	9.30	10.30	1
Bust span	4.70	5.70	6.70	7.70	8.70	1
Back neck	3	4	5	6	7	1
Waist arc						
front	5.80	7.80	9.80	11.80	13.80	2
back	4.60	6.60	8.60	10.60	12.60	2
Lower torso						2
Abdomen circumference	29	31	33	35	37	2
Hip circumference	36	38	40	42	44	2
Side hip length	6	8	10	12	14	2
Waist to ankle	36	38	40	42	44	2
Hip arc						
front	5.30	7.30	9.30	11.30	13.30	2
back	6.5	8.5	10.5	12.5	14.5	2
sleeve						
Bicep circumference	11.80	12.80	13.80	14.80	15.80	1
elbow	9.50	10.50	11.50	12.50	13.50	1
Forearm circumference	8.25	9.25	10.25	11.25	12.25	1
wrist	6.5	7	7.50	8	8.5	0.5
Sleeve length	17.50	19.50	21.50	23.50	25.50	2
Under arm length	16	17.5	19	20.5	21	1.5

4.3 Calculating the size code

After deriving five size step values from the body size, the size code is found. According to numerical encoding techniques, the size codes are BD 8, BD 10, BD 12, BD 14, and BD 16. The size code and the body measurements are displayed in Table 3.

Table .3. Bangladeshi women's size code

Size code	ACROSS SHOULDER	BUST	WAIST	CENTRE LENGTH	BUST ARC	HIP CIRCUM	SLEEVE LENGTH	BICEP CIRCUM	WRIST
Size 8	**6.35**	**36**	**28**	**10**	**6.30**	**36**	**17.50**	**11.80**	**6.5**
Size 10	**7.35**	**38**	**31**	**12**	**7.30**	**38**	**19.50**	**12.80**	**7**
Size 12	**8.35**	**40**	**34**	**14**	**8.30**	**40**	**21.50**	**13.80**	**7.5**
Size 14	**9.35**	**42**	**37**	**16**	**9.30**	**42**	**23.50**	**14.80**	**8**
Size 16	**10.35**	**44**	**40**	**18**	**10.30**	**44**	**25.50**	**15.80**	**8.5**

4.4 Validation of Size Chart

Verifying the created size chart is crucial for increased acceptability. Validation is done through the development of the garment and its testing. A prototype garment was therefore constructed for experimental purposes by developing a pattern using the final size chart. Slack was added to the developed size chart to determine the dress dimensions. The researchers recorded visual observations based on the subject's movements and general fitness while standing, sitting, and walking.

5. Conclusion

The majority of participants had a decent fit and fell between sizes 10 and 14, according to the created size chart's verification. The creation of the sizing chart will make it easier to implement manufacturing plans for Bangladeshi

womenswear. Sixty to seventy percent of women fall within this range of the size charts, and most of them say they were pleased with the way their clothes fit. This study suggests that further anthropometric research be done on women in Bangladesh across all age groups and greater sample size. The study suggests that studies should include males as well as children of all ages because there are no specific sizing systems for the male body, teenagers, and children. The implementation of a sizing system will benefit apparel manufacturers by serving as a database and enhancing customer fit.

Reference

[1] Ola-Afolayan O, Zwane PE, Mastamet-Mason A. STATISTICAL MODELLING OF KEY BODY DIMENSIONS IN DEVELOPING THE SIZE CHART FOR THE SOUTH AFRICAN PEAR-SHAPED WOMEN. Journal of Consumer Sciences. 49:2021.

[2] Chun J. International apparel sizing systems and standardization of apparel sizes. In: Anthropometry, Apparel Sizing and Design. Elsevier Ltd.; 2014. p. 274–304.

[3] Otieno RB, Fairhurst C. The Development of New Clothing Size Charts for Female Kenyan Children. Part I: Using Anthropometric Data to Create Size Charts. Journal of the Textile Institute. 2000;91(2):143–52.

[4] Ashdown SP. An investigation of the structure of sizing systems. A comparison of three multidimensional optimized sizing systems generated from anthropometric data with the ASTM standard D5585-94. International Journal of Clothing Science and Technology. 1998;10(5):324–41.

[5] Faust ME, Carrier S. A Proposal for a New Size Label to Assist Consumers in Finding Well-fitting Women's Clothing, Especially Pants: An Analysis of Size USA Female Data and Women's Ready-to-wear Pants for North American Companies. Textile Research Journal. 2009;79(16):1446–58.

[6] Beazley A. Size and fit: procedures in undertaking a survey of body measurements. Journal of Fashion Marketing and Management. 1997;2(1):55–85.

[7] Ashdown SP. Creation of ready-made clothing: the development and future of sizing systems. In: Designing Apparel for Consumers. Elsevier; 2014. p. 17–34.

[8] Otieno RB, Fairhurst C. The Development of New Clothing Size Charts for Female Kenyan Children. Part II: Size-range Categorization and Presentation of Final Size Charts. Journal of the Textile Institute. 2000;91(2):153–62.

[9] Pisut G, Connell LJ. Fit preferences of female consumers in the USA. Journal of Fashion Marketing and Management. 2007;11(3):366–79.

[10] Mercy KK, Van-Dyke A. The Categorisation of Selected Women's Body Forms of Ghana: Implications for Product Development. Vol. 9, Journal Prevention & Ergonomics.

[11] Beazley A. Size and fit: The development of size charts for clothing - Part 3. Journal of Fashion Marketing and Management. 1999;3(1):66–84.