DIFFERENCES IN GIRTH MEASUREMENT OF BMI BASED AND LOCALLY AVALIABLE CATEGORIES OF SHIRT SIZES

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ABSTRACT

Consumers wearing ready-made clothes give significant importance to the fit of the garment. Given that ready-made (RM) apparel depend on an accurate estimate of the distribution of body shapes and sizes within a target population. The purpose of the study was to find out the sizes of local readymade shirt and compare them with established body mass index (BMI) based sizes for small, medium, large, and extra large. The selected girth measurements were shoulder, bust, waist, and hip. The total population/sample was 530 girls aged between 16-22 years, of a public college. Association through chi square was analyzed between BMI of girls and their actual body sizes for shoulder, bust, waist and Hip, these girth measurement showed significant association with BMI (P value $\leq$ 0.05). Pattern sizes were also developed by adding amount of ease in the standard sizes. It was concluded that locally available apparel garments are not manufactured on the right sizes of the girls (aged between 16-22 years), these available sizes are much larger than the actual body sizes of the girls, hence the available sizes of local ready-made garments need revisions and accuracy in order to obtain good fit as well as to provide satisfaction to the targeted consumers.

Keywords. Ready-made (RM), Body Mass Index (BMI), Girth measurement..

INTRODUCTION:

Sizing system in readymade garments is generally designed to fit a subset of a population. It may vary in the general population (Yeosun, Hei, and Woel.2001). It is therefore important for every country, and within countries, to develop their own sizing system for target population (Ashdown 2000; Simmons, Istook and Devarajan, 2004; Honey and Olds, 2007). According to Erwin,D.M (1967) not age but accurate apparel designing for an individual starts with a pattern of the accurate size based on actual body measurements, as sizes may differ in same age groups. Nowadays apparel industry is based on a pattern where dresses are made in ready-made sizes and aims to fit most people. (Laitala, Klepp&Hauge, 2009). Fitting is adjusting design to human figure; this depends on several body measurements like waist, hips, bust and length of shoulder and other sizes of body. These are generally summed up as garment sizes (Horn, 1975).

National Institute of Standard and Technology(NIST), American Society for Testing Material (ASTM), International Standard Organization (ISO), all have set standard sizes for consumers, but these standards are not applicable to Asian women especially on Pakistani women sizes. The major purpose of this study was to develop the standard Girth sizes based upon actual body measurements of girls aged between 16 to 20 years. The purpose of the study was to find out the sizes of local readymade shirt and compare them with established BMI based sizes for small, medium, large and extra large(EX-L). The total population/sample was 530 girls aged between 16-22 years, of a public college. Association through chi square was analyzed between BMI of girls and their actual body sizes for shoulder, bust, waist and Hip, these girth measurement showed significant association with BMI (P value $\leq$ 0.05). Pattern sizes were also developed by adding amount of ease in the standard sizes. On the basis of the results analyzed in the study, it was concluded that locally available RM shirts are not manufactured on the right sizes of the girls (aged between 16-22 years), these available sizes are much larger than the actual body sizes of the girls, hence the available sizes of local ready-made garments need revision and

accuracy in order to obtain good fit as well as to provide satisfaction to the targeted consumers.

To estimate average girth measurements of 16-22 year old girls on the basis of their four levels of BMI.

To check whether the average measurements of readymade shirts of corresponding sizes are appropriate for 16-22 year old girls having various BMI

METHODOLOGY:

To estimate the standard shirt sizes (Small, Medium, Large and Extra Large) for the girl's age between 16-22 years, a quantitative (purposive and analytical study design) was used. Questionnaire was used as a research tool; the questionnaire was based upon a form in which the girth sizes of girls were entered including their height and weight. 100% population of Home Economics College was the sample of the selected study. Girls aged between 16 to 22 years were taken as subject; the total population was 530 from first year, second year and BS Semester 1,3,5,7. A sample of 50 girls was taken for pilot testing. Shoulder, bust, waist and hip measurements were taken in order to check the accuracy of the standard sizes.

In order to determine the average girth measurements of girls four basic measurement were taken: Shoulder, Bust, Waist and Hip. The technique used for measuring the above mentioned body girth sizes were followed by Metric pattern system. Equipments used for taking the measurements were MINIMETER by CMS London for height, EKS digital weighing machine for weight and measuring tape for taking the shoulder, bust, waist and hip measurements. Height in inches and weight in kilograms were taken in order to calculate their BMI, Height was converted into meter square and BMI was calculated dividing height by weight. In next step four levels of BMI were made by using BMI interpretation followed by Lancet (Relationship of BMI among Asian population, public health) and a new variable of BMI categories was formed having four levels (Small, Medium, Large and Extra-Large). Each girth measurement of girls was estimated by using BMI categories as a factor for estimation for average sizes of Small, Medium, Large and Extra-Large.

In order to develop pattern sizes of shirts, above estimated average sizes of girth were converted into pattern sizes by using standard formulas followed by Erwin,D.M (1967) For converting average girth sizes into pattern sizes of shirt, ½ inch was added into shoulder, Bust and Hip was divided by 2 and 1 inch was added, Waist was divided by 2 and ½ inch was added.

The nature of the study was also survey type as the second part of the study comprised upon checking whether the average measurements of readymade shirts of corresponding sizes in small, medium, large and extra large are appropriate for 16-22 year old girls having various BMI.

For this purpose shirt sizes of locally available RM garments were measured .The sample size consists of 25 local readymade garment shops, 11 from Tariq road and 14 from Hydri. Local readymade garments in this study define the garments with no specific brand as the style and design of garments were similar in various shops but each shop was selling these garments under their own name labeled. The selected measurements of readymade shirt: (Shoulder measurement, Bust measurement, Waist measurement, and Hip measurement) was measured by using measuring tape in inches. The small, medium, large and extra large sizes of these readymade shirts varies among almost all selected shop, for example small size of shirt in one shop differ with small size of second shop or matches with medium size of another shop. Duo to this variety of sizes, adjustment was done for all the standards in order to recompense the dissimilarity. For this purpose four ranges were developed in each girth measurement on the bases of minimum and maximum value, four categories for each girth measurement (shoulder, bust, waist and hip) were

developed i.e. Small, Medium, Large, and Extra-Large.

After estimation of average girth measurement (Small, Medium, Large and Extra-Large) of girls aged 16-22 years on the bases of four level of BMI, and similarly after developing the four average sizes of readymade shirts, comparison of both sizes (average girth sizes of girls and average readymade shirts sizes) were done in order to check whether the average measurements of readymade shirts of corresponding sizes are appropriate for 16-22 year old girls having various BMI.

For analysis body measurements were entered on SPSS 17. Few readings were shifted to Microsoft Excel 2007 for conversion of units and formula calculation. Height was converted into meter square for the purpose of BMI calculation. These formulated variables were again exported to SPSS where cut offs were defined for BMI.

Association between BMI and the body sizes of girls (shoulder, bust, waist, hip) were analyzed by using Pearson Chi square (P value < 0.05).

Then Mean of selected shirt measurements were taken out on the basis of BMI, and then these sizes were converted in to pattern sizes by using the formulas.

Recoding of the locally available shirt sizes was done on the bases of ranges developed for small, medium, large and extra large sizes.

The standard shirt sizes by BMI for each measurement (shoulder, bust, waist, hip) was compared with local RMG size.

RESULTS:

Analysis of association between BMI and the body sizes of girls age 16-21 years (small, medium, large, extra Large). According to the selected study the mean sizes of shirt for girls aged between 16-21 years were planned to establish on the basis of girl's BMI. However before establishing these standard sizes it was necessary and important to find out whether BMI is an appropriate factor in determining the standard shirt sizes. For this purpose association through chi square was analyzed between BMI of girls and their actual body sizes for shoulder, bust, waist and Hip (P value < 0.05). Results are shown in Table number 1. The results clearly indicate that the actual sizes of shoulder, bust, waist and hip of the girls were significantly associated with their BMI (P value 0.000). Estimation of average sizes of shirts (Small, Medium, Large and Extra large) for female on the basis of their four level of BMI.

Averge sizes of shirts (small, medium, large and EX-L were determined on the basis of BMI. Sizes are given in Table Number 2. These sizes include shoulder, bust, waist and hip. The shoulder sizes indicates that the shoulder in small and medium size have minor variation 0.44 inch only, similarly sizes variation between large and extra large is 0.06 inch. However size of small shoulder has a difference of 1.28, 1.22 inch with large and extra large shoulder respectively. All sizes of bust have an approximate difference of 3 inch with each other which shows notable difference among all sizes. All waist sizes shows difference of 2 inch with each other (small, medium, large and EX-L), which is a considerable difference in all sizes. Among all sizes of hip, a variation of 4 inch has been observed, which indicates the persistent change among all sizes of hip for female apparel shirt

Mean differences of BMI based sizes in bust measurement (3"), waist measurement (3"), hip measurement (4") and shoulder measurement (0.4"-1.6") has been identified. It means according to set standards, bust and waist measurement exceeds 1", hip size exceeds 2"and no measurement of shoulder is given as standard.. (Table number 3.)

The standard mean sizes of shirt developed on the basis of BMI, were converted into pattern sizes by using formula. Extra amount of ease was added for the pattern sizes in order to achieve accurate fit and comfort to the wearer. As shown in table number 4.

The results clearly indicates (Table Number 5) that the available readymade shirt sizes of

female are not appropriate according to the actual body sizes of the girls, age between 16-21 years. The average readymade shirt sizes are larger than the average girth sizes of girls, for shoulder sizes are larger with the standard BMI sizes from 0.86-2.80 inch, for Bust 6.74-9.47 inch, for waist 7.29-10.68 inch and for hip 7.45-8.7 inch. This shows that the readymade shirt sizes are much larger than the average girth sizes of the girls age between 16-21 years with various BMI.

Table No 1: Association between BMI and the sizes of shoulder, bust, waist, hip of girls age between 16-21 years. (N=530)

SN	SHOULDER SIZES	BMI Categories								Total		P-Value
		Small		Medium		Large		EX-L				
		f	%	*f*	%	*f*	%	*f*	%	*f*	%	
1	Small	105	59.3	114	42.1	10	14.9	1	6.7	230	43.4	0.000
2	Medium	54	30.5	107	39.5	21	31.3	7	46.7	189	35.7	
3	Large	17	9.6	43	15.9	27	40.3	5	33.3	92	17.4	
4	EX-L	1	0.6	7	2.6	9	13.4	2	13.3	19	3.6	
	Total	177	100%	271	100%	67	100%	15	100%	530	100%	
	BUST SIZES											
1	Small	129	72.9	55	20.3	2	3.0	0	0.0	230	35.1	0.000
2	Medium	45	25.4	178	65.7	15	22.4	1	6.7	189	45.1	
3	Large	1	0.6	27	10.0	25	37.3	1	6.7	92	10.2	
4	EX-L	2	1.1	11	4.1	25	37.3	13	86.7	19	9.6	
	Total	177	100%	271	100%	67	100%	15	100%	530	100%	
	WAIST SIZES											
1	Small	125	70.6	66	24.4	3	4.5	0	0.0	194	36.6	0.000
2	Medium	40	22.6	123	45.4	8	11.9	2	13.3	173	32.6	
3	Large	7	4.0	65	24.0	27	40.3	1	6.7	100	18.9	
4	EX-L	5	2.8	17	6.3	29	43.3	12	80.0	63	11.9	
	Total	177	100%	271	100%	67	100%	15	100%	530	100%	
	HIP SIZES											
1	Small	136	76.8	69	25.5	3	4,5	0	0.0	208	39.2	0.000
2	Medium	39	22.0	156	57.6	12	17.9	1	6.7	208	39.2	
3	Large	2	1.1	43	15.9	39	58.2	2	13.3	86	16.2	
4	EX-L	0	0.0	3	1.1	13	19.4	12	80.0	28	5.3	
	Total	177	100%	271	100%	67	100%	15	100%	530	100%	

Table No 2. BMI based standard sizes of shoulder, bust, waist and hip for girls				
S/N	Shoulder Sizes	N	Mean	Std. Deviation
1	Small	177	14.38	1.26
2	Medium	271	14.82	0.84
3	Large	67	15.66	0.98
4	EX-L	15	15.60	0.98
	Total	530	14.83	0.94
	Bust Sizes			
1	Small	177	30.06	2.46
2	Medium	271	33.01	2.32
3	Large	67	36.85	2.80
4	EX-L	15	39.33	2.63
	Total	530	32.69	3.42
	Waist Sizes			
1	Small	177	25.67	2.56
2	Medium	271	28.38	2.48
3	Large	67	31.98	2.99
4	EX-L	15	34.76	3.80
	Total	530	28.11	3.46
	Hip Sizes			
1	Small	177	33.99	2.16
2	Medium	271	37.10	2.60
3	Large	67	41.20	3.23
4	EX-L	15	45.06	3.36
	Total	530	36.80	3.70

Table No 3 Differences of Small, Medium, Large and Extra Large sizes with Set standards.				
BMI based sizes	**Shoulder**	**Bust**	**Waist**	**Hip**
	Mean	**Mean**	**Mean**	**Mean**
Small (N=177)	**14.38**	**30.06**	**25.67**	**33.99**
Medium (N=271)	**14.82**	**33.01**	**28.38**	**37.10**
Large (N=67)	**15.66**	**36.85**	**31.98**	**41.20**
EXL (N=15)	**15.60**	**39.33**	**34.76**	**45.06**
Differences of sizes	**S/M=0.4”,L/EXL =1.6”**	**3”**	**3”**	**4”**
Standard difference = Minimum 2 inch difference for bust and hip, and 1-2 inch difference in waist followed by Mabel B Ervin. (Note: No difference for shoulder was available.)				

Table No 4 Pattern sizes of shirts developed on the basis of established standard sizes on the basis of BMI					
S/N	Sizes	Shoulder	Bust	Waist	Hip
1	Small	14.88	16.03	13.33	17.99
2	Medium	15.32	17.50	14.69	19.55
3	Large	16.16	19.42	16.49	21.6
4	Extra Large	16.10	20.66	17.88	23.53

Table No 5 Differences between BMI based standard sizes and Locally available readymade shirt sizes of girls age 16-22 years.				
Sn	Sizes	RM shirt average sizes	BMI based average sizes of shirt	Difference in size (inch)
1	**SHOULDER**			
1.1	Small	15.24	14.38	0.86
1.2	Medium	16.28	14.82	1.46
1.3	Large	17.32	15.66	1.66
1.4	Ex-Large	18.40	15.60	2.80
2	**BUST**			
2.1	Small	36.80	30.06	6.74
2.2	Medium	40.80	33.01	7.79
2.3	Large	44.16	36.85	7.31
2.4	Ex-Large	48.80	39.33	9.47
3	**WAIST**			
3.1	Small	32.96	25.67	7.29
3.2	Medium	36.80	28.38	8.42
3.3	Large	40.80	31.98	8.82
3.4	Ex-Large	45.44	34.76	10.68
4	**HIP**			
4.1	Small	41.44	33.99	7.45
4.2	Medium	45.44	37.10	8.34
4.3	Large	49.28	41.20	8.08
4.4	Ex-Large	53.76	45.06	8.7

DISCUSSION .

Women vary in figure dimensions and sizes, body proportions and posture resulting in a huge number of sizes, to be adjusted. These variations of figure dimensions have a significant association with the fit of apparel. The figure measurements, shapes and sizes vary within a target population, therefore it necessary for every country and region, to develop their own sizing patterns. The sizing standards play an important role in the ready-made apparel business and give guidelines for manufacturers and consumers. The focus of Standardized sizing is to provide garments which may fit a majority of consumers. Almost all manufacturers use standard sizing methods as a guide to create size, labeling and grading for all sizes of garments

National Institute of Standard and Technology (NIST), American Society Material (ASTM), and International Standard Organization (ISO) all have set standard sizes for consumers. However, these standards are not applicable to Asian women especially to Pakistani women's sizes.

Fit perceptions from the researcher's viewpoint has been examined to find practical ways to improve physical fit (Ashdown &Loker, 2006; Ashdown & Loker,2010; Beazley, 1999; LaBat& DeLong, 1990). However, many studies have been published to date that investigate and provide standard sizes for garments for both male and female consumers (i.e., fit preference and concerns with fit and size of garments). Furthermore, many researchers have focused mostly on women's body size (e.g.,petite, tall, plus-sized) (Jones & Giddings, 2009), and specific garment categories (e.g.,pants, jacket, blouse) (Huck et al., 1997). But no studies conducted in Pakistan for young male and female consumer's garment sizes.

The aim of the selected study was to investigate whether locally available

readymade shirt sizes of female are appropriate for girls with age 16-22 years having various BMI level. The results of the selected study show significant association between BMI and girth measurements, results clearly indicate that the locally available shirt sizes for female are not appropriate in fit for the girls aged between 16-21 years. As the average readymade shirt sizes are much larger than the estimated BMI based shirt sizes, especially in case of extra large size, hence the available sizes of local ready-made garments needs revisions and accuracy in order to obtain good fit as well as to provide satisfaction to the targeted consumers.

On the bases of the study it is recommended to conduct such research on larger bases. A large sample size representing all the population within city and within country can be taken and the if the sizes developed on the basis of the measurements taken of the large sample, will be applicable on overall Pakistani female population and the developed sizes will provide, accuracy in fitting and good level of satisfaction to the apparel dress manufacturers as well as consumers.

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