Sohn and Kim *Fashion and Textiles* (2026) 13:8
https://doi.org/10.1186/s40691-026-00456-z

Fashion and Textiles

RESEARCH **Open Access**

Body shape and bust variations by ethnicity and BMI using SizeUSA data

MyungHee Sohn[1] and Dong-Eun Kim[2*]

*Correspondence:
dekim@ewha.ac.kr

[1] Fashion Merchandising and Design, Department of Family and Consumer Sciences, California State University, Long Beach, CA, USA
[2] Department of Fashion Industry, Ewha Womans University, #402-3, Human Ecology Building (Morris Hall), 52, Ewhayeodae-gil, Seodaemun-gu, Seoul 03760, South Korea

Abstract
This study examines variations in body shape and bust-related measurements, focusing on bust, waist, and hip dimensions while also considering the influence of BMI and ethnicity. Employing a quantitative approach, it analyzes anthropometric data of 2,750 women aged 26–45 from the SizeUSA database. The sample includes the following ethnicities: White, Black, Asian, non-Mexican Hispanic, and Mexican Hispanic. Variations in body measurements, BMI, and bra cup sizes across these groups are statistically analyzed using analysis of variance, cluster analysis, and chi-square tests. Body shape analysis reveals three shape clusters; Triangle shape (larger hips compared to upper body with moderate bra cup size), Rectangle shape (smaller waist–hip differences with a moderate cup size), and Inverted Triangle shape (larger upper body compared to hips with a large cup size). Each ethnic group exhibited distinct body shape patterns as follows: The Triangle group comprised a higher percentage of Black and White populations. The Rectangle group comprised a predominantly Asian population, while the Mexican Hispanics and non-Mexican Hispanics dominated the Inverted Triangle group. This study highlights trends in bra cup sizes across weight categories and suggests potential correlations between the former and body shape types. It contributes insights into the relationships among ethnicity, BMI, and bust-related measurements; identifies specific body shape clusters and bra size distributions; and offers valuable information in designing inclusive and well-fitted foundation garments for a diverse population.

Keywords: Body shape, Ethnicity, BMI, Bra cup size, Foundation garment, Inclusive apparel, Anthropometric data

Introduction
Leading fashion retailers increasingly recognize the importance of size inclusivity in appealing to diverse consumers (Naidu et al., 2025). For instance, Lululemon (Lanoue, n.d.) provides an "Asian fit" for a narrower waistbands and low crotch Fenty by Rihanna features the Savage X Fenty lingerie line, which offers an extensive size range from extra small (XS) to triple extra-large (3X) to suit a diverse range of body types (Vogue, 2018). Likewise, ThirdLove, a lingerie brand, adopts a personalized sizing strategy featuring half-cup sizes and inclusive alternatives with band and bra cup sizes ranging 30–48 and A–I, respectively (Thirdlove, 2023). In plus-size fashion, Torrid (n.d.) covers sizes ranging 10–30, accommodating standard and curvy fits across multiple categories. Stitch Fix

(n.d.) recommends how to style clothing according to the consumer's body shape. The industry's recognition of size inclusivity and body shape differences aligns with studies emphasizing the importance of understanding body shapes across ethnicities for addressing fit issues. However, fit challenges persist in the broader fashion landscape, stemming from issues such as non-standardized sizing, vanity sizing, and insufficient consideration for the diversity of body shapes (Gribbin, 2014; Reid et al., 2020). Previous studies have shown that body shape varies significantly across ethnic groups, affecting garment fit and sizing accuracy. For example, Makhanya et al. (2014) identified unique body proportion characteristics in African populations, and Shin and Istook (2007) emphasized the need for ethnicity-specific pattern development using 3D body scan data. These findings support the importance of considering body shape diversity in sizing systems.

Form-fitting garments, including foundation and women's formal dress wear, require a careful consideration of the wearer's overall body shape and bra cup sizes to ensure optimal fit. Foundation garments, such as bras, shapewear, and corsets, may be worn under outer clothes but play a key role in daily comfort and appearance. A well-fitted foundation garment not only improves appearance but also enhances confidence, comfort, and health (Chen et al., 2011). Nevertheless, numerous women wear the wrong bra size; in a survey of 1,500 women in the United States (U.S.), over 65% reported discomfort, including problems related to the back band, straps, and poor support (Nethero, 2010).

Understanding and examining body shapes across diverse ethnicities and body sizes, including obese individuals, is becoming increasingly essential. Body Mass Index (BMI) crucially contributes to apparel implications, particularly for overweight and obese women in the US. Shin and Saeidi (2022) identified five distinct body shape categories—namely, Rectangle-curvy, Parallelogram-moderately curvy, Parallelogram-hip tilt, Inverted trapezoid-moderately curvy, and Inverted trapezoid-hip tilt—among overweight and obese females, highlighting significant differences from the general female population. Further, BMI's influence on breast characteristics and volumes underscores the multifaceted nature of body shape considerations (Brown et al., 2012; Coltman et al., 2017). Several studies (Chrimes et al., 2023) have examined women's body shape classifications concerning apparel fit issues and explored ethnic differences (Makhanya et al., 2014). However, research on women's body shape classification that considers bra sizes is limited. Thus, this study investigates variations in women's body shapes and bust-related measurements, focusing on diverse ethnicities and BMI categories. This study contributes valuable insights to inform the design and production of inclusive and well-fitted foundation garments for a broad spectrum of consumers. This study used SizeUSA data from 2750 U.S. women aged 26–45, representing diverse ethnic backgrounds, to analyze body shape variations using 12 measurements and four derived drop values.

Literature Review

Historical and industry context of apparel sizing system

Modern apparel sizing systems began in the early twentieth century to support standardization and mass-production. These systems were often developed using limited anthropometric data that was collected from a narrow segment of the population, mainly white male military recruits. As a result, early sizing standards failed to account for the diversity of body shapes across gender, ethnicity, and body size. (Ashdown, 2007; LaBat & DeLong, 1990). The ASTM sizing system, which is widely used in the U.S. apparel industry, has been criticized for its limited inclusiveness and failure to represent the actual body shapes of contemporary populations (Ashdown, 2007; Christe & Dunn, 2017).

Over the past two decades, the advancement in three-dimensional body scanning systems has significantly accelerated interest in collecting more detailed body data. Major national sizing surveys such as SizeUK, SizeUSA, SizeGermany, SizeJapan, SizeChina, and SizeKorea have adopted 3D scanning technologies to gather more accurate and comprehensive anthropometric data for the apparel industry. Studies show that 3D scans can help design garments that better fit contemporary populations and meet consumer demands more effectively than traditional one-dimensional sizing systems (Ashdown, 2007; Bougourd, 2015; Petrova & Ashdown, 2008; Shariff et al., 2022; Sohn & Bye, 2012). For example, Sohn and Bye (2012) emphasized that 3D scanning allows for improved fit through detailed analysis of various body shapes, including pregnant bodies for maternity wear, while Bougourd (2015) highlighted its application for aging populations. Zakaria and Gupta (2019) also pointed out that global studies utilizing 3D scans such as SizeUK, SizeGermany, capture ethnic and gender diversity more effectively, which informs more inclusive size charts.

Similarly, Song and Ashdown (2015) found that 3D scan research to promote greater inclusivity but are still primarily applied in premium and custom apparel sectors. Building on these findings, recent targeted 3D scan research is now developing specialized sizing systems for particular garment types, which may facilitate broader adoption in both custom and inclusive fashion. As these research efforts continue, the scientific understanding of body diversity expands to grow, and it reveals significant morphological variations overlooked by traditional sizing models.

Ethnic diversity and body shape variations

Previous research has demonstrated the association between body shapes and ethnicities and highlighted the importance of understanding diverse body shapes across ethnic groups to effectively fulfill the needs of diverse markets. Studies have compared body shapes across diverse ethnicities and various countries. Makhanya et al. (2014) utilized a three-dimensional (3D) full-body scanner on women aged 18–25 years old (109 African and 125 Caucasian women) to identify three predominant body shapes—namely, the triangle, hourglass, and rectangle; they classified body shape using key circumferential drop values as follows: The difference between hip and bust circumferences was used to classify the triangle body shape, while the bust and waist relationship was used to classify the hourglass and rectangle body shapes. They observed notable variations in body measurements and ratios, particularly between African and Caucasian triangle shapes, which differed from the commonly utilized Caucasian hourglass in the apparel industry. Lee et al. (2007) employed SizeUSA and SizeKorea data, analyzed measurements using the Female Figure Identification Technique (FFIT), and found that U.S. and Korean women have different body shapes; specifically, both groups typically have a “rectangle” shape, but U.S. women generally exhibit larger waist and hip measurements than Korean women.

Moreover, considering multiple other factors, such as socioeconomic and ethnic factors, is important to understand body morphology across diverse populations. Wells et al. (2008) investigated body shape variations across ethnic groups using SizeUSA and SizeUK data; they analyzed 10,374 participants (White British, White American, African American, and Hispanic American adults) using 3D body scans to measure weight, height, and body circumferences and, thereafter, categorized them by BMI. Key measurements included weight; height; and waist, bust, and thigh girth. The study showed that white Americans generally had larger body weight and waist measurements than white British adults. Among Americans, African Americans tended to have smaller waists but larger thighs, while Hispanic Americans had larger waists. These findings demonstrate that body shape can vary considerably among individuals of the same ethnic background depending on socioeconomic and cultural context, and that body morphology also differs across ethnic groups living within similar cultural settings. Thus, the results provide quantitative evidence of significant morphological differences based on socioeconomic factors, as well as ethnicity.

Body shape classification for inclusive fashion and current limitation

Body shape research has expanded to include diverse groups, including plus-size women and various ethnicities. A widely used classification method for categorizing women's body shapes is the FFIT—developed by Simmons et al. (2004). The FFIT classifies female body shapes into nine categories (namely, hourglass, rectangle, oval, triangle, spoon, diamond, bottom hourglass, top hourglass, and inverted triangle) based on numerical ratios of bust, waist, high hip, abdomen, and hip measurements. However, the FFIT and similar torso-centered methods have been shown to misclassify plus-size bodies. Parker et al. (2021) observed that the FFIT frequently misclassifies bodies, especially plus-size figures, because it overlooks key measurements (e.g., shoulder), resulting in limited applicability to diverse body types. Sokolowski and Bettencourt (2020) refined the FFIT formulas for plus-size women by conducting visual inspections of 3D body scans to detect misclassified plus-size figures with larger abdomens. Their modified formulas reinstated shape categories such as Oval and Diamond to better represent cases where the waist measurement exceeds the hip measurement, and revised the criteria for Triangle and Rectangle shapes to more accurately account for variations in bust, waist, and hip proportions. This qualitative assessment enhanced the accuracy of body shape classification for plus-sized women.

Furthermore, research on specific demographics (e.g., Indian plus-size women; Kumari & Anand, 2023) has highlighted unique fit challenges within these groups and reported that well-fitting sizes and trendy options complementing the curvy figure are lacking. Gupta and Roy (2024) outlined the specific challenges pertaining to lingerie for plus-size women—particularly concerning bras and bust-related fit; they found that numerous plus-size women struggle to find supportive, stylish lingerie with inclusive size ranges. Likewise, Shin and Saeidi (2022) noted that overweight and obese women in the U.S. frequently experience frustration when clothing sizes do not reflect real-world body shapes, particularly in the ASTM sizing system.

BMI represents an additional factor in body shape studies. Studies on body shape that focus on the plus-size classification assess overweight or obese women using BMI. The association between BMI and health outcomes varies significantly across diverse ethnic groups, and BMI alone may be an inaccurate indicator of health status, particularly when comparing ethnicities (Heymsfield et al., 2016). Pray and Riskin (2023) noted that BMI does not provide a direct measure of body fat, muscle mass, or fat distribution across the body. This limitation is crucial because body fat percentage at the same BMI differs between ethnic groups (Deurenberg et al., 1998). Despite these limitations, BMI is a critical factor in population-level research. Although it may not accurately indicate health status across ethnicities (Heymsfield et al., 2016), it provides a standardized metric for identifying weight distribution patterns among ethnic groups. This study employed BMI as a measure to examine the complex relationships among body shape, weight, and ethnicity, acknowledging that these associations vary significantly (Deurenberg et al., 1998).

Research gaps and justification

Although research has explored the relationship between diverse body shapes and ethnicities, gaps still exist in the comprehensive analysis of how BMI, bust-related measurements, and ethnicity interact across diverse populations. Previous studies have frequently examined specific ethnic groups and less varied datasets.

Existing body shape classifications, including the FFIT, predominantly examine the torso and hip areas. Li and Mitchell (2023) identified nine distinct female torso shapes through a principal component analysis of anthropometric measurements and 3D body scans. Cai et al. (2021) automated body-type identification using 3D scans and photos focusing on waist–abdomen–hip morphology. Alexander et al. (2012) observed significant variations in women's hip measurements across plus-size categories. However, few studies have assessed the relationship between bust-related measurements and female body shape classification. Zhang et al. (2022) classified breast shapes into nine categories based on detailed morphological parameters. Likewise, Pei et al. (2019) and Song et al., (2022b) emphasized the need for precise breast shape data to enhance sizing systems for improved fit and comfort. Klepser et al. (2018) highlighted the difficulty in quantifying how foundation garments and body shape tools accurately represent real-world bodies, particularly for plus-size individuals, underscoring the need for additional research to bridge these gaps. Importantly, research considering bust shape and bust-related measurements and their relationship to body shape remains limited.

This study aligns with the fashion industry's transitions toward inclusive fashion accommodating a wide range of body types (Hudson & Hwang, 2022; Shin & Saeidi, 2022). Previous studies have reported how ethnic and socioeconomic factors influence body shape, with differences in measurements and proportions between ethnic groups, such as the triangle, hourglass, and rectangle shapes observed in African and Caucasian women (Makhanya et al., 2014); these findings emphasize the importance various factors, including ethnicities, measurements, and proportion, in body shape classification systems. Specifically, bust-related measurements must be considered for female body shape classification; however, previous studies have generally neglected these measurements.

This study aimed to provide an enhanced understanding of body shape variations across diverse populations. Particularly, this study investigated body shapes, considering bust-related measurements, bra cup size, and BMI across diverse ethnicities. Further, this study investigated clustering approaches to effectively capture the relationships among bust-related measurements, bra cup size, BMI, and ethnicity.

Research purpose and questions

This study examined variations in body shape and bust-related measurements, focusing on bust, waist, and hip dimensions while also considering the influence of BMI and ethnicity. Its specific research questions are as follows:

Research Question 1: How do BMI and bust-related measurements vary across diverse ethnic groups?

1. How do BMI categories differ across diverse ethnic groups?
2. How do bust-related measurements vary across diverse ethnic groups?

Research Question 2: What are the relationships among BMI, ethnicity, and body shape?

1. How does body shape vary across diverse ethnic groups concerning differences in bust, waist, and hip girth?
2. How do body shape categories differ across diverse ethnic groups?

Research Question 3: What are the relationships among BMI, ethnicity, and bra cup sizes?

1. How do bra cup sizes vary according to ethnic groups and BMI categories?
2. How do bra cup sizes vary according to ethnic groups and body shapes?

Methods

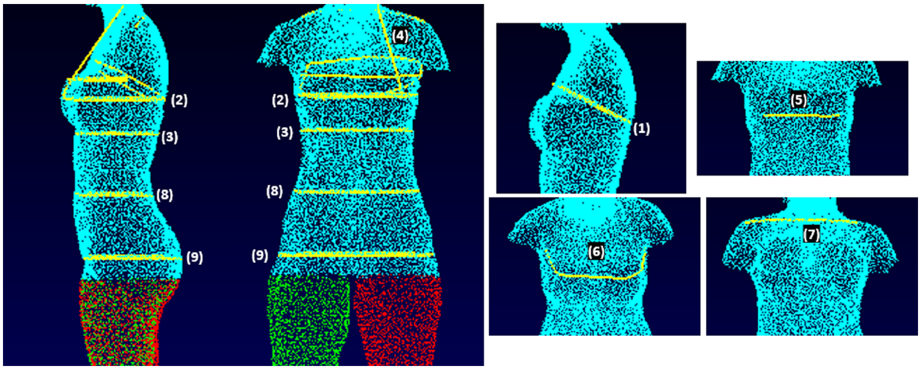
Sample and measurement items

This study employed a quantitative approach to analyze anthropometric data from SizeUSA, a nationwide anthropometric dataset in the U.S. (TC^2, n.d.). SizeUSA study has 6 age groups (18–25, 26–35, 36–45, 46–55, 56–65, 66+) among which, the age range of 26–45 was selected to focus on a younger adult population in the current study. From mid-age, aging-related body and posture changes, particularly in the upper body, become more pronounced (Song et al., 2022a). Therefore, women aged 46 and above were excluded to maintain a sample aligned with the objectives of this study.

Total number of women aged 26–45 were 2750 women with diverse ethnic background. Specifically, the sample comprised 1400 non-Hispanic White, 617 non-Hispanic Black, 275 Asian, 235 non-Mexican Hispanic, and 223 Mexican Hispanic individuals. The SizeUSA dataset reports ethnicity using predefined survey categories selected by participants. The data analysis used 12 measurement items from SizeUSA data. Additionally, we computed four drop values (Table 1). Twelve body measurement items were specifically selected for their relevance in analyzing bra fitting and body shape. Measurement items were theory- and practice-driven, selected for relevance to bra fit and torso shape. Bra cup sizes were calculated using Bust Girth and Underbust Girth—a standard industry practice (Chen et al., 2011). Chest Girth was incorporated to provide context

Table 1 Measurement items

Direct SizeUSA measurements
(1) Chest Girth, (2) Bust Girth, (3) Underbust Girth, (4) Side Neck to Bust, (5) Bust to Bust, (6) Chest Arc Width, (7) Back Shoulder Width (contoured), (8) Waist Girth, (9) Hip Girth, Height, Weight, BMI



Derived measurements	Definition
Bust-underbust drop value (Bra Cup)	Bust girth-underbust girth
Bust-waist drop value	Bust girth-waist girth
Hip-waist drop value	Hip girth-waist girth
Hip-bust drop value	Hip girth-bust girth

for the upper bust. Side Neck to Bust and Bust to Bust measurements were employed for determining the bust shape, in conjunction with Bust Girth and Underbust Girth, to ensure a precise fit in the bust area. Similar measurements items were selected in other studies developing bra or studying bust shape categories (Zhang et al., 2022). Measurements such as Chest Arc Width, Bust Girth, Waist Girth, Hip Girth, Height, and Weight were selected to assess overall body size and shape. These measurements are the main measurements commonly selected in research studying overall body shape categorizations and industry practice (Simmons et al., 2004; Sokolowski & Bettencourt, 2020).

Further, BMI was used to explore its impact on bust measurements and body proportions across diverse ethnic groups. As BMI alone has some limitations as noted in the literature review, we further analyzed bust–underbust difference and other drop values alongside BMI to interpret the body shape categorization.

Due to missing values in some variables, the analytic sample size varies slightly across tables (e.g., N = 2750 for BMI categories, N = 2749 for cluster analysis, and N = 2748–2747 for bra cup analyses).

Data analyses

To address the research questions, statistical analysis was performed through relevant quantitative techniques using SPSS Statistic. Descriptive statistics was employed to characterize the dataset and summarize key measurements. Inferential statistics—including analysis of variance (ANOVA), cluster analysis, and chi-square analysis—assessed relationships and variations within the data. Specifically, ANOVA examined variations in measurements across diverse ethnic groups; that is, body measurements, such as weight, BMI, height, and bra cup sizes among White, Black, Asian, non-Mexican Hispanic, and Mexican Hispanic populations. Further, cluster analysis categorized body shape

Table 2 Relationship between ethnic groups and BMI category n(%)

	White	Black	Asian	Non-Mexican Hispanic	Mexican Hispanic	Total
Underweight	44 (3.1)	6 (1.0)	19 (6.9)	1 (0.4)	3 (1.3)	73 (2.7)
Healthy weight	**684 (48.9)**	142 (23.0)	**179 (65.1)**	72 (30.6)	57 (25.6)	1134 (41.2)
Overweight	360 (25.7)	171 (27.7)	58 (21.1)	**99 (42.1)**	**88 (39.5)**	776 (28.2)
Obese	312 (22.3)	**298 (48.3)**	19 (6.9)	63 (26.8)	75 (33.6)	767 (27.9)
	1400(100)	617 (100)	275 (100)	235 (100)	223 (100)	2750 (100)

$\chi^2 = 347.720^{***}$, $df = 12$. Bold indicates a high percentage

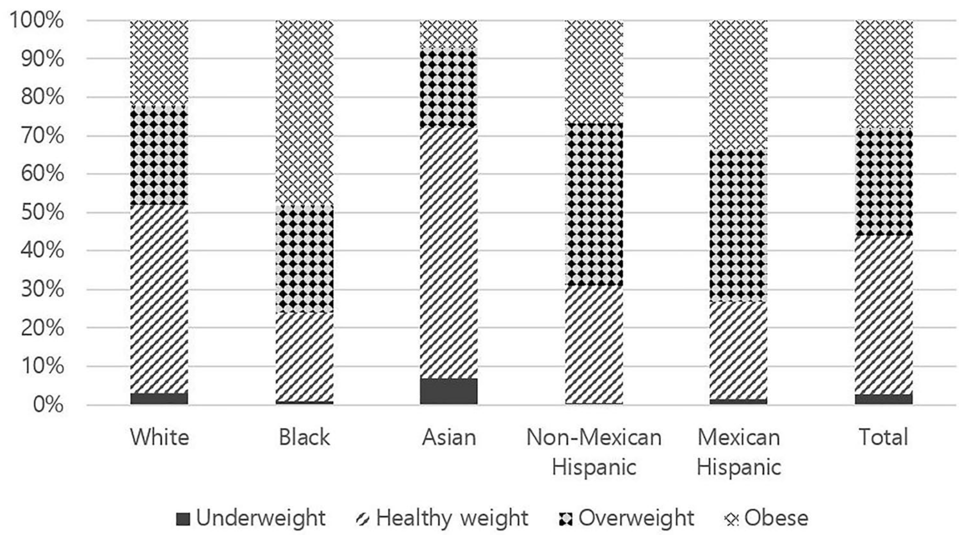


Fig. 1 Percentage distribution of BMI categories by ethnic group

types according to hip–waist drop, bust–waist drop, and hip–bust drop values. Chi-square analysis investigated the relationship between ethnic groups and bra cup sizes and the distribution of bra cup sizes across diverse ethnic groups to identify significant associations.

Results and Discussion

Research question 1: how do BMI and bust-related measurements vary across diverse ethnic groups?

Ethnic groups and BMI category

In the context of ethnic disparities in BMI categories, the ethnic groups exhibited notable variations (Table 2; Figs. 1). Notably, this study's utilization of BMI primarily focused on examining the relationship between body shape and ethnicity rather than a direct measure of health.

Among White women, the percentage in the healthy weight category (48.9%) is nearly equal to the combined percentage in the "overweight" (25.7%) and "obese" (22.3%) categories. Among Black women, most were either obese (48.3%) or overweight (27.7%), with 23.0% exhibiting a healthy weight range. Among Asian women, most exhibited a healthy weight range (65.1%), but a significant proportion was overweight (21.1%).

Non-Mexican Hispanic individuals exhibited a weight distribution wherein most (42.1%) were overweight, followed by those exhibiting a healthy weight range (30.6%). Concerning Mexican Hispanic women, most were either overweight (39.5%) or obese (33.6%). Asian women had the highest underweight proportion (6.9%) while the healthy weight range group predominantly comprised Asian (65.1%) and White (48.9%) women. The overweight range exhibited a more balanced distribution across ethnic groups, with non-Mexican Hispanic individuals exhibiting the highest percentage (42.1%). The obese range primarily comprised Black (48.3%) and Mexican Hispanic (33.6%) participants.

Ethnic groups and bust-related measurements

The ANOVA results (Table 3, Figs. 2 & 3) indicated that all measurement items exhibited significant differences among the ethnic groups. For most bust-related and anthropometric measurements, Black women exhibited the largest measurements, followed by Mexican Hispanics, non-Mexican Hispanics, Whites, and Asians. Post-hoc tests revealed that Mexican Hispanic women measured similarly to Black women, while non-Mexican Hispanic women measured similarly to White women.

Table 3 Relationship between ethnic groups and bust-related measurements Unit: inch

	White *M*(*SD*)	Black *M*(*SD*)	Asian *M*(*SD*)	Non-Mexican Hispanic *M*(*SD*)	Mexican Hispanic *M*(*SD*)	Total *M*(*SD*)	*F*-value
Chest Girth	38.66 (4.37)B	40.62(4.92)A	36.54 (3.06)C	39.24 (3.55)B	40.44 (4.51)A	39.08 (4.50)	52.11***
Bust Girth	40.7 (5.17)C	43.3 (5.97)A	37.52 (3.89)D	41.66 (4.46)BC	42.59 (4.67)AB	41.2 (5.41)	68.4***
Underbust Girth	34.02 (5.16)C	36.83 (6.63)A	31.38 (3.4)D	34.98 (4.56)BC	36.09 (4.53)AB	34.64 (5.52)	61.63***
Side Neck to Bust	11.01 (1.16)B	11.56 (1.46)A	10.4 (0.89)C	10.97 (1.03)B	11.21 (1.1)B	11.09 (1.24)	49.95***
Bust to Bust	8.3 (0.94)B	8.75 (1.07)A	7.61 (0.77)C	8.33 (0.82)B	8.39 (0.85)B	8.34 (0.98)	71.97***
Che-stArcWidth	19.71 (3.02)B	20.98 (3.36)A	18.23 (2.14)C	20.42 (2.74)A	20.99 (2.71)A	20.01 (3.09)	51.49***
BackShoul-derWidth (contoured)	15.57 (1.34)B	15.99(1.42)A	14.98 (1.07)C	15.43 (1.22)B	15.95 (1.29)A	15.62 (1.35)	33.19***
Bust-Under-bust Drop Value (Bra Cup)	6.68 (1.4)A	6.45 (2.00)AB	6.13 (1.31)B	6.69 (1.36)A	6.49 (1.27)AB	6.56 (1.54)	8.81***
Waist Girth	34.72 (5.72)C	37.63 (6.74)A	32.03 (4.05)D	35.51 (4.97)BC	36.6 (5.25)AB	35.33 (5.95)	54.24***
Hip Girth	42.64 (5.39)B	45.32 (6.06)A	38.82 (3.26)C	42.47 (4.59)B	43.01 (4.64)B	42.87 (5.53)	75.43***
Height	64.75 (2.67)A	64.54 (2.84)A	62.54 (2.53)B	62.35 (2.69)B	62.26 (2.52)B	64.08 (2.87)	98.74***
Weight	157.86 (40.69) B	183.62 (48.81) A	130.95 (26.38) C	154.37 (33.23) B	159.47 (35.22) B	160.78 (43.06)	89.58***
BMI	26.47 (6.63)C	30.99 (8.02)A	23.53 (4.34)D	27.92 (5.75)BC	28.92 (5.97)B	27.51 (7.03)	77.91***
Hip-Bust Drop Value	1.93 (2.57)A	2.02 (2.75)A	1.30 (2.10)B	0.80 (2.58)BC	0.43 (2.48)C	1.67 (2.61)	27.73***
Hip-Waist Drop Value	7.91 (2.27)A	7.69 (2.71)A	6.79 (2.04)BC	6.99 (2.20)B	6.41 (2.30)C	7.55 (2.40)	32.67***
Bust-Waist Drop Value	5.98 (1.99)AB	5.68 (2.03)BC	5.48 (1.85)C	6.18 (2.04)A	5.98 (2.11)AB	5.88 (2.01)	6.65***

***$p < .001$, A-D: Scheffee's multiple range test (A > B > C > D)

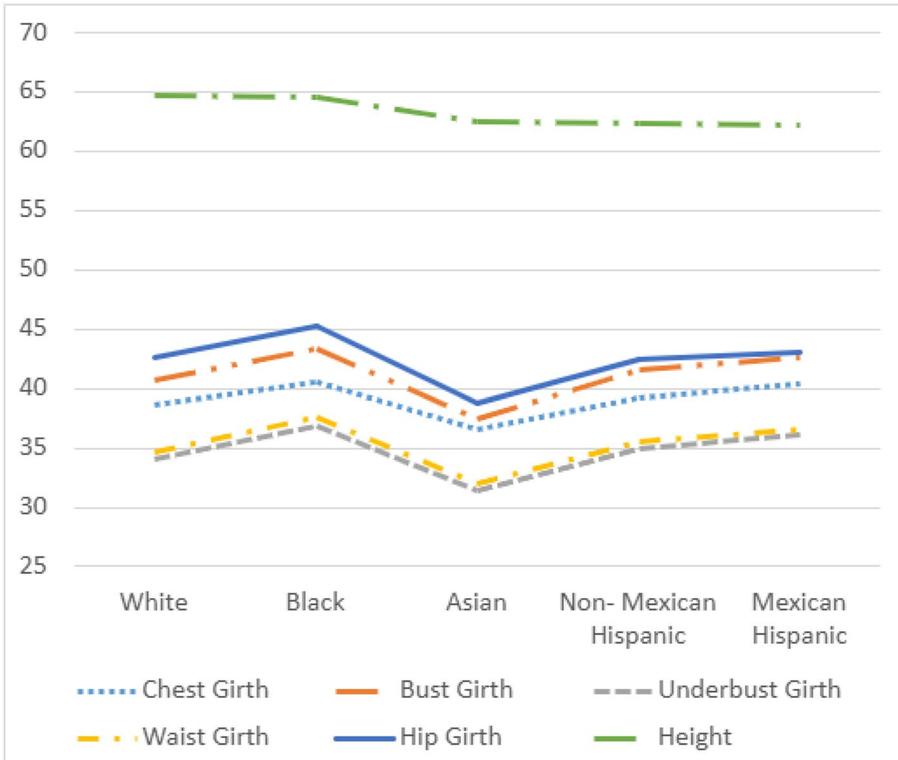


Fig. 2 Relationship between ethnic groups and major body measurements

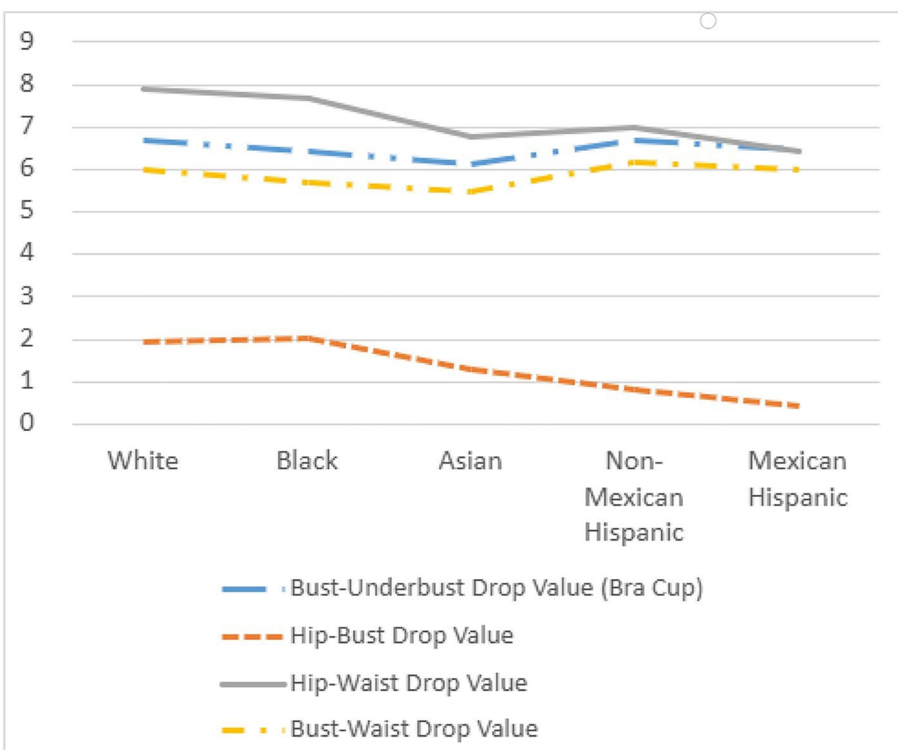


Fig. 3 Relationship between ethnic groups and drop values

Regarding weight, Black women exhibited the largest values, followed by White, Mexican Hispanic, and non-Mexican Hispanic women with similarly intermediate values; the Asian group exhibited the lowest weight. Likewise, for BMI, Black women measured the largest, followed by women in the Mexican Hispanic group. White and non-Mexican Hispanic women were tied in third place, while the Asian group exhibited the smallest BMI. However, height demonstrated a different trend, with Black and White women similarly divided into taller groups, while the Asian, Mexican Hispanic, and non-Mexican Hispanic groups were similarly divided into shorter groups.

Furthermore, the drop value indicated a different trend. Concerning bust–underbust drop value, which serves as the base measurement for calculating bra cup size, the White and non-Mexican Hispanic groups exhibited the largest drop values. The Black and Mexican Hispanic groups exhibited intermediate values, with the Asian groups exhibiting the smallest drop values. For hip girth–bust girth and hip girth–waist girth drop values, the Black and White women groups exhibited the largest values, the Asian and Non-Mexican Hispanic groups had intermediate values, and the Mexican Hispanic group had the smallest values. This finding suggests that Black and White women generally have a larger hip girth than bust and waist girths. In contrast, the smallest drop values in Mexican Hispanic women indicate a fuller upper body with less waist definition.

Regarding the bust girth–waist girth drop value, non-Mexican Hispanics exhibited the largest value, with Mexican Hispanic and White groups exhibiting the second largest value. The Black group exhibited the third largest value, while the Asian group exhibited the smallest value. This result indicates that non-Mexican Hispanics have the most contoured upper body, whereas Asians exhibit the straightest upper body shape among ethnic groups.

To enhance the body shape visualization of the ethnic groups, key measurements—such as Bust Girth, Underbust Girth, Side Neck to Bust, Back Shoulder Width, Waist Girth, Hip Girth, and Height were entered into a 3D avatar using the 3D virtual simulation software, CLO version 2024 (Table 4). This selection was determined considering the software's limitations, which only allow input for specific measurement locations on the avatar.

Although Mexican Hispanic women exhibited relatively high bust girth, their corresponding bra cup sizes were not proportionally larger. This suggests that increased bust circumference in this group may result more from torso width or underbust dimensions rather than breast volume. In contrast, post-hoc results showed that White women had relatively smaller bust girth compared to other groups, yet they exhibited the largest bra cup sizes along with non-Mexican Hispanics. This indicates that both White and non-Mexican women tend to have greater breast volume. These discrepancies highlights the benefit of interpreting body shape in conjunction with bra cup sizes.

Research question 2: what are the relationships among BMI, ethnicity, and body shape?

How does body shape vary across ethnic groups concerning differences in bust, waist, and hip girth?

K-means cluster analysis assessed body shape characteristics using drop values (hip–bust, hip–waist, and bust–waist). The cluster analysis yielded three body shape types (Table 5; Fig. 4). Further, ANOVA determined the shape characteristics (Table 6).

Table 4 Three-dimensional body shape visualization of ethnic groups

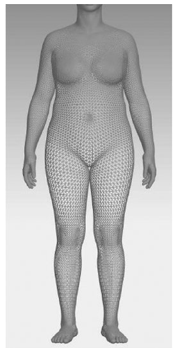
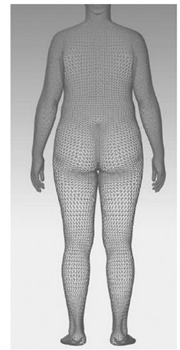
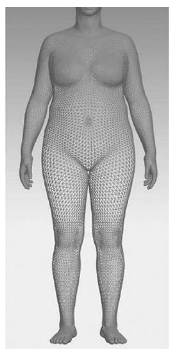
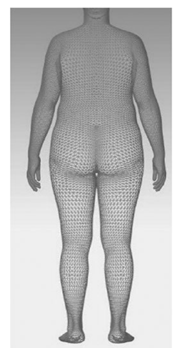
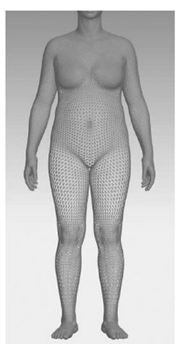
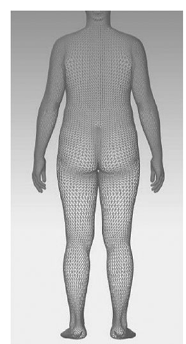
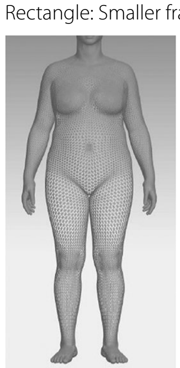
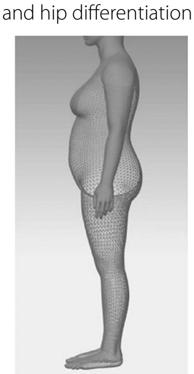
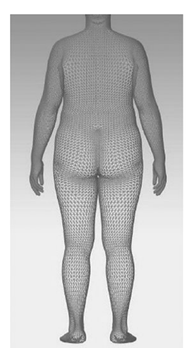
	Front	Side	Back
White			
	Triangle: Fuller bust volume with more pronounced lower-body curves		
Black			
	Triangle: Fuller bust volume with the most pronounced lower-body curves		
Asian			
	Rectangle: Smaller frame with minimal bust and hip differentiation		
Non-Mexican Hispanic			
	Inverted Triangle: Larger upper body with fuller bust volume		

Table 4 (continued)

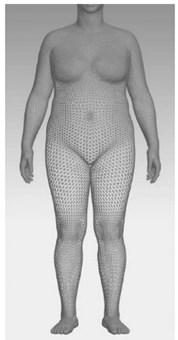
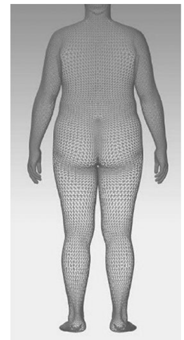
	Front	Side	Back
Mexican Hispanic	 Inverted Triangle: Larger upper body		

Table 5 Body shape categorization

	Cluster 1 (Triangle-Shape) (n = 1,077) *M*(*SD*)	Cluster 2 (Rectangle-Shape) (n = 695) *M*(*SD*)	Cluster 3 (Inverted Triangle-Shape) (n = 977) *M*(*SD*)	Total *M*(*SD*)	*F*-value
Bust Girth-Waist Girth	5.68 (1.61)B	3.94 (1.41)C	7.49 (1.31)A	5.88 (2.01)	1212.640***
Hip Girth-Waist Girth	9.61 (1.51)A	5.41 (1.67)C	6.80 (1.80)B	7.55 (2.40)	1507.224***
Hip Girth-Bust Girth	3.93 (1.73)A	1.48 (1.74)B	− 0.69 (1.59)C	1.67 (2.61)	1932.757***

***$p < .001$, A-C: Scheffee's multiple range test (A > B > C)

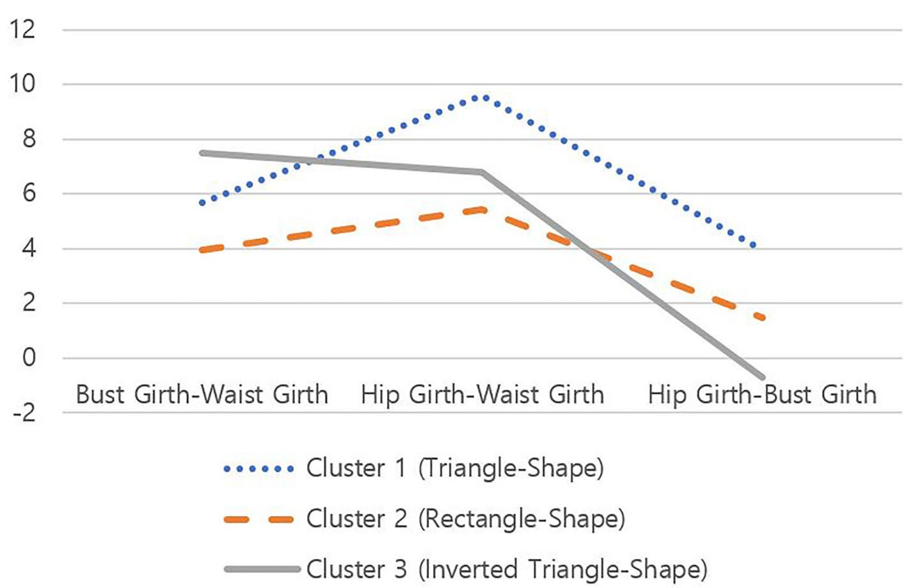


Fig. 4 Body shape categories in relation to drop values

Table 6 Relationship between body shape category and bust-related measurements Unit: inch

	Triangle-Shape (n = 1,077) *M*(*SD*)	Rectangle-Shape (n = 695) *M*(*SD*)	Inverted Triangle-Shape (n = 977) *M*(*SD*)	Total (n = 2,749) *M*(*SD*)	*F*-value
Chest girth	38.32 (4.61)C	40.03 (5.06)A	39.24 (3.74)B	39.08 (4.5)	32.136***
Bust girth	40.05 (5.45)B	42.13 (6.16)A	41.82 (4.48)A	41.21 (5.41)	42.500***
Underbust girth	33.65 (5.52)C	36.17 (6.5)A	34.64 (4.41)B	34.64 (5.52)	45.314***
Side neck to bust	10.94 (1.25)B	11.26 (1.35)A	11.13 (1.11)A	11.09 (1.24)	14.664***
Bust to bust	8.19 (0.99)B	8.41 (1.08)A	8.47 (0.87)A	8.34 (0.98)	24.418***
Chest arcwidth	19.41 (3.07)B	20.43 (3.4)A	20.35 (2.71)A	20.00 (3.07)	34.127***
Back shoulder width (contoured)	15.42 (1.33)C	15.86 (1.47)A	15.67 (1.26)B	15.62 (1.35)	23.486***
Bust-underbust drop value (Bra Cup)	6.38 (1.49)B	5.96 (1.57)C	7.18 (1.35)A	6.56 (1.54)	155.576***
Waist girth	34.37 (5.83)B	38.19 (6.69)A	34.34 (4.73)B	35.33 (5.95)	117.415***
Hip girth	43.98 (5.96)A	43.61 (6.01)A	41.14 (4.07)B	42.88 (5.53)	80.148***
Height	64.63 (2.76)A	63.69 (2.77)B	63.75 (2.97)B	64.08 (2.87)	33.401***
Weight	163.50 (46.24)A	167.28 (48.1)A	153.22 (33.49)B	160.80 (43.06)	25.567***
BMI	27.52 (7.6)B	28.92 (7.76)A	26.51 (5.49)C	27.51 (7.03)	24.290***

****p* < .001, A-C: Scheffee's multiple range test (A > B > C)

Cluster 1 exhibited the largest difference in the measurements between hip and waist girth and between hip and bust girth, while a moderately significant difference was observed between bust and waist girth. This cluster comprised 1,077 individuals. The ANOVA results indicated that Cluster 1 exhibited a significantly large hip girth but significantly smaller bust, underbust, and chest girths than the other groups. Moreover, it had significantly smaller chest arc and back shoulder widths in relation to the upper body width. Regarding the bra cup size, Cluster 1 had a moderate size, with cup size C being the most prevalent (Table 13). Therefore, Cluster 1 was labeled the "Triangle" shape owing to its distinctive feature of larger hips than the upper body with a moderate size bust cup. This body shape is often associated with fit challenges such as tightness around the hip area and looseness in the bust region, as garments are typically designed for more balanced proportions.

Cluster 2 presented the smallest disparities between bust and waist girths and hip and waist girths, exhibiting a relatively small difference between the hip and bust girths. This cluster comprised 695 individuals. The ANOVA results indicated that Cluster 2 had significantly larger chest girth, bust girth, and underbust girth; chest arc width; and back shoulder width than the other clusters. Further, Cluster 2 displayed a noticeably larger waist girth and a moderate bra cup size, with the C cup being the most prevalent (Table 13). Therefore, Cluster 2 was labeled the "Rectangle" shape owing to its distinctive feature of smaller waist differences with a moderate bra cup size. Due to the body's relatively straight proportions, this shape often results in garments appearing less fitted or lacking curvature at the waistline.

Cluster 3 presented the most significant variation between bust and waist girths, exhibiting a small difference between hip and bust girths. However, the contrast between hip and waist circumferences was moderate. This cluster comprised 977 individuals. The ANOVA results revealed that compared to the other clusters, Cluster

3 had a significantly larger bust girth and chest arc width than the other groups and significantly smaller waist girth and hip girth. Cluster 3 had a large bra cup size, with the D cup being the most prevalent (Table 13). Therefore, Cluster 3 was labeled the "Inverted Triangle" shape owing to its distinctive feature of a larger upper body with a large bra cup size. This body shape may encounter gaping or tightness around the bust and shoulder areas, while garments may fit more loosely around the hips.

To enhance the body shape visualization of the three body shapes, key measurements were entered into a 3D avatar using the 3D virtual simulation software, CLO version 2024, in the same manner as indicated in Table 4 (Table 7).

Table 7 Three-dimensional visualization of body shape categories

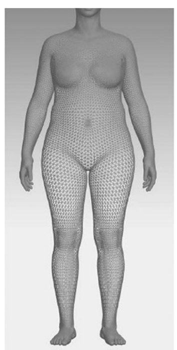
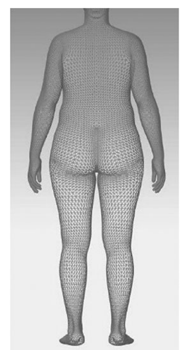
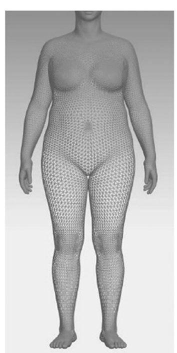
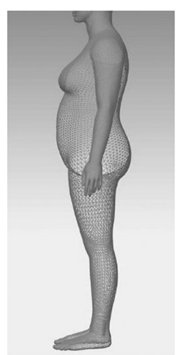
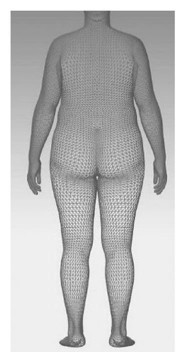
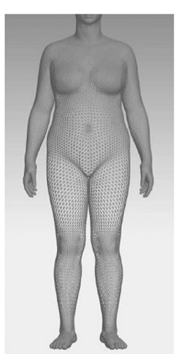
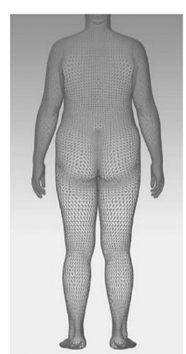
	Front	Side	Back
Triangle			
Rectangle			
Inverted Triangle			

Table 8 Distribution of body shape categories across ethnic groups n(%)

	White	Black	Asian	Non-Mexican Hispanic	Mexican Hispanic	Total
Triangle	**626 (44.7)**	**275 (44.6)**	72 (26.2)	58 (24.8)	46 (20.6)	1077 (39.2)
Rectangle	295 (21.1)	147 (23.8)	**111 (40.4)**	66 (28.2)	76 (34.1)	695 (25.3)
Inverted Triangle	479 (34.2)	195 (31.6)	92 (33.5)	**110 (47.0)**	**101 (45.3)**	977 (35.5)
Total	1400 (100)	617 (100)	275 (100)	234 (100)	223 (100)	2749 (100)

$\chi^2 = 120.386^{***}$, $df = 8$

Table 9 Distribution of body shape categories across BMI groups n(%)

	Triangle	Rectangle	Inverted triangle	Total
Underweight	26 (2.4)	22 (3.2)	25 (2.6)	73 (2.7)
Healthy weight	**483 (44.8)**	227 (32.7)	**423 (43.3)**	1133 (41.2)
Overweight	283 (26.3)	187 (26.9)	306 (31.3)	776 (28.2)
Obesity	285 (26.5)	**259 (37.3)**	223 (22.8)	767 (27.9)
	1077 (100.0)	695 (100.0)	977 (100.0)	2749 (100.0)

$\chi^2 = 54.621^{***}$, $df = 6$

How do body shape categories differ across diverse ethnic groups?

The distribution of ethnic groups varied significantly among the clusters (Table 8). The Triangle group comprised a higher percentage of Black and White populations. By contrast, the Rectangle group comprised a predominantly Asian population, while the Mexican Hispanics and non-Mexican Hispanics dominated the Inverted Triangle group. However, analyzing these findings more closely with the BMI levels in each ethnic group is imperative (Tables 9 and 10).

Black and White women exhibited a similar trend in the overall findings. The highest percentage of Black (44.6%) and White (44.7%) women exhibited a Triangle shape. Further analysis by dividing the ethnic group by BMI category (Table 10) revealed that Black and White women in the healthy and overweight groups were more likely to be in the Triangle group, followed by Inverted Triangle groups. By comparison, obese women were more frequently in the Triangle and Rectangle groups. Black women rarely appeared in the underweight category, while underweight White women were predominantly in the Rectangle and Inverted Triangle groups. Generally, the percentage of Asians was the highest in the Rectangle group (40.4%; Table 8).

A more detailed analysis by dividing the ethnic group by BMI category (Table 10) revealed that Asian women in the underweight category were more likely to exhibit a Triangle shape. Concerning Asian women in the healthy weight, overweight, and obese categories, the Rectangle shape was the most prevalent, while the percentage of those with a Rectangle shape rose as BMI increased.

The Mexican Hispanic (45.3%) and non-Mexican Hispanic (47.0%) groups comprised the largest percentage in the Inverted Triangle group. Additionally, healthy weight and overweight Mexican Hispanics primarily exhibited an Inverted Triangle shape. Obese Mexican Hispanics predominantly exhibited a Rectangle shape, followed by an Inverted Triangle shape. Healthy-weight non-Mexican Hispanics were highly prevalent in the

Table 10 Distribution of body shape categories across ethnic groups with BMI category

					n(%)
		Triangle	Rectangle	Inverted Triangle	Total
Underweight	White	13 (29.5)	**15 (34.1)**	**16 (36.4)**	44 (100.0)
	Black	2 (33.3)	1 (16.7)	3(50.0)	6 (100.0)
	Asian	**9 (47.4)**	5 (26.3)	5(26.3)	19 (100.0)
	Non-Mexican Hispanic	0 (0.0)	1 (100.0)	0 (0.0)	1 (100.0)
	Mexican Hispanic	2 (66.7)	0 (0.0)	1 (33.3)	3 (100.0)
	Subtotal	26 (35.6)	22 (30.1)	25 (34.2)	73 (100.0)
Healthy weight	White	**319 (46.6)**	111 (16.2)	**254 (37.1)**	684 (100.0)
	Black	**73 (51.4)**	19 (13.4)	**50 (35.2)**	142 (100.0)
	Asian	51 (28.5)	**70 (39.1)**	**58 (32.4)**	179 (100.0)
	Non-Mexican Hispanic	**26 (36.6)**	12 (16.9)	**33 (46.5)**	71 (100.0)
	Mexican Hispanic	14 (24.6)	15 (26.3)	**28 (49.1)**	57 (100.0)
	Subtotal	483 (42.6)	227 (20.0)	423 (37.3)	1133 (100.0)
Overweight	White	**160 (44.4)**	73 (20.3)	**127 (35.3)**	360 (100.0)
	Black	**79 (46.2)**	36 (21.1)	**56 (32.7)**	171 (100.0)
	Asian	10 (17.2)	**26 (44.8)**	**22 (37.9)**	58 (100.0)
	Non-Mexican Hispanic	19 (19.2)	24 (24.2)	**56 (56.6)**	99 (100.0)
	Mexican Hispanic	15 (17.0)	28 (31.8)	**45 (51.1)**	88 (100.0)
	Subtotal	283 (36.5)	187 (24.1)	306 (39.4)	776 (100.0)
Obese	White	**134 (42.9)**	**96 (30.8)**	82 (26.3)	312 (100.0)
	Black	**121 (40.6)**	**91 (30.5)**	86 (28.9)	298 (100.0)
	Asian	2 (10.5)	**10 (52.6)**	**7 (36.8)**	19 (100.0)
	Non-Mexican Hispanic	13 (20.6)	**29 (46.0)**	**21 (33.3)**	63 (100.0)
	Mexican Hispanic	15 (20.0)	**33 (44.0)**	**27 (36.0)**	75 (100.0)
	Subtotal	285 (37.2)	259 (33.8)	223 (29.1)	767 (100.0)
	Total	1077 (39.2)	695 (25.3)	977 (35.5)	2749 (100.0)

$\chi^2 = 213.370$***, $df = 38$; bold indicates a high percentage

Inverted Triangle shape group. By contrast, obese non-Mexican Hispanic women were common in the Rectangle group, followed by the Inverted Triangle group. Across all racial categories, the percentage of those with a Rectangle shape rose as BMI increased.

Noteworthily, the Triangle shape was prevalent among Blacks and Whites at healthy weights, overweight, and obese levels. However, as BMI increased across all ethnic groups, a noticeable trend exists toward an increased prevalence of the Rectangle shape.

Research question 3: what are the relationships among BMI, ethnicity, and bra cup sizes?

How do bra cup sizes vary according to ethnic groups and BMI category?

In the context of bust cup size distribution across ethnic groups (Table 11; Fig. 5), White women predominantly exhibited C cups (26.6%) and D cups (25.9%). Likewise, among Black women, the prevalent cup sizes were C (24.1%) and D (19.8%) cups. Notably, Black women exhibited a distinct trend compared to other ethnicities, with relatively higher proportions of AA (9.4%) and DD (16.6%) cups. Conversely, the most common bra cup sizes among Asian women were B (29.8%) and C (26.9%) cups. Additionally, Asian women exhibited relatively higher proportions of A cups (14.5%) than other ethnic groups. Non-Mexican Hispanic women most commonly wore a C (24.7%) or D (24.3%)

Table 11 Distribution of bra cup sizes across ethnic groups n(%)

	White	Black	Asian	Non-Mexican Hispanic	Mexican Hispanic	Total
AA	60 (4.3)	58 (9.4)	19 (6.9)	9 (3.8)	9 (4.0)	155 (5.6)
A	118 (8.4)	54 (8.8)	40 (14.5)	17 (7.2)	25 (11.2)	254 (9.2)
B	247 (17.6)	90 (14.6)	**82 (29.8)**	47 (20.0)	43 (19.3)	509 (18.5)
C	**372 (26.6)**	**148 (24.1)**	**74 (26.9)**	**58 (24.7)**	**74 (33.2)**	726 (26.4)
D	**363 (25.9)**	**122 (19.8)**	34 (12.4)	**57 (24.3)**	43 (19.3)	619 (22.5)
DD	160 (11.4)	102 (16.6)	16 (5.8)	31 (13.2)	23 (10.3)	332 (12.1)
E	80 (5.7)	41 (6.7)	10 (3.6)	16 (6.8)	6(2.7)	153 (5.6)
Total	1400 (100)	615 (100)	275 (100)	235 (100)	223 (100)	2748 (100)

$\chi^2 = 116.107^{***}$, $df = 24$; Bold indicates a high percentage

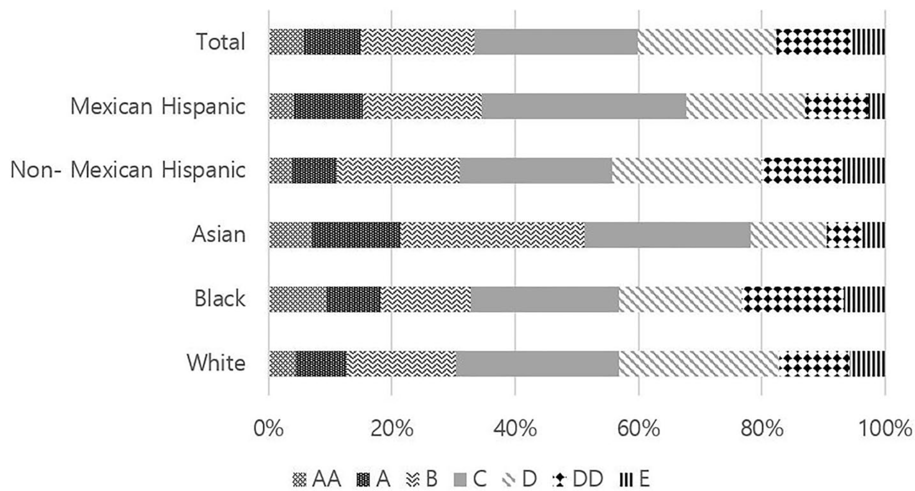


Fig. 5 Distribution of bra cup sizes across ethnic groups

cup. On the contrary, the C cup was most prevalent (33.2%) for the Mexican Hispanic demographic.

Examining the link between women's BMI and bra cup size across ethnic groups revealed the following results (Table 12): The predominant bra cup size among underweight women was B (31.5%), followed by A (26.0%). Regarding the ethnic differences, the largest percentage of Asian and White women wore the B-cup size, followed by the A-cup size. Overall, only a small number of women were distributed in the underweight category.

Healthy-weight women exhibited the highest distribution in C cups (27.9%), followed by B (24.1%) and D (21.6%) cups. Among healthy-weight Asian women, B cups were the most prevalent (34.6%), followed by C cups (25.1%). In the other ethnic groups, C cups comprised the largest proportion of cup sizes, with notable numbers in B and D cups. Overweight women displayed a similar distribution between C (27.2%) and D (26.8%) cups. A closer comparison among ethnic groups revealed a noticeable shift toward the C (31.0%) and D (22.4%) cups in the Asian group. Most overweight Black women wore the C-cup size (27.5%), followed by the D-cup size (23.4%), with a notable proportion in the DD-cup size (18.7%).

Table 12 Distribution of bra cup sizes across ethnic groups with BMI category

		AA	A	B	C	D	DD	E	n(%) Total
Under-weight	White	2 (4.5)	**11 (25.0)**	**13 (29.5)**	7 (15.9)	7 (15.9)	2 (4.5)	2 (4.5)	**44 (100.0)**
	Black	1 (16.7)	2 (33.3)	1 (16.7)	2 (33.3)	0 (0.0)	0 (0.0)	0 (0.0)	6 (100.0)
	Asian	3 (15.8)	**5 (26.3)**	**7 (36.8)**	4 (21.1)	0 (0.0)	0 (0.0)	0 (0.0)	**19 (100.0)**
	Non-Mexican Hispanic	1 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (100.0)
	Mexican Hispanic	0 (0.0)	1 (33.3)	2 (66.7)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	3 (100.0)
	Subtotal	**7 (9.6)**	**19 (26.0)**	**23 (31.5)**	13 (17.8)	7 (9.6)	2 (2.7)	2 (2.7)	73 (100.0)
Healthy weight	White	25 (3.7)	60 (8.8)	146 (21.3)	**196 (28.7)**	**179 (26.2)**	54 (7.9)	24 (3.5)	684 (100.0)
	Black	9 (6.3)	15 (10.6)	**35 (24.6)**	**38 (26.8)**	26 (18.3)	18 (12.7)	1 (0.7)	142 (100.0)
	Asian	15 (8.4)	29 (16.2)	**62 (34.6)**	**45 (25.1)**	15 (8.4)	10 (5.6)	3 (1.7)	179 (100.0)
	Non-Mexican Hispanic	2 (2.8)	5 (6.9)	**16 (22.2)**	**18 (25.0)**	**16 (22.2)**	12 (16.7)	3 (4.2)	72 (100.0)
	Mexican Hispanic	3 (5.3)	7 (12.3)	**14 (24.6)**	**19 (33.3)**	9 (15.8)	4 (7.0)	1 (1.8)	57 (100.0)
	Subtotal	54 (4.8)	116 (10.2)	**273 (24.1)**	**316 (27.9)**	**245 (21.6)**	98 (8.6)	32 (2.8)	1134 (100.0)
Over-weight	White	4 (1.1)	18 (5.0)	47 (13.1)	**94 (26.1)**	**108(30.0)**	60 (16.7)	29 (8.1)	360 (100.0)
	Black	6 (3.5)	12 (7.0)	17 (9.9)	**47 (27.5)**	**40 (23.4)**	32 (18.7)	17 (9.9)	171 (100.0)
	Asian	0 (0.0)	6 (10.3)	10 (17.2)	**18 (31.0)**	**13 (22.4)**	4 (6.9)	7 (12.1)	58 (100.0)
	Non-Mexican Hispanic	1 (1.0)	8 (8.1)	16 (16.2)	**24 (24.2)**	**29 (29.3)**	13 (13.1)	8 (8.1)	99 (100.0)
	Mexican Hispanic	1 (1.1)	12 (13.6)	16 (18.2)	**28 (31.8)**	**18 (20.5)**	9 (10.2)	4 (4.5)	88 (100.0)
	Subtotal	12 (1.5)	56 (7.2)	106 (13.7)	**211 (27.2)**	**208 (26.8)**	118 (15.2)	65 (8.4)	776 (100.0)
Obese	White	29 (9.3)	29 (9.3)	41 (13.1)	**75 (24.0)**	**69 (22.1)**	44 (14.1)	25 (8)	312 (100.0)
	Black	42 (14.2)	25 (8.4)	37 (12.5)	**61 (20.6)**	**56 (18.9)**	52 (17.6)	23 (7.8)	296 (100.0)
	Asian	1 (5.3)	0 (0.0)	3 (15.8)	**7 (36.8)**	**6 (31.6)**	2 (10.5)	0 (0.0)	19 (100.0)
	Non-Mexican Hispanic	5 (7.9)	4 (6.3)	**15 (23.8)**	**16 (25.4)**	12 (19.0)	6 (9.5)	5 (7.9)	63 (100.0)
	Mexican Hispanic	5 (6.7)	5 (6.7)	11 (14.7)	**27 (36.0)**	**16 (21.3)**	10 (13.3)	1 (1.3)	75 (100.0)
	Subtotal	**82 (10.7)**	63 (8.2)	107 (14.0)	**186 (24.3)**	**159 (20.8)**	114 (14.9)	54 (7.1)	765 (100.0)
	Total	155 (5.6)	254 (9.2)	509 (18.5)	**726 (26.4)**	**619 (22.5)**	332 (12.1)	153 (5.6)	2748 (100.0)

$\chi^2 = 367.088^{***}$, $df = 114$

Shading indicates the highest percentage

Bold indicates a high percentage

Among overweight White women, most wore the D-cup size (30.0%), followed by the C-cup size (26.1%), with a significant number in the DD-cup size (16.7%). For Mexican women, C cups were predominant (31.8%), followed by D (20.5%) and B (18.2%) cups. Overweight non-Mexican Hispanic women exhibited a similar pattern, with D cups being the most common (29.3%), followed by C (24.2%) and B (16.2%) cups.

Table 13 Distribution of bra cup sizes across ethnic groups with body shape category

		AA	A	B	C	D	DD	E	n(%) Total
Triangle	White	35 (5.6)	67 (10.7)	133 (21.2)	**182 (29.1)**	139 (22.2)	53 (8.5)	17 (2.7)	626 (100.0)
	Black	23 (8.4)	24 (8.8)	44 (16.1)	**71 (26.0)**	52 (19.0)	40 (14.7)	19 (7.0)	273 (100.0)
	Asian	6 (8.3)	16 (22.2)	**23 (31.9)**	15 (20.8)	5 (6.9)	3 (4.2)	4 (5.6)	72 (100.0)
	Non-Mexican Hispanic	3 (5.2)	3 (5.2)	15 (25.9)	**17 (29.3)**	10 (17.2)	6 (10.3)	4 (6.9)	58 (100.0)
	Mexican Hispanic	1 (2.2)	4 (8.7)	10 (21.7)	**15 (32.6)**	12 (26.1)	3 (6.5)	1 (2.2)	46 (100.0)
	Subtotal	68 (6.3)	114 (10.6)	**225 (20.9)**	**300 (27.9)**	**218 (20.3)**	105 (9.8)	45 (4.2)	1075 (100.0)
Rectangle	White	23 (7.8)	37 (12.5)	57 (19.3)	**78 (26.4)**	74 (25.1)	19 (6.4)	7 (2.4)	295 (100.0)
	Black	23 (15.6)	22 (15.0)	25 (17.0)	**37 (25.2)**	23 (15.6)	15 (10.2)	2 (1.4)	147 (100.0)
	Asian	11 (9.9)	20 (18.0)	**36 (32.4)**	27 (24.3)	14 (12.6)	2 (1.8)	1 (0.9)	111 (100.0)
	Non-Mexican Hispanic	5 (7.6)	11 (16.7)	**16 (24.2)**	15 (22.7)	14 (21.2)	5 (7.6)	0 (0.0)	66 (100.0)
	Mexican Hispanic	6 (7.9)	15 (19.7)	16 (21.1)	**20 (26.3)**	16 (21.1)	3 (3.9)	0 (0.0)	76 (100.0)
	Subtotal	68 (9.8)	105 (15.1)	**150 (21.6)**	**177 (25.5)**	**141 (20.3)**	44 (6.3)	10 (1.4)	695 (100.0)
Inverted Triangle	White	2 (0.4)	14 (2.9)	57 (11.9)	112 (23.4)	**150 (31.3)**	88 (18.4)	56 (11.7)	479 (100.0)
	Black	12 (6.2)	8 (4.1)	21 (10.8)	40 (20.5)	**47 (24.1)**	**47 (24.1)**	20 (10.3)	195 (100.0)
	Asian	2 (2.2)	4 (4.3)	23 (25.0)	**32 (34.8)**	15 (16.3)	11 (12.0)	5 (5.4)	92 (100.0)
	Non-Mexican Hispanic	1 (0.9)	3 (2.7)	16 (14.5)	25 (22.7)	**33 (30.0)**	20 (18.2)	12 (10.9)	110 (100.0)
	Mexican Hispanic	2 (2.0)	6 (5.9)	17 (16.8)	**39 (38.6)**	15 (14.9)	17 (16.8)	5 (5.0)	101 (100.0)
	Subtotal	19 (1.9)	35 (3.6)	134 (13.7)	**248 (25.4)**	**260 (26.6)**	**183 (18.7)**	**98 (10.0)**	977 (100.0)
	Total	155 (5.6)	254 (9.2)	509 (18.5)	725 (26.4)	619 (22.5)	332 (12.1)	153 (5.6)	2747 (100.0)

$\chi^2 = 418.422^{***}$, $df = 84$

Shading indicates the highest percentage

Bold indicates a high percentage

Among obese women, most were in the C cup (24.3%), followed by the D cup (20.8%). In all ethnic groups, the C cup was the most prevalent. In Asian, Black, White, and Mexican groups, the D cup was the next most prevalent, whereas for non-Mexican women, B and D cups were similarly prevalent, followed by C cups.

As the BMI increased to reach the overweight and obese categories, a notable transition was observed toward larger cup sizes, such as C, D, and DD, across all ethnicities. Asian women exhibited smaller cup sizes in each BMI range. Notably, underweight and obese women exhibited a relatively higher prevalence of AA cups (9.6 and 10.7%, respectively) than the other BMI groups.

How do bra cup sizes vary according to ethnic groups and body shapes?

Investigating the relationships among body shapes and bra cup sizes revealed significant differences between the body shape types (Table 13). For the Triangle and Rectangle groups, B-, C-, and D-cup sizes were relatively evenly distributed, with C-cup sizes slightly more prevalent. Conversely, although C-cup sizes were common in the Inverted Triangle shape group, the largest cup sizes—namely, D-, DD-, and E-cup sizes—markedly increased in frequency in this group, suggesting a potential correlation between this body shape type and larger bust sizes.

Even in the same body shape category, ethnic differences were observed. In the Triangle and Rectangle groups, Asian women most commonly had a B cup, followed by a C cup. Meanwhile, the C cup was the most prevalent among the Black, White, and Mexican Hispanic groups, with a significant number having B and D cups. Most non-Mexican Hispanic women had B cups, followed by C and D cups.

In the Inverted Triangle group, the C cup was the most common among Asian women, followed by B cups. Black, White, and non-Mexican Hispanic women predominantly had D cups, with a large portion in C and DD cups, and also exhibited an increase in E cups. The Mexican group's distribution indicated C cups as the most common, with a similar proportion in B, D, and DD cups but with a less significant increase in E cups. This result can be contextualized with the bust girth measurements in Table 3 , which indicate that Black women exhibited the largest bust girth measurements, followed by Mexican Hispanics, non-Mexican Hispanics, Whites, and Asians. However, Mexican Hispanics—despite having large bust girths—did not necessarily exhibit a corresponding increase in cup size.

Even with the same body shape, varying patterns of bra cup sizes are noted based on ethnic groups. Black, White, and non-Mexican Hispanic women's cup size was D when categorized in the Inverted Triangle group, compared to being categorized Triangle and Rectangle groups, in which case the cup size was C. Likewise, Asians saw a one-cup increase from B to C in the Inverted Triangle shape group. However, Mexican Hispanics consistently demonstrated the highest C-cup prevalence across all three body shapes irrespective of their body type.

Conclusions

This study examined body measurements, body shape, and bra cup size variations across ethnic groups, including White, Black, Asian, and Hispanic populations. Its findings revealed differences in BMI and bust-related measurements among these groups. While healthy weights were predominant among both Asian and White women, the Asian women showed a higher proportion of underweight individuals compared to other ethnicities. However, overweight individuals exhibited a more balanced distribution across ethnic groups, with obesity being predominant among Black and Mexican Hispanic women. Regarding bust-related and other body measurements, Black women generally exhibited the largest measurements, followed by Mexican Hispanics, non-Mexican Hispanics, Whites, and Asians. Moreover, this pattern was evident in weight and BMI values, with Black women exhibiting the highest values, followed by Mexican Hispanics, non-Mexican Hispanics, Whites, and Asians. Height distribution demonstrated variations, with Black and White women being taller, while Asian, Mexican Hispanic, and non-Mexican Hispanic groups were shorter.

Further, the groups' distinct body shape clusters highlight these complex relationships. The following three body shape clusters emerged: a Triangle shape with a distinctive feature of larger hips compared to the upper body with a moderate bra cup size, a Rectangle shape with a distinctive feature of smaller waist differences with a moderate bra cup size, and an Inverted Triangle shape with a distinctive feature of a larger upper body with a large bra cup size. Each cluster exhibited varying ethnic compositions, with the Triangle shape skewed toward Black and White, the Rectangle shape toward Asian, and the Inverted Triangle shape significant in Mexican Hispanic and non-Mexican Hispanic women.

A consistent trend was observed across all ethnic groups regarding the relationship between BMI and body shape: As BMI increased, the prevalence of the Rectangle body shape also increased across all ethnicities. This suggest that as size increases, the body does not grow proportionally in the bust, waist, and hip areas, but rather exhibits changes in overall shape. Thus, this finding is significant for plus-size grading as it recommends the consideration of body shape changes, not merely measurement increases. Moreover, this study's findings revealed distinct trends in bra cup sizes across diverse BMI categories, ethnic groups, and body shape classifications. Underweight women predominantly exhibited B (31.5%) and A (26.0%) cups, with Asian and White women exhibiting the largest percentage. Healthy-weight women exhibited the highest distribution in C cups (27.9%), followed by B (24.1%) and D (21.6%) cups, with Asian women predominantly wearing B cups. Overweight women displayed a similar distribution between C and D cups, with a noticeable transition toward these sizes in the Asian group. Obese women were predominantly distributed in the C-cup group (24.3%), followed by the D-cup group (20.8%), with variations observed across ethnic groups. As BMI rose to overweight and obese categories, cup sizes increased to C, D, and DD across all ethnic groups. The Asian group exhibited smaller cup sizes in each BMI group. Notably, underweight and obese women exhibited a higher proportion of AA cups (9.6%, 10.7%, respectively) than other BMI groups. This suggests that some individuals with high BMI still wear smaller sizes, calling for further investigation into potential factors influencing this phenomenon. Although BMI is generally associated with larger bra cup sizes, some individuals with high BMI still wear smaller sizes such as A cups (Saeed & Ibrahim Sheikja, 2024). This suggests that BMI alone may not fully explain bra size, and that individual anatomical differences or measurement issues could be contributing factors. One possible explanation lies in the limitations of body-scanning technology. As Han (2023) noted, body scans often struggle to accurately capture. Breast sagging alters the shape, position, and perceived volume of the breast, particularly with age, weight fluctuations, or post-pregnancy changes. These factors may confound the relationship between weight and cup size, potentially skewing data representation and interpretation (Li et al., 2016).

Across the ethnic groups studied, Asian women predominantly wore B (29.8%) and C (26.9%) cups, with a higher prevalence of A cups (14.5%) compared to other ethnicities. White women, along with non-Mexican Hispanics, exhibited the largest bra cup sizes; notably, White women showed a greater relative breast volume despite their smaller overall bust girth. Among Black women, the prevalent cup sizes were C (24.1%) and D (19.8%) cups, with a relatively higher occurrence of AA (9.4%) and DD (16.6%) cups. White women predominantly wore C (26.6%) and D (25.9%) cups. By contrast, Mexican Hispanic women predominantly wore C cups (33.2%), while non-Mexican Hispanic women commonly wore C cups (24.7%), followed by D cups (24.3%).

This finding indicated significant differences in bra cup sizes across diverse body shape categories. The Triangle and Rectangle groups demonstrated relatively even distributions of the B-, C-, and D-cup sizes, with the C-cup size being slightly more prevalent. However, the Inverted Triangle groups exhibited a notable increase in larger cup sizes, such as D, DD, and E, implying a potential correlation between this body shape type and larger bust sizes. We observed ethnic variations in each body shape category. In the Inverted Triangle group, Asian women primarily wore C cups, whereas Black, White, and Non-Mexican Hispanic groups predominantly wore D cups, with some also wearing C, DD, and E cups. Mexican Hispanic women predominantly wore C cups, with fewer women wearing B, D, DD, and E cups compared to the Non-Mexican Hispanic group. This suggests that Mexican Hispanics—despite having large bust girths—do not necessarily have larger cup sizes, highlighting complexities in body shape and bra cup size relationships.

In the apparel industry, the bust cup's size is crucial for the fit of lingerie as well as jackets, blouses, and dresses. Traditional grading methods typically scale patterns proportionally, maintaining consistent dart intake amounts across all sizes. However, Bye et al. (2008) reported the need for adjusting dart intake to better accommodate bust areas when grading for larger sizes. Additionally, Dove (2019) indicated that considering bust circumference in isolation is inadequate; instead, it must be analyzed together with bra cup size to develop effective size charts catering to diverse body shapes. These findings support the advancement of data-driven adaptive pattern design, which goes beyond current grading methods. Recent developments using 3D body scan data demonstrate how garment patterns can be customized to various individual body shapes with precise contouring and fit (Han, 2025). Such approaches allow for more personalized pattern construction, improving both fit and accessibility, especially for bodies that are problematic under current grading systems.

This study underscores the importance of examining overall body shape along with bra cup sizes, thereby offering significant practical applications relevant to the apparel industry. When developing size charts or creating garment patterns, the bust, waist, and hip measurements, in addition to the bra cup size, should be adjusted according to the target ethnic group. Additionally, this study provides guidance on modifying the amount and placement of bust darts, as well as designing and defining cutlines in the chest area, to better fit diverse bra cup sizes. This approach will provide valuable insights for the industry on how to tailor garments more effectively, ensuring that they fit effectively and are proportionally accurate across diverse body sizes and shapes, particularly in the bust area. Moreover, larger-breasted women frequently report dissatisfaction with bra fit (McGhee & Steele, 2010; Nethero, 2010). This study's findings can guide advanced sizing methods offering a wider range of sizes for foundation garments.

Notably, these findings present valuable insights into the diversity of physical characteristics across diverse ethnicities and BMI categories. While other studies have frequently categorized body shapes solely based on ethnicity, this study integrated both BMI and ethnicity to illustrate more complex variations in body shape.

Further, these findings highlight the significance of employing inclusive approaches for addressing size and fit perspectives in apparel design, particularly in accommodating diverse populations' varied body shapes and sizes. These insights offer practical implications for fashion brands, and it is suggested that inclusive sizing systems and garments tailored to cater to diverse ethnic backgrounds and body shapes must be developed. Such efforts are crucial for enhancing consumer satisfaction and body inclusivity in the fashion industry.

However, this study's reliance on the SizeUSA dataset may constrain its findings' generalizability owing to potential regional differences. Therefore, future research must utilize broader global datasets to validate and refine these findings, thus ensuring a more comprehensive understanding of size and fit perspectives across diverse populations.

We analyzed ethnicity using five broad categories (White, Black, Asian, Non-Mexican Hispanic, Mexican Hispanic). While common in many industries, these umbrella groups combine heterogeneous subpopulations; for BMI, body measurements, and cup size, such coarse grouping may mask meaningful within-group variation. Additionally, the sample sizes across ethnic groups in the SizeUSA dataset were disproportionate, and it may have limited the reliability of subgroup comparisons. This study relies on SizeUSA data, which use broad ethnicity categories; therefore, finer subgroup analyses were not possible within this dataset. Future work should consider adopting the U.S. Census Bureau standards to enable more detailed analyses.

Acknowledgements
Not applicable.

Author contributions
DK designed the study and statistically analyzed the data. DK and MS interpreted the data and wrote the manuscript. All authors read and approved the final manuscript.

Funding
Not applicable.

Data availability
The data results presented in this study are available on request from the corresponding author on reasonable request. However, the raw measurement data cannot be disclosed due to licensing agreement with the company that provided the data.

Declarations

Ethics application and consent to participate
Not applicable.

Competing interests
The authors declare that they have no competing interests. Dong-Eun Kim is an Editorial Board Member of Fashion and Textiles. Editorial Board Member status has no bearing on editorial consideration.

Received: 28 August 2024 Accepted: 14 January 2026
Published online: 18 February 2026

References

Alexander, M., Pisut, G. R., & Ivanescu, A. (2012). Investigating women's plus-size body measurements and hip shape variation based on SizeUSA data. *International Journal of Fashion Design, Technology and Education, 5*(1), 3–12. https://doi.org/10.1080/17543266.2011.589083

Ashdown, S. P. (2007). *Sizing in clothing*. Woodhead Publishing.

Bougourd, J. (2015). Ageing populations: 3D scanning for apparel size and shape. In J. McCann & D. Bryson (Eds.), *Textile-led design for the active ageing population* (pp. 139–169). Woodhead Publishing.

Brown, N., White, J., Milligan, A., Risius, D., Ayres, B., Hedger, W., & Scurr, J. (2012). The relationship between breast size and anthropometric characteristics. *American Journal of Human Biology, 24*(2), 158–164. https://doi.org/10.1002/ajhb.22212

Bye, E., LaBat, K., McKinney, E., & Kim, D. E. (2008). Optimized pattern grading. *International Journal of Clothing Science and Technology, 20*(2), 79–92. https://doi.org/10.1108/09556220810850469

Cai, X., Gu, B., & He, H. (2021). Classification analysis of young female students' waist–abdomen–hip based on body photos. *Textile Research Journal, 91*(11–12), 1409–1418. https://doi.org/10.1177/0040517520979742

Chen, C. M., LaBat, K., & Bye, E. (2011). Bust prominence related to bra fit problems. *International Journal of Consumer Studies, 35*(6), 695–701. https://doi.org/10.1111/j.1470-6431.2010.00984.x

Chrimes, C., Boardman, R., McCormick, H., & Vignali, G. (2023). Investigating the impact of body shape on garment fit. *Journal of Fashion Marketing and Management: An International Journal, 27*(5), 741–759. https://doi.org/10.1108/JFMM-03-2022-0049

Christel, D. A., & Dunn, S. C. (2017). Average American women's clothing size: Comparing national health and nutritional examination surveys (1988–2010) to ASTM international misses & women's plus size clothing. *International Journal of Fashion Design, Technology and Education, 10*(2), 129–136. https://doi.org/10.1080/17543266.2016.1214291

Coltman, C. E., Steele, J. R., & McGhee, D. E. (2017). Breast volume is affected by body mass index but not age. *Ergonomics, 60*(11), 1576–1585. https://doi.org/10.1080/00140139.2017.1330968

Deurenberg, P., Yap, M., & van Staveren, W. A. (1998). Body mass index and percent body fat: A meta analysis among different ethnic groups. *International Journal of Obesity, 26*(9), 1141–1146. https://doi.org/10.1038/sj.ijo.0800741

Dove, T. (2019). Building patternmaking theory to better represent the female form. *DHM and Posturography* (pp. 761–769). Academic Press.

Gribbin, E. A. (2014). Body shape and its influence on apparel size and consumer choices. In M.-E. Faust & S. Carrier (Eds.), *Designing apparel for consumers: The impact of body shape and size* (pp. 3–16). Woodhead Publishing.

Gupta, P., & Roy, A. (2024). Exploring challenges encountered by plus-size women in the selection of lingerie: A comprehensive study. *International Journal of Home Science, 10*(1), 200–203. https://doi.org/10.22271/23957476.2024.v10.i1c.1571

Han, H. (2023). Development of automatic 3D body scan measurement line generation method. *International Journal of Clothing Science and Technology, 35*(3), 350–362. https://doi.org/10.1108/IJCST-08-2022-0113

Han, M. (2025). Integrating artificial intelligence to automate pattern making for personalized garment design. *International Journal of Advanced Computer Science & Applications*. https://doi.org/10.14569/IJACSA.2025.0160229

Heymsfield, S. B., Peterson, C. M., Thomas, D. M., Heo, M., & Schuna, J. M., Jr. (2016). Why are there race/ethnic differences in adult body mass index-adiposity relationships? A quantitative critical review. *Obesity Reviews, 17*(3), 262–275. https://doi.org/10.1111/obr.12358

Hudson, K., & Hwang, C. (2022). Application of 3D prototyping to promote size-inclusive design practices for plus-size apparel. *Fashion Practice, 14*(1), 5–25. https://doi.org/10.1080/17569370.2020.1804152

Klepser, A., Hiss, S., Mahr-Erhardt, A., & Morlock, S. (2018). Three-dimensional quantification of foundation garment's shaping effects. *Proceedings of 3DBODY.TECH* (pp. 92–104). Lugano Switzerland: Hometrica Consulting.

Kumari, A., & Anand, N. (2023). Exploration of Indian plus-size women's ready-to-wear: Problems and preferences. *Journal of Fashion Marketing and Management: An International Journal, 27*(6), 1088–1112. https://doi.org/10.1108/JFMM-10-2022-0206

LaBat, K. L., & DeLong, M. R. (1990). Body cathexis and satisfaction with fit of apparel. *Clothing and Textiles Research Journal, 8*(2), 43–48. https://doi.org/10.1177/0887302X9000800206

Lanoue, S. (n.d.). *Lululemon Asia fit vs. normal: What's the difference?* Apart Style. https://www.apartstyle.com/post/lululemon-asia-fit-vs-normal

Lee, J. Y., Istook, C. L., Nam, Y. J., & Park, S. M. (2007). Comparison of body shape between USA and Korean women. *International Journal of Clothing Science and Technology, 19*(5), 374–391. https://doi.org/10.1108/09556220710819555

Li, D., Cheong, A., Reece, G. P., Crosby, M. A., Fingeret, M. C., & Merchant, F. A. (2016). Computation of breast ptosis from 3D surface scans of the female torso. *Computers in Biology and Medicine, 78*, 18–28. https://doi.org/10.1016/j.compbiomed.2016.09.002

Li, P., & Mitchell, K. B. (2023). A shape classification scheme for female torso. *Applied Ergonomics, 106*, Article 103904. https://doi.org/10.1016/j.apergo.2022.103904

Makhanya, B. P., de Klerk, H. M., Adamski, K., & Mastamet-Mason, A. (2014). Ethnicity, body shape differences, and female consumers' apparel fit problems. *International Journal of Consumer Studies, 38*(2), 183–191. https://doi.org/10.1111/ijcs.12079

McGhee, D. E., & Steele, J. R. (2010). Breast elevation and compression decrease exercise-induced breast discomfort. *Medicine and Science in Sports and Exercise, 42*(7), 1333–1338. https://doi.org/10.1249/mss.0b013e3181ca7fd8

Naidu, D., Howlett, E., & Perkins, A. W. (2025). The bigger the better: An investigation of consumer responses to clothing retailers' extended-sized product lines. *Journal of Retailing*. https://doi.org/10.1016/j.jretai.2025.09.003

Nethero, S. (2010). U.S. Patent Application No. 12/732,831.

Parker, C. J., Hayes, S. G., Brownbridge, K., & Gill, S. (2021). Assessing the female figure identification technique's reliability as a body shape classification system. *Ergonomics, 64*(8), 1035–1051. https://doi.org/10.1080/00140139.2021.1902572

Pei, J., Park, H., & Ashdown, S. P. (2019). Female breast shape categorization based on analysis of CAESAR 3D body scan data. *Textile Research Journal, 89*(4), 590–611. https://doi.org/10.1177/0040517517753633

Petrova, A., & Ashdown, S. P. (2008). Three-dimensional body scan data analysis: Body size and shape dependence of ease values for pants' fit. *Clothing and Textiles Research Journal, 26*(3), 227–252. https://doi.org/10.1177/0887302X07309479

Pray, R., & Riskin, S. (2023). The history and faults of the body mass index and where to look next: a literature review. *Cureus*. https://doi.org/10.7759/cureus.48230

Reid, L. F., Vignali, G., Barker, K., Chrimes, C., & Vieira, R. (2020). Three-dimensional body scanning in sustainable product development: An exploration of the use of body scanning in the production and consumption of female apparel. *Technology-driven sustainability: Innovation in the fashion supply chain* (pp. 173–194). Springer.

Saeed, D. A., & Ibrahim Sheikha, A. K. (2024). Impact of breast size and body mass index on the prevalence of breast cancer in the Sulaimaniyah Province of Iraqi Kurdistan. *Bahrain Medical Bulletin, 46*(1), 1880.

Shariff, S. M., Japar, S., Shahlal, N., & Shariff, A. A. (2022). Importance of sizing and fit using 3D technology. In N. Zakaria (Ed.), *Digital manufacturing technology for sustainable anthropometric apparel* (pp. 167–184). Woodhead Publishing. https://doi.org/10.1016/B978-0-12-823969-8.00006-X

Shin, E., & Saeidi, E. (2022). Body shapes and apparel fit for overweight and obese women in the US: The implications of current sizing system. *Journal of Fashion Marketing and Management: An International Journal, 26*(5), 759–775. https://doi.org/10.1108/JFMM-09-2020-0213
Shin, S. J. H., & Istook, C. L. (2007). The importance of understanding the shape of diverse ethnic female consumers for developing jeans sizing systems. *International Journal of Consumer Studies, 31*(2), 135–143. https://doi.org/10.1111/j.1470-6431.2006.00581.x
Simmons, K., Istook, C. L., & Devarajan, P. (2004). Female figure identification technique (FFIT) for apparel. Part I: Describing female shapes. *Journal of Textile and Apparel, Technology and Management, 4*(1), 1–16.
Sohn, M., & Bye, E. (2012). Visual analysis of body shape changes during pregnancy. *International Journal of Fashion Design, Technology and Education, 5*(2), 117–128. https://doi.org/10.1080/17543266.2011.649792
Sokolowski, S. L., & Bettencourt, C. (2020). Modification of the female figure identification technique (FFIT) formulas to include plus size bodies. *Proceedings of the 11th International Conference and Exhibition on 3D Body Scanning and Processing Technologies (3DBODY. TECH 2020)*. https://doi.org/10.15221/20.22
Song, H. K., & Ashdown, S. P. (2015). Investigation of the validity of 3-D virtual fitting for pants. *Clothing and Textiles Research Journal, 33*(4), 314–330. https://doi.org/10.1177/0887302X15592472
Song, H. K., Baytar, F., Ashdown, S. P., & Kim, S. (2022a). 3D anthropometric analysis of women's aging bodies: Upper body shape and posture changes. *Fashion Practice, 14*(1), 26–48. https://doi.org/10.1080/17569370.2021.1879463
Song, S., Parmeshwar, N., Steiner, G., & Kim, E. A. (2022b). Morphometric analysis of gender-affirming breast augmentation. *Plastic and Reconstructive Surgery, 10*(11), Article e4691. https://doi.org/10.1097/GOX.0000000000004691
Stitch Fix. (n.d.). The Stitch Fix guide to dressing for your body type. https://www.stitchfix.com/women/blog/fashion-tips/find-fit-for-your-body-type/
TC^2. (n.d.). SizeUSA: National sizing survey. https://www.tc2.com/size-usa.html
ThirdLove. (2023). How a whole lot of data led to half cups. https://www.thirdlove.com/blogs/learn/how-a-whole-lot-of-data-led-to-half-cups
Torrid. (n.d.). Size guide: Apparel & accessories. https://www.torrid.com/size-guide.html
Vogue. (2018). Rihanna's Savage x Fenty lingerie campaign is all about body positivity. https://www.vogue.com/article/rihanna-savage-x-fenty-lingerie-campaign-body-positivity
Wells, J. C. K., Cole, T. J., Bruner, D., & Treleaven, P. (2008). Body shape in American and British adults: Between-country and inter-ethnic comparisons. *International Journal of Obesity, 32*(1), 152–159. https://doi.org/10.1038/sj.ijo.0803685
Zakaria, N., & Gupta, D. (2019). *Anthropometry, apparel sizing and design*. Woodhead Publishing.
Zhang, B., Sun, Y., Zhong, Z., Xia, Y., Jin, S., Li, Y., & Gu, B. (2022). Breast shape classification and discrimination driven by local features-focusing on Chinese women in their 20s. *International Journal of Industrial Ergonomics, 90*, Article 103304. https://doi.org/10.1016/j.ergon.2022.103304

Publisher's Note

MyungHee Sohn Ph.D. is an Associate Professor in the Fashion Merchandising and Design, Department of Family and Consumer Sciences at California State University, Long Beach, USA

Dong-Eun Kim Ph.D. is a Professor in the Department of Fashion Industry at Ewha Womans University, South Korea.