# THE ANTHROPOMETRICS OF JUNIOR SIZING: DOES THE SIZE FIT THE POPULATION?

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Master of Science

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by

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The undersigned, appointed by the dean of the Graduate School, have examined the

[thesis or dissertation] entitled

THE ANTHROPOMETRICS OF JUNIOR SIZING:
DOES THE SIZE FIT THE POPULATION?

presented by Aline Kuykendall,

a candidate for the degree of Master of Science,

and hereby certify that, in their opinion, it is worthy of acceptance.

Professor Lynn Boorady

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Professor Laurel Wilson

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Professor Alex Waigandt

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# DEDICATION

This work is dedicated to those people and places that touched me most during it's ups and downs. Christina Kelley and Ben Chlapek, you probably put up with much more any normal person would during the many mood swings and victories. Without you, there is no Columbia to me. Thank you to all my other friends willing to listen to me recite paragraphs out loud over and over. A credit is due to Uprise Bakery/Ragtag Cinema, where the vast majority of my work was completed.

I must thank my family for their constant support, their unwavering belief, their attempts to decipher my babble, and their humoring me when the time called for it.

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Abstract

Junior apparel and sizing was explored in this study. Teenage females, between the ages of thirteen and eighteen, had their body measurements taken with a 3D body scanner to determine if the current sizing standards for juniors are appropriate for the demographic they serve. The results show that the body type and dimensions do not fit the current population and that a revision of sizing standards would be necessary in order to better fit the junior apparel customer.

## Introduction

Juniors departments in apparel stores are often sensory experiences. Loud pop music and bright visual merchandising market directly to the teenage female demographic, indicating to them their place in the retail environment. Overall, current marketing focuses on children and teenagers, as it has been shown that they have great influence over family purchases, and the buying power of teenagers as a whole is over a hundred billion dollars a year (Jones, 2008). However, apparel and accessory styles have to be on trend, with the right look, construction and details top attract these consumers. In the effort to visually appeal to potential customers, fit can become an afterthought for the retailer.

This subset of the population has discretionary income and the desire to purchase fashion goods, yet the apparel available to them is not made with their bodies as references. The current sizing standards used for junior apparel is not based on the current junior market, but rather on outdated children and missy data from the mid-20th century (O'Brien & Shelton, 1941). Much of this incongruity stems from the 1920s debate revolving around the junior being a size and not an age (Mestres, 2008), but since then distinction has become much more clear; currently "Juniors" is considered an age, and that age group requires a different sizing structure than both children and misses.

The results of this research determine the importance of reevaluating the current junior sizing standards set by The American Society for Testing and Materials. The current standards use an hourglass figure as the basis for junior measurements, when the hourglass is not a common figure type on teenage females (Newcomb & Istook, 2004).

The participant responses showed that teenage females feel that clothing in juniors' departments does not fit well, and data from this study established that the conventional sizes do not work for the age group.

In addition, the current junior standards only extend to size 19, while junior plus sizing (though still relatively obscure) is becoming more prevalent in retail offerings. Minority groups are often not taken into account when fit is considered as well, even with the growth of several minority populations in recent years (U.S. Census Bureau, 2008).

With these obstacles, the teenage females of the United States are finding it difficult to dress themselves simultaneously in the styles they desire and the fit they need. A revision of sizing in a clear mannered approach will be necessary to accommodate the modern junior customer and her apparel fitting needs.

## Review of Literature

"Overall, among children and adolescents aged 2 to 19 years, 17.1% were overweight in 2003-2004" (Ogden, et. al., 2006). In light of the changing size and shape of the United States population, particularly as related to obesity, the question arises regarding the extent to which the U.S. apparel industry is keeping up with the needs of the consumers in the marketplace with regards to fit and sizing. An important and lucrative segment of the U.S. apparel market is commonly called the "junior market." The junior apparel market is a specific category of ready-to-wear clothing that originated from a need for an intermediate size range in the industry created during the 1920s for smaller females of all ages (Mestres, 2008).

### History of Junior Sizes

The ambiguity of the classification "junior" also causes problems with fit. In *Women's Wear Daily* in 1926, the junior wear section functioned as an addition to children's sizes (Mestres, 2008). This is about the same time that junior wear began to appear as its own category in the market, however, the definition of junior was greatly debated at the time (Mestres, 2008). The junior category was often referred to as a size, not an age by many industry professionals in its inception, and even SizeUSA data has been analyzed under this belief (Mestres, 2008; Ashdown, Loker & Schoenfelder, 2005). There is a 55-plus junior designation that refers to slim women over the age of 55, a far cry from the teenage demographic mostly associated with the sizing category (Newcomb & Istook, 2004).

However, in the past ten years, junior sizes seem to have made a definite shift into the younger age group by becoming a specific style, and not a merely a size category. Junior sized clothing is styled for the teenage consumer and sold in departments which attract this consumer – by playing loud music, highlighting flashy displays and selling garments which are fashion forward and tighter fitting than their misses sized counterparts. Due to the rise of obesity in youth, junior sizes can now be found in a much larger size range which includes what would, in a misses sized garment, be referred to as "plus size". Originally junior sizes ranged from 7 to 19 however, in 2008, the ASTM committee recommended and expanded the junior size range from 0 to 19. Some retailers, particularly catalog and Internet e-tailers, have expanded this size range by offering up to a size 27 in many styles. Factors such as the introduction of this "plus size" junior wear, the fast-fashion appeal, and the marketing to a teenage demographic, raise the question as to whether the junior is a separate size category and if so, does the junior sizing fit the target market.

O'Brien and Girshick published data in 1939 on the body measurements of 147,088 children from the ages of four to seventeen in 15 states and Washington D.C. (O'Brien & Girshick, 1939). Only 133,807 of the original 147,088 body measurements were used in the proposed materials, 64,146 of which were girls (O'Brien & Girshick, 1939). Among other important findings, the researchers noted that age was significantly less reliable in sizing than stature and that children of the same age could bear completely different body measurements (O'Brien & Girshick, 1939). They proposed that height and hip measurements might be the best indicator of size, but that weight was the best

measurement to use in developing children's size standards (O'Brien & Girshick, 1939; O'Brien, et. al., 1941).

The sizing for juniors has not remained stagnate. Using the information from the 1941 study, the National Bureau of Standards created a range of seven sizes for juniors, ranging from 7 to 19 (Kunick, 1984). Size 7 began with a 30.5 inch bust measurement and a 32 inch hip measurement (Kunick, 1984). The current ASTM junior sizing shows that a bust/hip measurement of 30.5 inches and 32.5, respectively, constitutes a size 0 (ASTM International, 2008). A revision of the first ASTM Junior standardsn(1958) in 1971 altered the sizes to range from 3 to 17, using the same base measurements as the 1958 standards, but with slightly different bust/hip intervals (Kunick, 1984). None of these revisions were based on actual measurements taken of the target market.

A study conducted by Reich and Goldsbury (1993) at the University of Arizona in 1993 took body measurements of women 55 years and older and divided them into size categories (Salusso, Borkowski, Reich & Goldsbury, 2006). One such category was the Women 55+ Junior Figure Type, ASTM D5586 - 95, in which 864 of the 6786 participants were identified as such (ASTM International, 1995). This type of "junior" fits into the original description of women with a smaller, slighter frame, but not with the current and more common association of "junior" as teenage females. As can be seen in Table 1 in the Appendix, which shows the ASTM Junior Sizing Standards and the junior sizing of a chosen major clothing retailers, the 55+ Junior has much less of an hourglass shape than the ASTM D6829 Junior, particularly in size 13 which had the highest number of participants falling into that grouping with 271 (Salusso, et. al., 2006). In comparison with the ASTM D6829 Junior and other industry sizing, the body measurements taken for

the ASTM 55+ Junior reflect the real need for a revision in the shape and size of apparel in the U.S. for this target market as well (Salusso, et. al., 2006).

ASTM revised their junior sizing standards in 2008, extending to size 19, and adding additional "Junior Plus" sizes (ASTM International, 2008). Demand for plus-size apparel from younger customers has caused a shift in the offerings of U.S. clothing manufacturers. Ashdown, Loker and Schoenfelder (2005) suggest that the "creation of new sizing systems based on fit characteristics for the actual target market anthropometrics should lead to improved fit and boost the competitiveness of the U.S. apparel industry" (2).

Junior apparel sizing standards are based on a population older than what is now generally considered the youthful, teenage "junior" (Newcomb & Istook, 2004). Since the SizeUSA body scans did not include females under the age of 18, this demographic has yet to be truly represented in fit studies and by the apparel industry (Devarajan & Istook, 2004). The junior wear industry originated in the 1920s from a size, not an age, fitting a slimmer and more fashion-conscious consumer of any age (Mestres, 2008). Currently, the junior industry is synonymous with teenage girls, and with the recent addition of plus-size junior apparel it is straying farther away from the initial definition (ASTM International, 2008) of being for the less developed female. It's apparent that junior sized apparel has become a style-focused market.

Previous to the conception of junior wear, an intermediate size did not exist (Cook & Kaiser, 2004). Girls went from children's apparel into misses with no transitional clothing in either size or style. Apparel manufacturers today tend to create junior lines with the teen population in mind. Contemporary styles, trends and fits dominate

department stores and boutiques, attempting to capture loyalty in youthful customers (Tucker, 2008). Successful brands such as Forever 21 have launched plus-size lines for the "junior" market, further straying from the "junior is a size, not an age" viewpoint (Krawitz, 2009). The Oxford English Dictionary in 1933 seemed to weigh in on the topic with some confusion, defining 'junior' as both meant for juveniles as well as the "junior is a size, not an age" argument (U.S. Department of Commerce, 1933). This muddling of viewpoints has possibly confused the past junior audience as to which department they should be shopping in.

**The Junior Consumer**

Currently, there are approximately 16 million females between the ages of 12 and 19 in the United States (American Community Survey, 2007). These teenagers comprise the base of the junior apparel market. The American Society for Testing and Materials (ASTM) technical committee describes the junior size as "…younger, not fully developed, with a higher waistline than other women's size ranges" (ASTM, 2008). This is assumed to describe the female teenage market.

The number of teens residing in the U.S. is expected to be the largest in history by 2010 (ASTM International, 2008). The 2008 estimated populations of females aged 10-14 was nearly 9.8 million and almost 10.5 million females aged 15-19, 9.3% and 9.9% of the population, respectively (U.S. Census Bureau, 2009). These numbers show a large demographic with unique apparel needs and with the ability to purchase in the marketplace. Teens are the most desired and marketed to demographic today for retailers due to their influence over peers and family spending, their status as "future consumers", and the size of the current teen population (Taylor & Cosenza, 2002).

Teenagers, in 2007, spent over $127 billion dollars in the retail marketplace (Jones, 2008). Fashion, which includes clothing, shoes and accessories, was the biggest portion of spending done by teens at 41 percent (Jones, 2008). This is up significantly from just ten years ago when clothing accounted for 34 percent of teen spending (Klein, 1998). As a generation, United States teenagers spend about $1 billion dollars a week, with a median of $50 per teen (Taylor & Cosenza, 2002). Teenagers have a strong influence in the market with this type of spending power and the store that can not only get the style and fashion right, but also fit their consumers, can gain a large share of that spending.

As previously mentioned, research shows that as a group teens are spending money on apparel (Jones, 2008). Gaining more influence over the family spending, teens are eager and enthusiastic, weighing in on about 90% of apparel purchases (O'Donnell & Kutz, 2008). The mean income for single-parent female head of household with children under the age of 18 is $46,000 (U.S. Census Bureau, 2008). For married couples with children under the age of 18, the household mean income is roughly $78,000 (U.S. Census Bureau, 2008). Disposable income for twenty percent of families in 2008 ranged from $15,000 to $24,999, however this does not include figures for teenagers earning their own money or receiving gifts of money (U.S. Census Bureau, 2008).

Teenagers in 2007 were responsible for $127 billion in purchases (Jones, 2008). Forty-one percent of this was allocated towards fashions, including clothing, accessories and shoes (Jones, 2008). In 1997, only 34 percent of teen spending was on fashion, showing a marked increase in this area (Klein, 1998). This powerful influence on the market makes teenagers a target for advertisers and retailers, but the product has to be up

to their high standards of style. Teenagers today tend to consider shopping as entertainment and look for "cool" brands that are made specifically for teens (Taylor & Cosenza, 2002).

Teen stores currently outperform more traditional shops, with stores such as Urban Outfitters posting increased sales, even in this time of economic instability (O'Donnell & Kutz, 2008; Shaw, 2008; Albright, 2009). Even niche teen boutiques (such as the gothic-themed Hot Topic) are experiencing positive revenues, as well as surprising loyalty from the traditionally fickle teen market (Albright, 2009; O'Donnell & Kutz, 2008). The preference for mall shopping by teens is mainly focused on specialty boutiques and not department stores which tend to display junior apparel ineffectively (Taylor & Cosenza, 2002).

**Problems with Fit**

Size and fit of apparel is a major factor in the purchasing decision for all age groups and body types. Several studies throughout the years have shown that at least 50 percent of women have issues finding clothing that fits properly (Ashdown, Loker & Schoenfelder, 2005; Goldsbury, Shim, & Reich, 1996; LaBat, 1989). The junior apparel market is a specific sector of ready-to-wear clothing that originated from a need for an intermediate size range in the industry during the 1920s (Mestres, 2008). The Junior Standard for sizing, ASTM D6829 sizes 0-19, is based on an hourglass figure which is not commonly found in females ages 13 to 18 (Newcomb & Istook, 2004). An hourglass shape is defined by the shoulder and hip having roughly the same measurement, and the difference between the bust, hip and waist measurements, or the 'drop' is eight to ten inches between the bust and waist and the hip and waist (Armstrong, 1995). A size 5 in

the ASTM Junior size chart has a bust, waist and hip measurements of 33½", 25½, and 35½, respectively, showing that the size standards are established for hourglass figures. (ASTM, 2008).

Another area of concern with the sizing of apparel is that clothing manufacturers develop their own sizing systems in order to fit a target customer (Devarajan & Istook, 2004). These dimensions are usually taken from a fit model encompassing the body type each brand finds ideal to their image (Ashdown, Loker & Schoenfelder, 2005). This may sometimes mean that manufacturers, while using the ASTM measurements as a starting point, change their fit according to customer feedback or the designers "vision" of how a garment should fit.

Currently, there is a lack of anthropometric data on junior customers. The SizeUSA (2003) and CAESAR (2000) studies were the first major undertaking to gather information on women's body dimensions since the 1940s (Ashdown, Loker & Schoenfelder, 2005). SizeUSA measured more than 12,000 people, none of whom were under the age of 18 (Newcomb & Istook, 2004). Since height generally does not increase in females after the seventeenth year (Kunick, 1984), it would seem vital for children and teens to have apparel sizes developed from measurements taken from their age group rather than an older population. Data from SizeUSA is assumed to be representative of the entire U.S. population and the findings were suggested extend to all age groups (Newcomb & Istook, 2004). However, it is important to note that the Junior and Missy standards are both based on the hourglass figure (which is not a predominate body shape in any age cohort) and proportional height to weight ratios (which would not be prevalent in obese juniors) (Newcomb & Istook, 2004).

A study of 10,042 participants in 1941 by O'Brien and Shelton is the original basis for female sizing standards. The participants were 98 percent white women, all were over 18 years old, and few participants over 60 years old volunteered at the time (O'Brien & Shelton, 1941). A variety of different factors have contributed to the physical changes of the U.S. population in the past 60-plus years. Regardless the explanation, data from 1941 is obsolete for the current generation (Devarajan & Istook, 2004).

If Ashdown, Loker and Schoenfelder (2005) are correct in stating that a new sizing system to fit the U.S. population is needed, apparel manufacturers could potentially look forward to monetary gains and savings. Sales would increase and build revenue, plus returns would decrease reducing the time and personnel needed to handle such transactions. The majority of retailer clothing returns are due to poor fit or incorrect size (Newcomb & Istook, 2004). However, it is vital to note that any new sizing models created have the possibility of fitting a previously ignored demographic, while simultaneously alienating another segment of the population (Ashdown, Loker & Schoenfelder, 2005). O'Brien, Girshick, and Hunt (1941) noted that more sizes would increase the probability of fit, and that fewer sizes would leave gaps in representation. Due to this, department stores and clothing manufacturers create sizing tables to fit their desired target market (Devarajan & Istook, 2004). Ideally, retailers want the minimal number of sizes to fit the maximum number of customers.

Body shape and physical measurements are both a part of how apparel fits (Devarajan & Istook, 2004). Beyond body dimensions, the curvature of the back, the shoulder slope, and posture were identified as components to apparel fit (Devarajan & Istook, 2004). Body scans were the source of the data used for Devarajan and Istook's

research in body shape (2004). Ashdown, et. al (2005) note, however, no matter how much data from body scanning is gathered and analyzed, it must be translated into useful and applicable information in order to effectively improve apparel manufacturer's sizing standards. These suggestions for better fit must be enacted in fit models and dress forms, and must be seen in the target population for a change to take place (Devarajan & Istook, 2004).

**Current Junior Apparel**

Even with the lack of data supporting the junior standards for today's target market, several retailers have sizing that closely resemble the ASTM D6829 – 02 standards for juniors (see Table 1). Apparel manufacturers have the freedom to create and adapt their sizing measurements in order to better serve their customer base (Simmons, 2002). Though the opportunity to create custom apparel for specific demographics exists, 62% of consumers claim dissatisfaction with the fit of their clothing (Devajaran & Istook, 2004).

Today, another category of intermediate clothing stores exists, with 'tween' merchandise being offered. The term 'tween' comes from being 'between' childhood and teenage years, and can apply to girls from age seven to age 13 or 14 (Cook & Kaiser, 2004). The body shape and size can be drastically different between 10 and 13 year old girls, thus spurring 'tween' sizes (Cook & Kaiser, 2004). The apparel for this new category is more modest and generally more youthful than junior and misses clothing (Cook & Kaiser, 2004).

'Age aspiration' is common among teenage girls, who want to look and act older than they are. Usually, the younger the teen, the larger the gap is between their real and

desired ages (Cook & Kaiser, 2004). ‘Coming of age’ purchases can signify the onset of maturation, as mothers take their ‘tween’ and teen daughters shopping for items such as make-up and bras (Cook & Kaiser, 2004). Retail outlets such as Justice Just for Girls and Limited Too serve ‘tweens' in a brightly colored and highly accessorized manner, and come as an alternative to the junior specialty stores (Cook & Kaiser, 2004).

Positive self-image is extremely important for girls of the ‘tween’ and teenage demographic and clothing has a role in promoting self-esteem in adolescents (Daters, 1990). Interest in personal appearance and clothing tends to peak at this time in life, and peer acceptance is vital to the formation of healthy young adults. Ill-fitting clothing draws unwanted attention to physical flaws of self-conscious youth, which can lead to poor self-image and unwillingness to wear popular styles of the time (Taylor & Cosenza, 2002). Teenagers are less likely to get involved in extracurricular activities if their clothing seems unsuitable or if they fear others will not accept them (Francis, 1992). The more essential one feels it is to achieve an identity, the greater the consumption to achieve that perceived identity will be (Dickson & Pollack, 2000). In other words, identity is often equated with appearance in relation to peers in female teenagers, and therefore the quality of fit in junior wear is imperative.

This research focused on a questionnaire and conducted body scans on teenage girls whose self-stated size falls within the junior category. The body scanner was capable of obtaining hundreds of body measurements in a matter of seconds and did so in a relatively private manner. The measurements obtained from these scans were compared to the measurements obtained from the ASTM standard junior size charts. This data was analyzed to see if junior sizes fit the current teenage population.

## Method

### Sampling

The females chosen were of a certain age group (13-17) and resided in a Midwestern city or town with a major University presence. The goal of one hundred scan participants was set in order to gain a large, yet achievable sample (approximately 20 participants per age group). The nature of studies such as this that rely on volunteers have the potential to end with skewed results. There was a possibility that those willing to have their body scanned were more comfortable with their appearance and the way their clothing fits in general. If only those who feel the apparel industry was serving their needs volunteer, a subset of the population would be absent. Also, it is important to note that the study excluded females who may have been pregnant, as they would fit into a different apparel category and size chart. In order to determine if the participant was pregnant, a list of excluding criteria was asked and the participant was then be able to exclude herself without disclosing personal information.

Stratified Quota sampling was planned for obtaining participants for the study. The first 81 females between the ages of 13 and 17 (the goal was twenty from each of the five ages) identifying themselves as wearing junior sized apparel were scanned. Flyers were distributed to area businesses advertising the opportunity to participate in this study, as well as compensation for their involvement. In order to receive the twenty-dollar cash compensation, participants needed to complete both a survey and body scan. A snowball effect from participant word of mouth brought in further participants. If participants felt uncomfortable completing either the scan or the survey, they had the option to quit at any

time. If they preferred to complete one or the other, ten dollars was given for the survey or scan alone.

The central Missouri area holds different backgrounds of potential participants due to the nature of the intersection of highly educated and rural families. The data collected from this group was expected to vary due to this, and create a well-rounded sample. Due to their age, participants required parental consent before participating. It was felt that participants may be more likely to participate in the questionnaire rather than the body scanning, therefore the body scanning was conducted first. IRB approval was granted. Due to the nature of the targeted group, the sample was a cluster.

**Data Collection**

The research collected body scans and questionnaires for 81 teenage girls. All participants completed both parts of the study. The participants were thirteen to seventeen years old. The breakdown of the participants was 18 thirteen year olds, 20 fourteen year olds, 20 fifteen year olds, 14 sixteen year olds, and 9 seventeen year olds. The measurements extracted from the body scans were compared to the measurements obtained from the ASTM standard junior size charts, as well as junior size charts used by retailers and e-tailers. The data was regressed using bivariate correlation in the statistics program Stata and then analyzed. The results of this analysis were then used to determine if junior sized garments are fitting the current teenage population. The scanner used to obtain these data is the Textile/Clothing Technology Corporation's NX16 3D body scanner at the University of Missouri. The body scanner is capable of obtaining hundreds of body measurements in a matter of seconds and does so in a relatively private manner.

**Scanning Procedure**

Potential participants contacted the primary investigator to obtain more information. If they fit the criteria and decided to proceed, an appointment time was made. Each participant and their parent (if present) were shown the scanner and instructed on scanning protocol, possible risks, confidentiality, and compensation for participation. The scanner and its use were described and any questions that the participant had were answered at that time. Participant data were entered in a database as a scan number and given a pseudonym in order to remain anonymous in the study files. Electronic files were kept in a secure server accessible only to study researchers, and all paper files were stored in a locked cabinet to ensure confidentiality. No identifying information was used in findings later in the study.

Scan participants needed to wear appropriate scan garments, much like their every day undergarments, in order to obtain an accurate scan image. Scan garments must be similar in coloration to their skin tone for the image to be clear. If the participant had not worn appropriate undergarments, scan garments in a range of sizes were provided in bras and bottoms for participant use. Attached to the scanner was a private changing area, allowing modesty to be observed when changing into scan garments. Any glasses, jewelry, hair clips, etc. were removed prior to scanning. Long hair was pulled up off of the neck, and hair accessories were provided at the scan site.

Once appropriately attired, the participant was asked to step into the scanner and close the curtain in order to block any light from interfering with the scan. Participants placed their feet in the marked position, standing upright with their chin slightly tilted

upwards while grasping the handrails in such a manner that holds their arms close to but not touching the body. A button on the right handhold allowed participants to begin the scanning process whenever they felt ready. Upon completion of the scan, participants were asked to wait in the scanner, in a relaxed stance, in order to determine if the image obtained was of acceptable quality. If not, additional scanning was completed until the image was acceptable. When a quality image was received, the participant then stepped out of the scanner, changed back into their clothing, and completed the survey. Parents could also participate in a short voluntary survey on demographics. Data from the scanner was stored in secure server, and survey information was kept in a confidential locked file.

After the body scan information was obtained, it was determined that the waist measurement had to be altered from the default setting to read the smallest horizontal circumference of the torso. Once this was accomplished, the body measurement data was then extracted from the scanner's database and put into an Excel spreadsheet. The surveys were processed and coded. Age was entered into the Excel file, and the participant's data was categorized by age group. From the survey data, birth month, birth year, height and weight were also entered into the spreadsheet, and Body Mass Index (BMI) was calculated for each participant. BMI for each age group was averaged, and the maximum and minimum of each age group was noted. One extreme outlier was removed from the 16 year old age group, and the average and maximum were recalculated. The total group's numbers were also recalculated after this outlier was removed.

The bust, waist and hip measurements from the scan data were used in statistical programming to determine the most common dimensions for the participants. For each size designation in the ASTM Junior D6829, both the bust and hip measurement were

separately computed, using the inch measurement of that size (bust or hip) and both one half inch above and below that number. For example, the bust measurement was held constant and the average waist and hip measurement were calculated for that size. The same was done for the hip measurement, and the bust and waist averages were calculated.

Next, the correlation between the variables of age, height, weight, bust, waist and hip totals were considered. Information was input into statistical computer software to analyze correlation of these variables for all participants and then again by age group. Also, an analysis of the most common sizes of the bust, waist and hip measurements for specific bust and hip measurements was done using statistical software. Mean, standard deviation, minimum and maximum of these dimensions were calculated for all the participants together. All these variables, including the number of participants within that size, were calculated according to the bust size, and then the hip size.

# Results

## Type of Research

The research done for this study was a human anthropometric data collection of teenage females. Informed consent from participants and their parents/legal guardians was essential in this study due to the underage population from which data was collected. The procedures, collection process, and end use of the data were fully disclosed to participants before the time of participation. IRB approval was obtained.

## Scope of Study and Limitations

This study was conducted over the course of 5 months, and teenage females volunteered to have their measurements taken via body scan and then complete a short survey on their buying habits and clothing preferences. Participants contacted the researcher and made appointments for the scan. Parental permission in written form was required as the participants were all under the age of 18. After the data was collected, it was extracted and analyzed.

The participants of this study were 81 thirteen to seventeen year old girls, all from or at the time living in Mid-Missouri, in towns under 150,000 residents. They attended middle school, junior high school and high school in the Mid-Missouri area. Of the 81 participants, 18 were thirteen years old, 20 were fourteen years old, 20 were fifteen years old, 14 were sixteen years old, and 9 were seventeen years old. The mean, median and mode household income of the participants was between $50,000 to $74,999 a year, according to parental questionnaire results. The family size averaged four (two parents and two children) and the most common occupation of the parental respondent was

professional or managerial. Only two parents responded that they were not currently employed and were homemakers. The mean, median and mode of level of education for participant's mothers were college graduate, and none had less than a high school degree. Many of their parents worked for the University of Missouri

Of the participants, 73 were White (non-Hispanic), three were African American, one was Hispanic, two were Asian, and the remaining two identified themselves as Other. When asked to name their favorite stores, Hollister, American Eagle, Kohl's, Target, Abercrombie & Fitch, Old Navy, Walmart, JC Penney and Aeropostale were the most consistent. Other stores mentioned were Wet Seal, Maurice's, Aerie, Dillard's and The Buckle. The participants described themselves as having a very active to about as active as others lifestyle. Seven described themselves as being underweight, two as quite a bit overweight, and the remaining thought they were a little overweight or about the right weight.

In order to be eligible to participate, participants must have been thirteen, fourteen, fifteen, sixteen or seventeen years of age and self identified as wearing junior sized clothing. Only females were taken, as junior apparel is made for females. Participants who were pregnant were eliminated due to the fact that pregnancy requires different sizing than junior apparel. Those who may be extremely sensitive to light or prone to seizures were self-eliminated as the scanner uses white light technology that could potentially trigger neurological incidences for this group. Participants were required to have parental consent in express written form. In return for participation, participants were compensated with a total of $20 (twenty) cash. This incentive assisted in the recruitment efforts.

The recruitment of participants began in August 2009 and continued through January 2010. Fliers were posted in local businesses in the downtown area. Word of mouth generated a great deal of participation. Teachers, parents, and guidance counselors posted the recruitment fliers in local high schools. In November of 2009, an advertisement was placed in the University of Missouri campus- and employee-wide email server MUInfo. A second MUInfo advertisement was placed in January 2010. Scanning was conducted from September 2009 until February 2010. Most participants were recruited through the MUInfo email system, as the parents of participants were minors and much more likely to participate if encouraged by a parent. Fliers were not posted in clothing or apparel stores for juniors due to the management's concerns with insinuations that their products fit poorly.

All scanning, data collection, and recruitment took place in Columbia, Missouri. The scanning and data collection took place in the Department of Textile and Apparel Management on the University of Missouri campus. Body scanning was completed using the Textile/Clothing Technology Corporation's NX16 3D body scanner belonging to the Department of Textile and Apparel Management at the University. Potential participants contacted the primary investigator to obtain more information. If they fit the criteria and decided to proceed, an appointment time was made.

**Findings**

Data from the study included body measurements from each participant. The drop, or difference in number of inches from the bust to waist and waist to hip, proved substantial in the analysis and measurement portion of this study. Bust, waist and hip dimensions formulate the sizes of clothing. The bust is measured at the maximum girth,

horizontally (U.S. Department of Commerce, 1958). The waist is also measured horizontally at the smallest portion of the abdomen (U.S. Department of Commerce, 1958). The scanner identifies the small of the back and measures 2 1/2 inches upward to obtain the waist measurement (Simmons, 2002). Upon scanning the participants, it was noted that several of the waist measurements were lower than the smallest portion of the abdomen, so the default setting was overridden on the scanner in order to set the measurement at the same location as identified by ASTM. Hip girth is taken at generally the widest part of the body, horizontally over the largest projection from the rear (U.S. Department of Commerce, 1958; Simmons, 2002).

This study, comparing the apparel industry's junior wear standards to the population intended for junior clothing, depended on these three body dimensions. The scan results were then compared to the corresponding size standards on junior apparel industry size charts. A foreseen difficulty with this method lies in the human body's potential to greatly vary in the hip, waist and bust dimensions, where each measurement may fall into a different size category. Extremely varying measurements had to be treated cautiously, and any outliers were eliminated from the study. Body shape based on the drop was also considered when analyzing results as to determine a more appropriate body shape for industry sizing standards.

**Data Collection and Analysis**

Upon completing the scanning portion of the research, the resulting measurements were extracted from the scanner's database and placed into an Excel spreadsheet. The information was then formatted into statistics software Stata, where correlation and regression analysis were computed.

When all age groups were included, age correlated with the other measurements did not have significant correlations. The sample size for all age groups was 81. Height was fairly significant with all the other circumference and vertical measurements taken. Weight was significantly correlated with bust and waist with .88 and .87 correlation, respectively. Weight and hips for all age groups were very highly significantly correlated with .95. Similarly, the bust, waist and hips are correlated with each other in the .8 range, throughout all age groups (see Figure 1.1).

For 13 year olds, weight had a significance of .88, .87, and .95 for bust, waist and hips, respectively. However, the correlation between height and weight in 13 year olds was .3, which is not highly significant for a sample (n) of 17. Bust, waist and hips are all significant with each other, with waist and hips having the highest correlation to each other in this age group with .92 (see Figure 1.2).

For 14 year olds, there were 20 participants. The highest correlations for this age group were in the weight category. The most highly correlated measurements were again weight with bust, waist and hips, all having significance .9 or higher. Bust, waist and hips were all correlated to each other with .88 significance each (see figure 1.3).

For the 15-year-old age group, height was most correlated with weight at .72, but all other variables were more significant in relation to height than to weight. Bust, waist and hips were highly correlated with one another, with a range of .73 to .78. Weight for 15 year olds was highly significant in correlation with bust, waist and hip measurements. Twenty participants fell into the fifteen year old age group (see figure 1.4).

Fourteen 16 year olds participated in the study. There were no significant correlations between height and any of the other variables. Height was not significantly

correlated with any of the other measurements. Weight was the strongest correlation for bust, waist and hips, with .90, .90, and .95 respectively. Bust, waist and hips were all highly significant in their correlation with weight as well, with .90 or higher (see figure 1.5).

There were nine 17-year-old participants. Height was not significant in correlation with the variables of weight, bust, waist, and hip, however it was the most correlated with weight for this age group with .429. For this age group, bust, waist, and hip were all significantly correlated from .83 to .95 (see figure 1.6).

For height, weight was consistently the highest in correlation significance, although height only held high correlation with the remaining variables for 14 and 15 year olds in the study (bust, waist and hips for 14 and 15 year olds correlated with height ranging from .56 to .66). Bust, waist and hips were continually highly correlated with one another, as well as with weight. When all age groups were considered, age had very little correlation (positive or negative), and none significant with any of the other variables. It is important to note that the small sample size statistically made height significant, and that with the same proportion of heights with a larger sample height would not be significant.

Of the eighty-one total participants, all had their height and weight recorded. All eighty-one had their bust, waist and hips measured and recorded. The mean weight was 120.5 pounds. The minimum was 73 pounds and the maximum was 180 pounds. The mean height was 64.2 inches, or slightly over 5 feet 2 inches. The minimum height was 58 inches (4 feet, 10 inches) and the maximum was 70 inches (5 feet, 10 inches).

The standard deviation for bust was 3.6 inches, meaning that roughly sixty-eight percent (68%) of the participants, assuming a normal distribution, have a bust measurement within 3.6 inches of 34.8 inches. If the mean is rounded up to 35 inches, sixty-eight percent had a bust measurement between 31.5 inches and 38.5 inches.

The standard deviation for waist was 3 inches, meaning that roughly sixty-eight percent (68%), assuming a normal distribution, of the participants have a waist measurement within 3 inches of 29.1 inches. If the mean is rounded down to 29 inches, sixty-eight percent had a waist measurement between 26 inches and 32 inches.

The standard deviation for hips was 3.3 inches, meaning that roughly sixty-eight percent (68%), assuming a normal distribution, of the participants have a hip measurement within 3.3 inches of 37.3 inches. If the mean is rounded down to 37 inches, sixty-eight percent had a waist measurement between 33.5 inches and 40.5 inches.

Also analyzed were the most common sizes of the bust, waist and hip measurements for specific bust and hip measurements, respectively. The number of participants, mean, standard deviation, minimum and maximum were calculated for all the participants together. Then these same variables were calculated according to the bust size, and then the hip size. Appendix C displays Figures 3.1 through 3.29, which completely detail this information.

When analysis was done on the corresponding measurements and averages when the busts and hips were held constant (respectively), data showed that those with a given bust measurement did not consistently have the same waist and hip measurements. Busts were analyzed based on the ASTM D6829 Junior designation size chart, and were run in the statistics program half an inch above and below the given bust measurements in order

to incorporate all possible measurements gathered from the data. For example, for a 34" bust the acceptable range was 33.5 to 34.5 inches. Hip measurements were done in the same manner. Waist measurements were not computed this way because the larger measurements (bust and hip) are generally the more difficult to fit. Table 1.3 in Appendix A displays this information.

The measurements for waist and hips were less varying for those with smaller busts. Waists tended to be larger than those in the ASTM chart and hips were smaller. Once the bust measurement reached 36.5 inches, or roughly the ASTM D6829 size 11, the pattern changed in that the waist measurement was consistent with or smaller than that of ASTM and hip measurements were smaller by half an inch to two and a half inches.

When using the hip measurements according to the ASTM D6829 Junior standards, the bust measurements showed no pattern until hips were 42.5 inches (ASTM size 15), where they were fairly consistent with both the ASTM and the regressed bust data. The waist measurements for the hip-regressed data were consistently larger than the ASTM charts until hip measurements of 40.5 (ASTM size 13), where they became smaller than the ASTM measurements. The waists then again became larger than the standards after hips reached 43.5 inches. Of all the 81 participants, only five had an hourglass figure (the 8-10 inch drop previously mentioned). Three of the five were 16 years old or older, and the remaining two were both 13 years of age with measurements in the junior sizes 13-17.

When the BMI for all participants was calculated, it was then done for all the age groups. Including all age groups, the minimum BMI was 14.26 and the maximum was

35.15, with an average of 20.6. As can be seen from the Table 1.2A in Appendix A, the average BMI for the separate age groups ranged from 19.7 to 21.6. According to the Center for Disease Control's (CDC) Body Mass Index for girls ages 2 to 20, the minimum for all participants (14.26 BMI for a 14 year old) was considered in the 5$^{th}$ percentile, or underweight for that age group. On the other end of the spectrum, the maximum of the participants (35.15 BMI for a 16 year old) was in the 95$^{th}$ percentile, or very overweight for that age group. For all participants considered, the average of 20.6 hovers around the 50$^{th}$ percentile in all age groups, and is a healthy weight for teenage females (The Center for Disease Control, 2000).

The participant with a BMI of 35.15 was an outlier, significantly different from the next highest BMI from all age groups, which was 28.3. When the outlier BMI of 35.5 was removed from the equations, the minimum and maximum BMI for all age groups were 14.26 and 28.3, respectively. A BMI of 28.3 is still in the 90$^{th}$ percentile would still be considered overweight, but significantly less than the removed outlier. The average BMI for the separate age groups then ranged from 19.7 to just under 20. The difference between the totals with the outlier and those without are not great, but it is important to note that a difference in calculations is visible between the two.

## Discussion and Conclusions / Future Research

Upon analyzing the data in the Summary of Variables (see Figure 2.0 in Appendix B) and the data from the individual age groups (Figures 2.1-2.5), the bust, waist and hips corresponded very closely to one another in each age group. Throughout all age groups of participants in this study, the means of the bust, waist and hips were almost identical, varying by less than an inch or a single size. However it is important to note that in the sizing of apparel, the mean has very little significance. This information indicated that the different age groups within this study vary minimally in horizontal circumference measurements on average.

The information gathered from these numbers suggested that females in their teenage years did not consistently have the same bust measurements based on hip measurements, and similarly did not have the same hip measurements based on bust measurements. The same could be concluded for waists, although the regressions were not run specifically on these dimensions. The information also shows weight was not the best indicator of size when looking at teenage females.

Perhaps the most significant finding from the data was that none of the participants in the study had all three bust, waist and hip measurements to fit into any single one of the ASTM sizes for juniors. Even allotting a one-inch tolerance (+/- ½ inch), the bust and waist dimensions for all participants fell into separate size categories. After all the size information was computed, none of participants fit into any one size group from the ASTM Junior chart. To clarify, no single participant in the study had bust,

waist and hip measurements that correlated with the measurements of any one ASTM Junior size. This was determined by analyzing if the measurements of each participant fell within a half inch above and below the ASTM measurements for each the bust, waist and hip. These findings suggest that the standards for junior sizing are not relevant to the current population wearing junior apparel and that revision of these sizing standards is necessary.

The participants all came from a Midwestern region with a major university presence. The majority was white, which is not representative of the entire United States population. The small sample tested is a limitation of this research. If further research is intended for this age group, a greater number of participants should be solicited for a more accurate sample. Teenage girls are often body-conscious, so the participants may have skewed toward those who are comfortable with their body. This potentially leaves a missing segment of the population that is experiencing problems with the fit of their clothing.

In order to more effectively revise standards for juniors' sizing, a wider scope of participants and regions would be necessary, as well as continued research on a larger scale. Other areas of the country may have different results, and it is important to obtain a comprehensive dataset before a major revision of the sizing standard was conducted in order to determine the most appropriate manner of standardization of the junior size charts. The population tested in this study was not racially representative of the entire country, therefore a more representative sample population would be required. Overweight or obese females from this age group were also lacking in this study. Future research on this subset would be valuable as previous anthropometric data does not

extend to junior plus-sizes, which may prove vital as the United States population becomes physically larger.

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# Appendix A

**Table 1.1 Current Junior Sizing in the United States (in inches)**

| | Size 0 | | | | |
|---|---|---|---|---|---|
| | **ASTM D6829*** | **Target** | **JC Penney** | **U.O.**** | **Hollister** |
| **Bust** | 30.5 | | 30-30.5 | | |
| **Waist** | 22.5 | | 22-22.5 | | 23-24 |
| **Hip** | 32.5 | | 32.5-33 | | 33.5-34 |
| | Size 1 | | | | |
| | **ASTM D6829** | **Target** | **JC Penney** | **U.O.** | **Hollister** |
| **Bust** | 31.5 | 31.5 | 31-31.5 | 32.5-33 | |
| **Waist** | 23.5 | 24 | 23-23.5 | 24.5-25 | 24-25 |
| **Hip** | 33.5 | 34 | 33.5-34 | 34.5-35 | 34.5-35 |
| | Size 3 | | | | |
| | **ASTM D6829** | **Target** | **JC Penney** | **U.O.** | **Hollister** |
| **Bust** | 32.5 | 32.5 | 32-32.5 | 33.5-34 | |
| **Waist** | 24.5 | 25 | 24-24.5 | 25.5-26 | 25-26 |
| **Hip** | 34.5 | 35 | 34.5-35 | 35.5-36 | 35.5-36 |
| | Size 5 | | | | |
| | **ASTM D6829** | **Target** | **JC Penney** | **U.O.** | **Hollister** |
| **Bust** | 33.5 | 33.5 | 33-33.5 | 34.5-35 | |
| **Waist** | 25.5 | 26 | 25-25.5 | 26.5-27 | 26-27 |
| **Hip** | 35.5 | 36 | 35.5-36 | 36.5-37 | 36.5-37 |
| | Size 7 | | | | |
| | **ASTM D6829** | **Target** | **JC Penney** | **U.O.** | **Hollister** |
| **Bust** | 34.5 | 34.5 | 34-34.5 | 35.5-36 | |
| **Waist** | 26.5 | 27 | 26-26.5 | 27.5-28 | 27-28 |
| **Hip** | 36.5 | 37 | 36.5-37 | 37.5-38 | 37.5-38 |
| | Size 9 | | | | |
| | **ASTM D6829** | **Target** | **JC Penney** | **U.O.** | **Hollister** |
| **Bust** | 35.5 | 35.5 | 35-35.5 | 36.5-37 | |
| **Waist** | 27.5 | 28 | 27-27.5 | 28.5-29 | |
| **Hip** | 37.5 | 38 | 37.5-38 | 38.5-39 | |
| | Size 11 | | | | |
| | **ASTM D6829** | **Target** | **JC Penney** | **U.O.** | **Hollister** |
| **Bust** | 37 | 37 | 36-37 | 38-38.5 | |
| **Waist** | 29 | 29.5 | 28-29 | 30-30.5 | 29-30 |
| **Hip** | 39 | 39.5 | 38.5-39.5 | 40-40.5 | 39.5-40 |
| | Size 13 | | | | |
| | **ASTM D6829** | **Target** | **JC Penney** | **U.O.** | **Hollister** |
| **Bust** | 38.5 | 38.5 | 37.5-38.5 | | |
| **Waist** | 30.5 | 31 | 29.5-30.5 | | |
| **Hip** | 40.5 | 41 | 40-41 | | |

| | Size 15 | | | | |
|---|---|---|---|---|---|
| | **ASTM D6829** | **Target** | **JC Penney** | **U.O.** | **Hollister** |
| **Bust** | 40 | 40 | 39-40 | | |
| **Waist** | 32 | 32.5 | 31-32 | | |
| **Hip** | 42 | 42.5 | 41.5-42.5 | | |
| | Size 17 | | | | |
| | **ASTM D6829** | **Target** | **JC Penney** | **U.O.** | **Hollister** |
| **Bust** | 41.5 | 41.5 | 40.5-41.5 | | |
| **Waist** | 33.5 | 34 | 32.5-33.5 | | |
| **Hip** | 43.5 | 44 | 43-44 | | |
| | Size 19 | | | | |
| | **ASTM D6829** | **Target** | **JC Penney** | **U.O.** | **Hollister** |
| **Bust** | 43 | 43 | 42-43.5 | | |
| **Waist** | 35 | 35.5 | 34-35.5 | | |
| **Hip** | 45 | 45.5 | 44.5-46 | | |
| | Size 21 | | | | |
| | **ASTM D6829** | **Target** | **JC Penney** | **U.O.** | **Hollister** |
| **Bust** | | | 44-45.5 | | |
| **Waist** | | | 36-37.5 | | |
| **Hip** | | | 46.5-48 | | |

***ASTM D6829 is the designation for the young adult junior figure type, sizes 0 to 19 (ASTM International, 2008).**

****U.O. - Urban Outfitters**

**Table 1.2A Calculated BMIs of Scan Participants, All Ages**

| | MIN | MAX | AVERAGE |
|---|---|---|---|
| THIRTEEN | 16.94559229 | 27.24947971 | 20.97296566 |
| FOURTEEN | 14.25527778 | 26.44987906 | 19.73501496 |
| FIFTEEN | 16.72010212 | 24.71484375 | 20.32414385 |
| SIXTEEN | 17.57027681 | 35.15 | 21.57130438 |
| SEVENTEEN | 15.5450052 | 28.33963215 | 20.84993418 |
| ALL AGES | 14.25527778 | 35.15 | 20.59684231 |

**Table 1.2B Calculated BMIs of Scan Participants, All Ages, With the Outlier Removed**

| | MIN | MAX | AVERAGE |
|---|---|---|---|
| THIRTEEN | 16.94559229 | 27.24947971 | 20.97296566 |
| FOURTEEN | 14.25527778 | 26.44987906 | 19.73501496 |
| FIFTEEN | 16.72010212 | 24.71484375 | 20.32414385 |
| SIXTEEN | 17.57027681 | 25.23745675 | 20.52678933 |
| SEVENTEEN | 15.5450052 | 28.33963215 | 20.84993418 |
| ALL AGES | 14.25527778 | 28.33963215 | 20.41492784 |

**Table 1.3 Comparison of ASTM D6829 and Regressed Bust and Hip Averages**

| | ASTM D6829 Sizes | By Bust Averages | By Hip Averages |
|---|---|---|---|
| Size 0 | | | |
| Bust | 30.5 | 30.5 | 31 |
| Waist | 22.5 | 26 | 26 |
| Hips | 32.5 | 34.5 | 32.5 |
| Size 1 | | | |
| Bust | 31.5 | 31.5 | 29 |
| Waist | 23.5 | 27 | 24 |
| Hips | 33.5 | 35 | 30.5 |
| Size 3 | | | |
| Bust | 32.5 | 32.5 | 31 |
| Waist | 24.5 | 27.75 | 26 |
| Hips | 34.5 | 35.5 | 32.5 |
| Size 5 | | | |
| Bust | 33.5 | 33.5 | 33 |
| Waist | 25.5 | 28 | 27 |
| Hips | 35.5 | 36 | 35.5 |
| Size 7 | | | |
| Bust | 34.5 | 34.5 | 35 |
| Waist | 26.5 | 28.5 | 29 |
| Hips | 36.5 | 37 | 36.5 |
| Size 9 | | | |
| Bust | 35.5 | 35.5 | 34 |
| Waist | 27.5 | 29 | 29 |
| Hips | 37.5 | 37 | 37.5 |
| Size 11 | | | |
| Bust | 37 | 36.5 | 37.75 |
| Waist | 29 | 29.75 | 31 |
| Hips | 39 | 38.5 | 39.5 |
| Size 13 | | | |
| Bust | 38.5 | 38.5 | 35* |
| Waist | 30.5 | 32.5 | 30* |
| Hips | 40.5 | 40 | 40.5* |

| Size 15 | | | |
|---|---|---|---|
| Bust | 40 | 39.5 | 39.5 |
| Waist | 32 | 32.5 | 32 |
| Hips | 42 | 42 | 42.5 |

| Size 17 | | | |
|---|---|---|---|
| Bust | 41.5 | 40.5 | 41 |
| Waist | 33.5 | 34 | 35.5 |
| Hips | 43.5 | 42.5 | 43.5 |

| Size 19 | | | |
|---|---|---|---|
| Bust | 43 | | 42 |
| Waist | 35 | | 36 |
| Hips | 45 | | 45 |

*Only 1 participant with this size

## Appendix B

**Figure 1.1 Correlations of Variables for All Participants**

| | age | height | weight | bust | waist |
|---|---|---|---|---|---|
| age | 1.0000 | | | | |
| height | -0.0431 | 1.0000 | | | |
| weight | 0.0501 | 0.5067 | 1.0000 | | |
| bust | 0.0563 | 0.3275 | 0.8841 | 1.0000 | |
| waist | -0.0166 | 0.3193 | 0.8658 | 0.8356 | 1.0000 |
| hips | 0.0372 | 0.4124 | 0.9472 | 0.8130 | 0.8623 |

**Figure 1.2 Correlation of Variables for 13-year-old Participants**

| | age | height | weight | bust | waist |
|---|---|---|---|---|---|
| age | | | | | |
| height | | 1.0000 | | | |
| weight | | 0.3034 | 1.0000 | | |
| bust | | 0.1437 | 0.8787 | 1.0000 | |
| waist | | 0.0774 | 0.8656 | 0.8213 | 1.0000 |
| hips | | 0.1919 | 0.9473 | 0.8405 | 0.9201 |

**Figure 1.3 Correlation of Variables for 14-year-old Participants**

| | age | height | weight | bust | waist |
|---|---|---|---|---|---|
| age | | | | | |
| height | | 1.0000 | | | |
| weight | | 0.7224 | 1.0000 | | |
| bust | | 0.5624 | 0.9224 | 1.0000 | |
| waist | | 0.6565 | 0.9036 | 0.8808 | 1.0000 |
| hips | | 0.6474 | 0.9558 | 0.8846 | 0.8811 |

**Figure 1.4 Correlation of Variables for 15-year-old Participants**

| | age | height | weight | bust | waist |
|---|---|---|---|---|---|
| age | | | | | |
| height | | 1.0000 | | | |
| weight | | 0.7231 | 1.0000 | | |
| bust | | 0.5837 | 0.8758 | 1.0000 | |
| waist | | 0.5929 | 0.8483 | 0.7436 | 1.0000 |
| hips | | 0.6364 | 0.9397 | 0.7264 | 0.7817 |

**Figure 1.5 Correlation of Variables for 16-year-old Participants**

| | age | height | weight | bust | waist |
|---|---|---|---|---|---|
| age | | | | | |
| height | | 1.0000 | | | |
| weight | | 0.4319 | 1.0000 | | |
| bust | | 0.2074 | 0.9033 | 1.0000 | |
| waist | | 0.2361 | 0.9001 | 0.8999 | 1.0000 |
| hips | | 0.3711 | 0.9512 | 0.8413 | 0.8886 |

**Figure 1.6 Correlation of Variables for 17-year-old Participants**

| | age | height | weight | bust | waist |
|---|---|---|---|---|---|
| age | | | | | |
| height | | 1.0000 | | | |
| weight | | 0.4196 | 1.0000 | | |
| bust | | 0.3462 | 0.8860 | 1.0000 | |
| waist | | 0.2537 | 0.9349 | 0.8344 | 1.0000 |
| hips | | 0.2884 | 0.9759 | 0.8539 | 0.9529 |

**Figure 2.0 Summary of Variables for All Participants in Inches**

| Variable | N | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| weight | 78 | 120.5449 | 22.23987 | 73 | 180 |
| height | 78 | 64.19872 | 2.820771 | 58 | 70 |
| bust | 81 | 34.81813 | 3.580056 | 27.12403 | 45.47272 |
| waist | 81 | 29.13896 | 3.053536 | 23.60008 | 38.4974 |
| hips | 81 | 37.33846 | 3.306578 | 30.29314 | 45.30112 |

**Figure 2.1 Summary of Variables for 13-year-old Participants in Inches**

| Variable | N | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| weight | 18 | 121.7222 | 20.30012 | 96 | 155 |
| height | 18 | 63.88889 | 2.291644 | 61 | 69 |
| bust | 18 | 35.34292 | 3.479311 | 30.28976 | 41.20343 |
| waist | 18 | 29.81458 | 3.405341 | 26.35038 | 38.4974 |
| hips | 18 | 37.95127 | 3.65524 | 32.28674 | 44.81946 |

**Figure 2.2 Summary of Variables for 14-year-old Participants in Inches**

| Variable | N | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| weight | 17 | 115.1765 | 22.53951 | 73 | 163 |
| height | 17 | 64.73529 | 3.255369 | 58 | 69 |
| bust | 20 | 34.25871 | 3.611311 | 28.94264 | 44.46084 |
| waist | 20 | 28.70448 | 3.116907 | 23.60008 | 37.68207 |
| hips | 20 | 36.53076 | 3.072222 | 30.29314 | 43.77674 |

**Figure 2.3 Summary of Variables for 15-year-old Participants in Inches**

| Variable | N | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| weight | 20 | 121.125 | 20.56432 | 88.5 | 170 |
| height | 20 | 64.575 | 2.482968 | 61 | 70 |
| bust | 20 | 33.93947 | 3.180934 | 27.12403 | 39.47598 |
| waist | 20 | 28.57064 | 1.727024 | 25.86862 | 31.74903 |
| hips | 20 | 37.60946 | 3.104086 | 33.95165 | 45.00064 |

**Figure 2.4 Summary of Variables for 16-year-old Participants in Inches**

| Variable | N | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| weight | 14 | 124.3214 | 25.78954 | 89 | 180 |
| height | 14 | 63.64286 | 3.718088 | 58 | 69 |
| bust | 14 | 35.68102 | 4.010979 | 30.09 | 45.47272 |
| waist | 14 | 29.55141 | 3.684232 | 24.85014 | 38.40741 |
| hips | 14 | 37.72324 | 3.499192 | 32.76697 | 45.30112 |

**Figure 2.5 Summary of Variables for 17-year-old Participants in Inches**

| Variable | N | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| weight | 9 | 121.1667 | 26.32727 | 85 | 160 |
| height | 9 | 63.83333 | 2.29129 | 59 | 66.5 |
| bust | 9 | 35.62201 | 3.991708 | 28.01238 | 41.26628 |
| waist | 9 | 29.37459 | 3.703757 | 23.75284 | 34.43983 |
| hips | 9 | 37.40007 | 3.675315 | 32.31984 | 43.23247 |

## Appendix C

**Figure 3.1 Summary of Bust, Waist and Hips if the Bust Measurement is less than 29 inches**

| Variable | N | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| bust | 4 | 28.26519 | 0.8828854 | 27.12403 | 28.98169 |
| waist | 4 | 25.61463 | 1.796263 | 23.75284 | 27.50514 |
| hips | 4 | 32.3759 | 1.542842 | 30.29314 | 33.95165 |

**Figure 3.2 Summary of Bust, Waist and Hips if the Bust Measurement is between 29 and 30 inches**

| Variable | N | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| bust | 0 | | | | |
| waist | 0 | | | | |
| hips | 0 | | | | |

**Figure 3.3 Summary of Bust, Waist and Hips if the Bust Measurement is between 30 and 31 inches**

| Variable | N | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| bust | 5 | 30.33123 | 0.3196741 | 30.06067 | 30.85545 |
| waist | 5 | 26.21768 | 2.221908 | 23.60008 | 29.25397 |
| hips | 5 | 34.51995 | 1.919265 | 32.76697 | 37.43449 |

**Figure 3.4 Summary of Bust, Waist and Hips if the Bust Measurement is between 31 and 32 inches**

| Variable | N | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| bust | 11 | 31.57132 | 0.330609 | 31.05647 | 31.95966 |
| waist | 11 | 27.0132 | 0.6980246 | 25.98721 | 28.11017 |
| hips | 11 | 35.12173 | 1.444166 | 33.39317 | 37.8854 |

**Figure 3.5 Summary of Bust, Waist and Hips if the Bust Measurement is between 32 and 33 inches**

| Variable | N | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| bust | 6 | 32.4474 | 0.2034585 | 32.27119 | 32.83463 |
| waist | 6 | 27.70713 | 1.693525 | 25.26764 | 30.33782 |
| hips | 6 | 35.57027 | 1.383203 | 33.75331 | 37.91028 |

**Figure 3.6 Summary of Bust, Waist and Hips if the Bust Measurement is between 33 and 34 inches**

| Variable | N | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| bust | 7 | 33.55664 | 0.3607115 | 33.1234 | 33.95932 |
| waist | 7 | 28.08959 | 1.551882 | 25.53236 | 30.02967 |
| hips | 7 | 36.31916 | 0.7291216 | 35.44879 | 37.29257 |

**Figure 3.7 Summary of Bust, Waist and Hips if the Bust Measurement is between 34 and 35 inches**

| Variable | N | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| bust | 11 | 34.38509 | 0.3138821 | 34.03786 | 34.93915 |
| waist | 11 | 28.52724 | 1.637888 | 26.49092 | 31.21387 |
| hips | 11 | 36.86083 | 2.455046 | 32.71587 | 41.63633 |

**Figure 3.8 Summary of Bust, Waist and Hips if the Bust Measurement is between 35 and 36 inches**

| Variable | N | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| bust | 11 | 35.39531 | 0.294739 | 35.06034 | 35.97512 |
| waist | 11 | 28.83157 | 1.217892 | 26.66579 | 30.42703 |
| hips | 11 | 36.86355 | 2.296115 | 32.28674 | 40.31393 |

**Figure 3.9 Summary of Bust, Waist and Hips if the Bust Measurement is between 36 and 37 inches**

| Variable | N | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| bust | 6 | 36.40046 | 0.3274259 | 36.00194 | 36.86509 |
| waist | 6 | 29.7484 | 2.182569 | 25.96297 | 32.03009 |
| hips | 6 | 38.59499 | 2.086731 | 35.34973 | 41.45916 |

**Figure 3.10 Summary of Bust, Waist and Hips if the Bust Measurement is between 37 and 38 inches**

| Variable | N | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| bust | 7 | 37.5164 | 0.3816993 | 37.00014 | 37.97449 |
| waist | 7 | 30.79167 | 2.445743 | 28.25874 | 34.93382 |
| hips | 7 | 39.93841 | 2.104909 | 36.15329 | 42.45673 |

**Figure 3.11 Summary of Bust, Waist and Hips if the Bust Measurement is between 38 and 39 inches**

| Variable | N | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| bust | 2 | 38.59413 | 0.286666 | 38.39142 | 38.79683 |
| waist | 2 | 32.67708 | 2.704804 | 30.7645 | 34.58967 |
| hips | 2 | 39.98132 | 4.659783 | 36.68635 | 43.27628 |

**Figure 3.12 Summary of Bust, Waist and Hips if the Bust Measurement is between 39 and 40 inches**

| Variable | N | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| bust | 3 | 39.52402 | 0.0424815 | 39.47598 | 39.55664 |
| waist | 3 | 32.52578 | 1.667396 | 31.38847 | 34.43983 |
| hips | 3 | 41.8216 | 4.072104 | 37.2317 | 45.00064 |

**Figure 3.13 Summary of Bust, Waist and Hips if the Bust Measurement is between 40 and 41 inches**

| Variable | N | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| bust | 4 | 40.48015 | 0.2347761 | 40.17297 | 40.72797 |
| waist | 4 | 33.84941 | 3.150757 | 31.5788 | 38.4974 |
| hips | 4 | 42.45975 | 1.718721 | 41.15156 | 44.81946 |

**Figure 3.14 Summary of Bust, Waist and Hips if the Bust Measurement is between 41 and 42 inches**

| Variable | N | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| bust | 2 | 41.23486 | 0.044445 | 41.20343 | 41.26628 |
| waist | 2 | 33.64818 | 1.575081 | 32.53443 | 34.76193 |
| hips | 2 | 40.93299 | 2.032902 | 39.49551 | 42.37047 |

**Figure 3.15 Summary of Bust, Waist and Hips if the Bust Measurement is between 42 and 43 inches**

| Variable | N | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| bust | 2 | 44.96678 | 0.7155092 | 44.46084 | 45.47272 |
| waist | 2 | 38.04474 | 0.5128914 | 37.68207 | 38.40741 |
| hips | 2 | 44.53893 | 1.077902 | 43.77674 | 45.30112 |

**Figure 3.16 Summary of Bust, Waist and Hips if the Hip Measurement is between 30 than 31 inches**

| Variable | N | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| bust | 1 | 28.94264 | - | 28.94264 | 28.94264 |
| waist | 1 | 24.45158 | - | 24.45158 | 24.45158 |
| hips | 1 | 30.29314 | - | 30.29314 | 30.29314 |

**Figure 3.16 Summary of Bust, Waist and Hips if the Hip Measurement is between 31 than 32 inches**

| Variable | N | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| bust | 0 | | | | |
| waist | 0 | | | | |
| hips | 0 | | | | |

**Figure 3.17 Summary of Bust, Waist and Hips if the Hip Measurement is between 32 than 33 inches**

| Variable | N | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| bust | 5 | 31.27158 | 3.18411 | 28.01238 | 35.20313 |
| waist | 5 | 25.81934 | 1.46482 | 23.75284 | 27.25385 |
| hips | 5 | 32.60568 | 0.2883873 | 32.28674 | 32.93898 |

**Figure 3.18 Summary of Bust, Waist and Hips if the Hip Measurement is between 33 than 34 inches**

| Variable | N | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| bust | 8 | 31.22859 | 2.36307 | 27.12403 | 35.52271 |
| waist | 8 | 26.32354 | 1.340338 | 23.60008 | 27.51561 |
| hips | 8 | 33.6341 | 0.2910829 | 33.24374 | 33.96507 |

**Figure 3.19 Summary of Bust, Waist and Hips if the Hip Measurement is between 34 than 35 inches**

| Variable | N | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| bust | 6 | 32.05876 | 1.174671 | 31.05647 | 34.25625 |
| waist | 6 | 27.07665 | 0.7966118 | 26.16262 | 28.10781 |
| hips | 6 | 34.58093 | 0.3786437 | 34.12053 | 34.98343 |

**Figure 3.20 Summary of Bust, Waist and Hips if the Hip Measurement is between 35 than 36 inches**

| Variable | N | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| bust | 10 | 33.13985 | 1.456149 | 30.85545 | 36.00194 |
| waist | 10 | 27.0796 | 1.055806 | 25.53236 | 28.46413 |
| hips | 10 | 35.4332 | 0.2349682 | 35.04485 | 35.82121 |

**Figure 3.21 Summary of Bust, Waist and Hips if the Hip Measurement is between 36 than 37 inches**

| Variable | N | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| bust | 10 | 34.81212 | 1.972783 | 31.87482 | 38.39142 |
| waist | 10 | 28.81071 | 1.17092 | 26.88532 | 30.7645 |
| hips | 10 | 36.49258 | 0.289247 | 36.04846 | 36.86639 |

**Figure 3.22 Summary of Bust, Waist and Hips if the Hip Measurement is between 37 than 38 inches**

| Variable | N | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| bust | 13 | 34.3112 | 2.422368 | 30.36024 | 39.55664 |
| waist | 13 | 29.27253 | 1.690716 | 27.01652 | 32.03009 |
| hips | 13 | 37.466 | 0.3162885 | 37.05035 | 37.97408 |

**Figure 3.23 Summary of Bust, Waist and Hips if the Hip Measurement is between 38 than 39 inches**

| Variable | N | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| bust | 7 | 35.51184 | 1.276496 | 34.03786 | 37.83423 |
| waist | 7 | 29.21567 | 0.9516254 | 27.89803 | 30.42703 |
| hips | 7 | 38.42064 | 0.2858605 | 38.04979 | 38.83237 |

**Figure 3.24 Summary of Bust, Waist and Hips if the Hip Measurement is between 39 than 40 inches**

| Variable | N | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| bust | 5 | 37.67595 | 2.087737 | 36.09694 | 41.26628 |
| waist | 5 | 30.83586 | 1.334076 | 29.18236 | 32.53443 |
| hips | 5 | 39.55657 | 0.1080153 | 39.41657 | 39.70393 |

**Figure 3.25 Summary of Bust, Waist and Hips if the Hip Measurement is between 40 than 41 inches**

| Variable | N | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| bust | 1 | 35.42545 | - | 35.42545 | 35.42545 |
| waist | 1 | 30.05647 | - | 30.05647 | 30.05647 |
| hips | 1 | 40.31393 | - | 40.31393 | 40.31393 |

**Figure 3.26 Summary of Bust, Waist and Hips if the Hip Measurement is between 41 than 42 inches**

| Variable | N | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| bust | 6 | 37.96408 | 0.485783 | 34.13053 | 40.72797 |
| waist | 6 | 32.29926 | 1.902375 | 29.75163 | 34.93382 |
| hips | 6 | 41.38218 | 0.2494991 | 41.13371 | 41.69581 |

**Figure 3.27 Summary of Bust, Waist and Hips if the Hip Measurement is between 42 than 43 inches**

| Variable | N | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| bust | 3 | 39.61852 | 1.923043 | 37.47917 | 41.20343 |
| waist | 3 | 32.10236 | 2.440287 | 29.96634 | 34.76193 |
| hips | 3 | 42.4929 | 0.1439569 | 42.37047 | 42.65149 |

**Figure 3.28 Summary of Bust, Waist and Hips if the Hip Measurement is between 43 than 44 inches**

| Variable | N | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| bust | 3 | 40.93237 | 3.078222 | 38.79683 | 44.46084 |
| waist | 3 | 35.57052 | 1.830187 | 34.43983 | 37.68207 |
| hips | 3 | 43.4285 | 0.3023823 | 43.23247 | 43.77674 |

**Figure 3.29 Summary of Bust, Waist and Hips if the Hip Measurement is between 43 than 44 inches**

| Variable | N | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| bust | 3 | 41.79866 | 3.21868 | 39.47598 | 45.47272 |
| waist | 3 | 36.21795 | 3.870455 | 31.74903 | 38.4974 |
| hips | 3 | 45.04041 | 0.2432832 | 44.81946 | 45.30112 |