

3D Scans of Toddlers and Kids - A Serial Measurement Survey

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Abstract

Babies and toddlers have never been included in a serial measurement in Germany before. Accordingly, there has been no reliable size table to date. The last German serial measurement only provides data from size 116. [1] It is generally known that babies and toddlers have very different body proportions than teenagers or even adults. However, reliable body measurements are essential for the product development of children's clothing. 5626 children (girls and boys) between the ages of 4 weeks and 18 years were recorded using the Vitus Smart XXL 3D body scanner whenever possible. Babies and toddlers who could not stand still were measured manually with the tape measure. From the scans, over 40 measurements were taken and 20 measurements were evaluated for the body measurement charts. For the development of the charts, sizes were first defined starting from body height. In a second step, body measurements relevant for clothing production and avatar generation were evaluated, e.g. back width, arm length, waist to sole and inner leg length. One focus here was the gender-specific consideration of body geometries. In the project, sizes 56 to 182 were described for the first time on the basis of real body data. Development stages were defined. These are: Babies Gr. 56-92, toddlers (unisex) Gr. 98-110 and children, differentiated into girls and boys Gr. 116-188. Factors such as diaper wearing and from when on body geometries differed significantly between the sexes contributed to the differentiation. These showed that boys adopt an upright posture significantly earlier, while girls start this process later. The new children's study and analyses of the project, as well as the newly developed avatars, have made it possible to create customized measurement charts, pattern and gradings suitable for children, and an optimal fit for babies, toddlers and teenagers. Important insights into the development of the child's body have been gained

Keywords: 3D body scanning, serial measurement, body measurements, kids' sizes, avatars

1. Introduction

For the development of well-fitting clothing in mass production, reliable anthropometric data is required. Only in this way can sizes be described in tables that allow the widest possible market coverage. For this reason, in contrast to many other countries, serial measurements have been carried out on defined target groups in Germany for over 60 years. Thus, serial measurements of women and girls were carried out at the end of the 1950s [1], 1972 [2], 1981/82 [3] and 1994 [4]. Men were measured in 1960 [5] and 1978/79 [6].

Since the turn of the millennium, 3D body scanner systems have been used for this purpose. This technology has been utilized to measure corsetry measurements [7], special target groups such as big sizes [8, 9] and senior women [10], and the last large serial measurement in Germany [11]. Based on the acquired 3D scans, body measurement charts were developed in each case, which are used as the basis for the respective company-specific body measurement charts. In addition to the one-dimensional body measurements, it is also possible to provide information on consumer body types, through which designers and manufacturers can improve the fit of garments [12].

Babies and toddlers have never been included in a serial measurement in Germany before. They represent a particularly challenging target group. Accordingly, there has been no reliable size table to date. The last German serial measurement only provides data from size 116. [11] Companies had to extrapolate downwards or use rather old data from France [13] or Switzerland [14]. The sizing surveys were proceeded with measurement tape or did not provide 3D body geometry. Yet, it is generally known that babies and toddlers have very different body proportions than teenagers or even adults. However, reliable body measurements are essential for the product development of children's clothing. This makes 3D avatars of babies and toddlers with realistic body geometries all the more important for the digital pipeline. [15, 16]. Therefore, the research aim was to conduct a kids sizing survey utilizing 3D scanning techniques.

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2. Method

Bodyscanning system Vitus Smart XXL was utilized whenever possible to capture 3D data. Therefore, a child-friendly scan environment was created. The booth was not darkened and parents were asked to stay in the booth with their children. A monitor was showing kids movies. All scans were assessed regarding straylights and artifacts. Both were erased manually to provide good scan quality as a basis for semi-automatic measurement acquisition. Software ScanWorx was used to perform measurements. Babies and toddlers who could not stand still were measured manually with the tape measure. From the scans, over 40 measurements were taken and 20 measurements were evaluated for the body measurement charts. For the development of the charts, sizes were first defined starting from body height. In a second step, body measurements relevant for clothing production and avatar generation were evaluated, e.g. back width, arm length, waist to sole and inner leg length. One focus here was the gender-specific consideration of body geometries.

3. Results

5626 children (girls and boys) between the ages of 4 weeks and 18 years participated at the sizing survey.

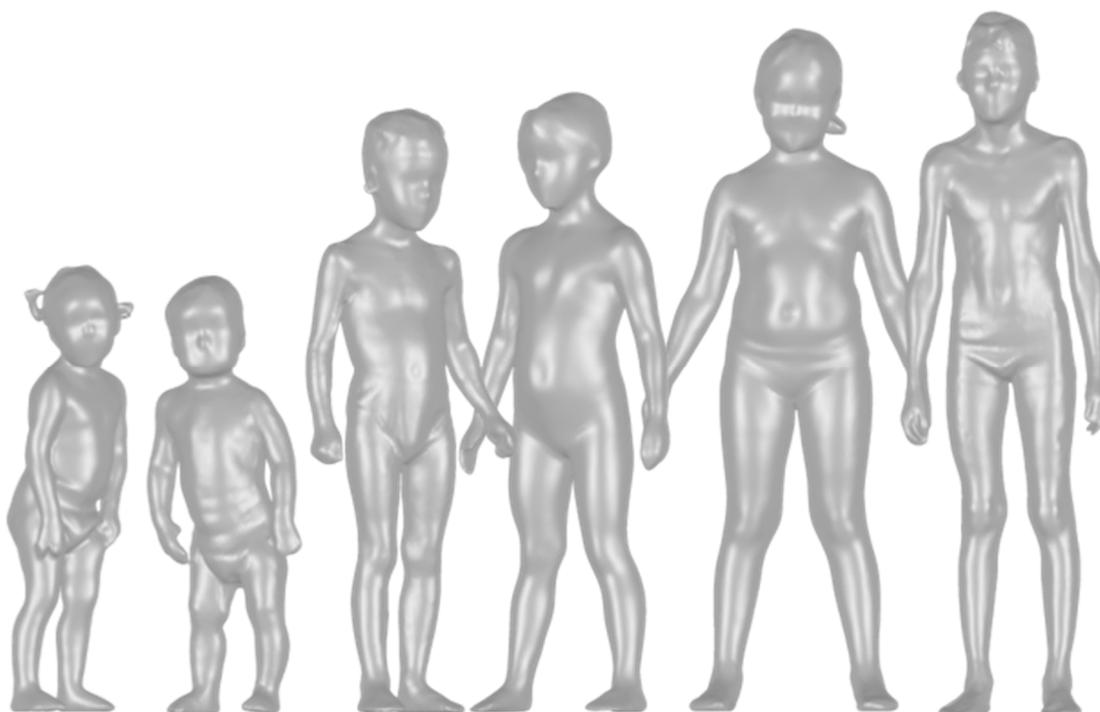


Figure 1. Kids scans.

In the project, sizes 56 to 182 were described for the first time on the basis of real body data in Germany. Development stages were defined to categorize the special requirements of each group. These are: Babies size 56-92, toddlers (unisex) size 98-110 and children, differentiated into girls and boys size 116-188. Babies wear a diaper and mainly lie or sit. From clothing size 74, the majority of the children are standing and could be recorded in the scanner with or without assistance. From size 98 onwards, the children mainly no longer wear a diaper. And finally, at size 116, there are sometimes clear differences in body geometry and body measurements between girls and boys.

A comprehensive analysis of the measurements was carried out. The aim was to generate a reliable body size chart and to better understand the physical development of children. The question was what body dimensions, body geometries and postures are prioritized in each size? Are there gender differences? And finally does all this has to be taken into account for pattern creation. Some results are shown below. After the clustering into the sizes according to body height, bust/chest girth was defined (see Figure 2).

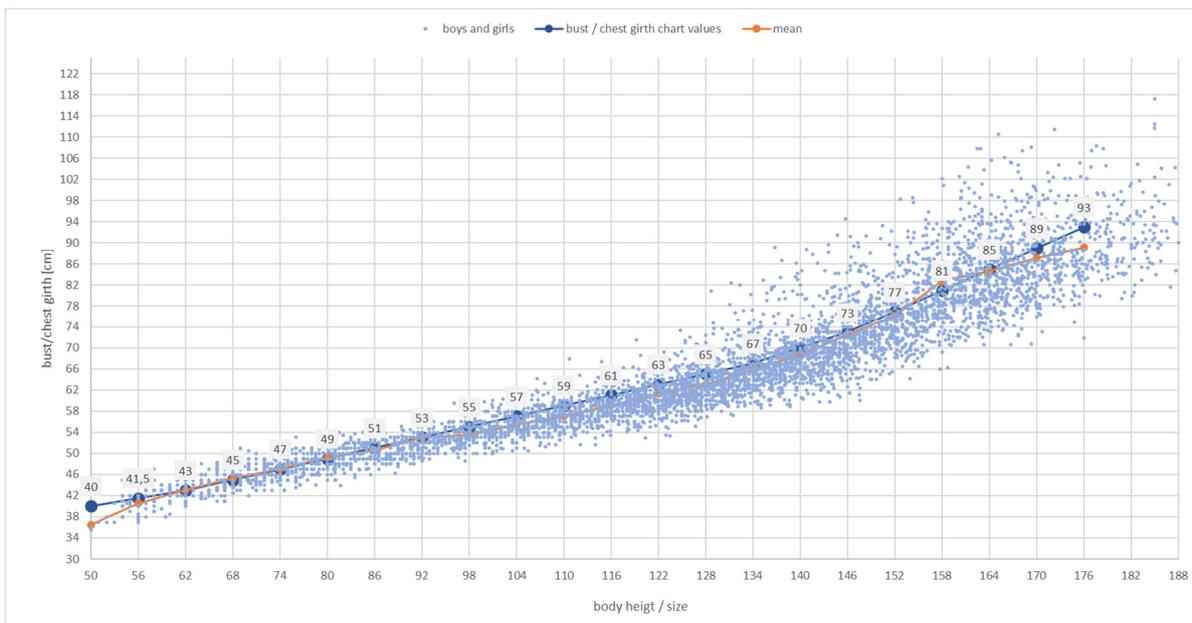


Figure 2. Correlation of body height and bust/chest girth.

Diaper wearing was considered in the size chart. As diapers are worn underneath the babies' garment, they are for pattern development to be viewed as part of the body and hip girth was measured without and with diaper.

Investigation the difference between boys and girls body measurements and geometry showed that beside other findings boys adopt an upright posture significantly earlier, while girls start this process later. Fig. 3 demonstrates this result with two individual scans in size 122 both in side view. On the left a boy standing upright on the left a girl with less tension in the trunk. It shows a hollow back and the belly is stuck out.

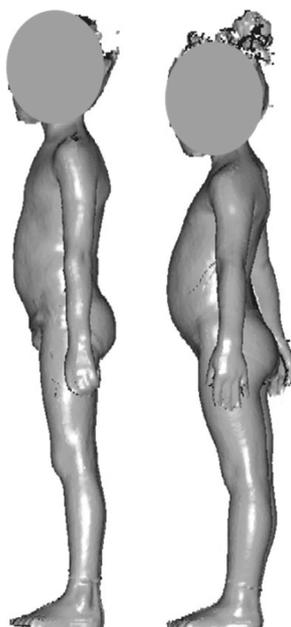


Figure 3. Individual scan of a boy (left) and a girl (right) with sizes 122.

In addition, the data shows that trunk and leg length are growing not uniformly. Trunk length is increasing from size to size in smaller steps than inner leg length (see Fig. 4 and 5). This leads to an increase in body height mainly due to the growth of legs in sizes 98 to 116. Comparing boys and girls there are no significant differences between the values of inner leg length and trunk length in each size.

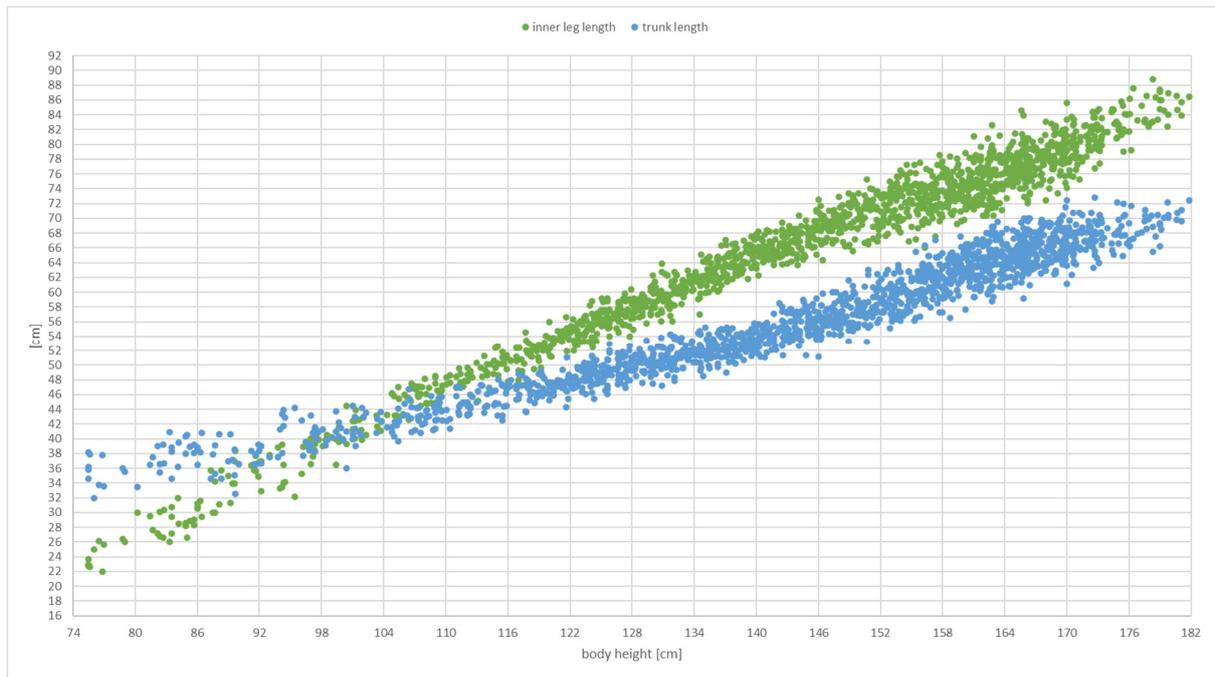


Figure 4. correlation of inner leg length and trunk length to body height – girls.

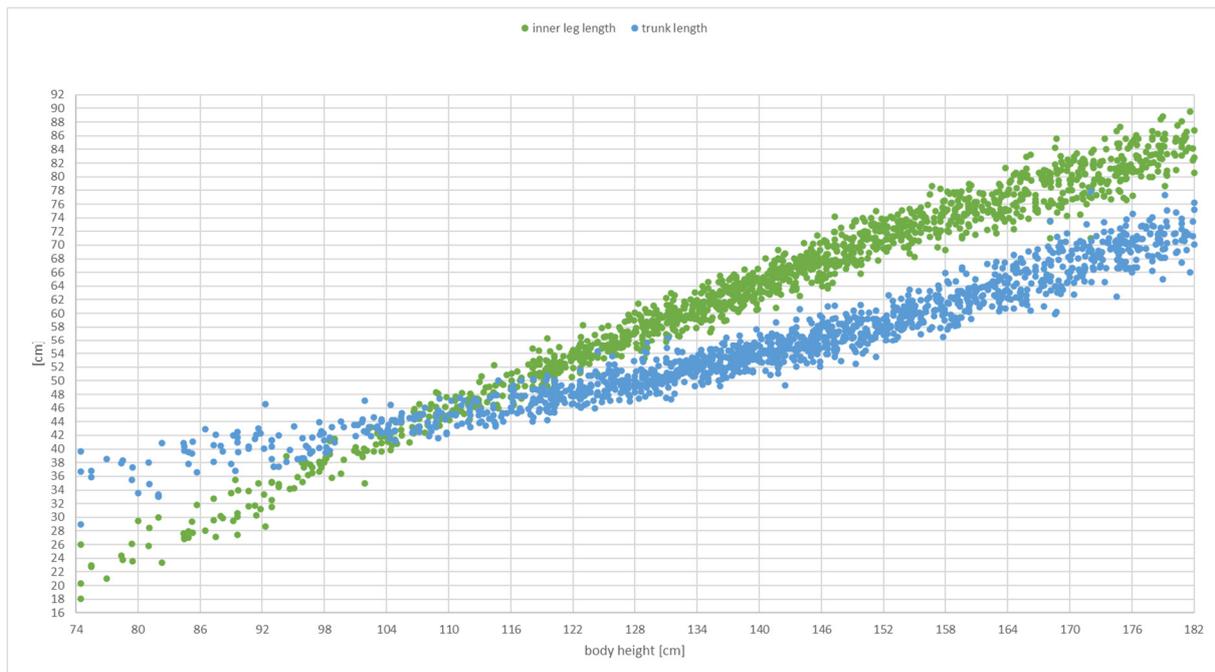


Figure 5. correlation of inner leg length and trunk length to body height – boys.

While the analysis of different body length did not show any significant differences between boys and girls, there are differences within the girths. The hip/waist ratio shows identical values up to size 110. Starting with size 116 girls become more prominent hips and the difference between hip girth and waist girth is increasing faster (see Tab. 1).

Table 1. Differences between hip and waist girth, sizes 116-176.

	size	116	122	128	134	140	146	152	158	164	170	176
Difference hip girth minus waist girth [cm]	girls	10,5	11,0	11,5	12,5	13,5	15,5	17,5	19,0	20,5	21,5	22,5
	boys	7,0	8,0	9,0	10,0	11,0	13,0	15,0	16,0	17,0	18,0	19,0

4. Conclusion

The new children's study and analyses of the project have made it possible to create customized measurement charts, pattern and gradings suitable for children, and an optimal fit for babies, toddlers and teenagers. The charts are linked to SizeGERMANY size charts to provide a smooth transition. Important insights into the development of the child's body have been gained. Measuring babies presented a particular challenge. Since the measurements are taken in a lying position, there are differences compared to the measurements taken on the digital scan. This had to be particularly taken into account in the development of the tables. Although findings indicate that there are differences between boys and girls from an early stage on, from an economic point of view is an implementation of different pattern for the two target groups only advisable from size 116 on. From this size on the body geometry is changing in that amount, that it can no longer be absorbed by pure design adjustments. The hollow back that girls shown in more sizes than boys as well as the greater hip/waist ratio of girls need to be considered in pattern development.

Based on the findings new kids' avatars were generated. They provide a reliable foundation for 3D garment simulation regarding body measurements, geometry and body posture of the investigated target group.

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