Comparison of Anthropometric Measurements of Children Population: Past and Present

Usporedba antropometrijskih mjera dječje populacije nekad i danas

Scientific paper / Znanstveni rad

Renata Hrženjak*, Blaženka Brlobašić Šajatović

University of Zagreb Faculty of Textile Technology, Department of Clothing Technology, Prilaz baruna Filipovića 28a, 10000, Zagreb, Croatia
*****Correspondence: renata.hrzenjak@ttf.unizg.hr

Abstract
Changes in the anthropometric characteristics of the population reflect changes in growth and development and provide an important basis for developing and updating clothing size systems. Contemporary anthropometric studies enable comparisons with data collected in earlier research and provide insight into changes in the body dimensions of children and adolescents over time. The aim of this study was to compare selected anthropometric measurements of girls from the clothing size system based on the Croatian Standard (HRN), developed from anthropometric data collected in 1962/1963, with the currently valid HRI 1148:2012 (Croatian Technical Report) clothing size system. The comparison was performed by analysing selected anthropometric measurements, and the results were presented in graphical form. The findings indicate changes in specific body dimensions between the two clothing size systems, highlighting the need for continuous monitoring and periodic updating in accordance with the current anthropometric characteristics of the population.

Keywords: anthropometric research; clothing size system; standard; children population

Sažetak
Promjene antropometrijskih obilježja stanovništva odražavaju promjene u rastu i razvoju te predstavljaju važnu osnovu za razvoj i ažuriranje sustava veličina odjeće. Rezultati suvremenih antropometrijskih istraživanja omogućuju usporedbu s podacima prikupljenima u ranijim istraživanjima te pružaju uvid u promjene tjelesnih dimenzija djece i mladih tijekom vremena. Cilj ovog rada bio je usporediti odabrane antropometrijske mjere djevojaka između sustava veličina odjeće prema Hrvatskoj normi (HRN), temeljenog na antropometrijskim podacima iz 1962./1963. godine, i trenutno važećeg sustava HRI 1148:2012 (Hrvatski tehnički izvještaj). Usporedba je provedena analizom odabranih antropometrijskih mjera, a rezultati su prikazani grafički. Dobiveni rezultati ukazuju na promjene pojedinih tjelesnih mjera između dvaju sustava veličina odjeće, što potvrđuje potrebu za njihovim kontinuiranim praćenjem i periodičnim usklađivanjem s aktualnim antropometrijskim obilježjima populacije.

Ključne riječi: antropometrijska istraživanja; sustav veličina odjeće; standard; dječja populacija

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1. Introduction

The average anthropometric characteristics of the population have changed considerably over recent decades as a result of changes in growth and development, lifestyle, dietary habits, and other socioeconomic factors. Monitoring these changes enables the identification of secular trends and provides the basis for the development and periodic updating of clothing size systems. Most countries have developed national sizing systems based on anthropometric surveys conducted on representative population samples. These systems differ according to the characteristics of the population and the period during which the anthropometric data were collected [1, 2].

In the Republic of Croatia, the Croatian Technical Report (HRI) was developed to establish a national clothing size system aligned with the anthropometric characteristics of the Croatian population [3]. The HRI system replaced the former HRN clothing size system, which originated from the former Yugoslav Standard (JUS). To develop the HRI system, a comprehensive anthropometric survey was conducted on a representative sample of the Croatian population. The survey included 2589 girls aged 12–16 years.

The JUS system, and subsequently the HRN clothing size system, was based on an anthropometric survey conducted between 1962 and 1963 in the Autonomous Province of Vojvodina. The study included 5,000 participants of both sexes aged 2–55 years, and the resulting data served as the basis for the development of a unified clothing size system for the former Yugoslavia. Following Croatia's independence, the JUS standards were renamed HRN, and their application was discontinued in 2008 [1, 2].

Given the secular changes in anthropometric characteristics over time, comparing data obtained from the HRN and HRI systems provides valuable insight into changes in body dimensions and their implications for the development of modern clothing size systems. Such comparisons are particularly important in apparel design and garment manufacturing.

The aim of this study was to compare selected anthropometric measurements of girls aged 12–16 years between the former HRN clothing size system and the currently valid HRI clothing size system in the Republic of Croatia. The comparison was based on the analysis of selected body measurements, and the results are presented in graphical form to identify changes in anthropometric characteristics over time.

2. Experimental part

The study sample comprised 2589 girls aged 12–16 years from the Republic of Croatia. The anthropometric survey was conducted between 2005 and 2007 with the aim of collecting and analyzing anthropometric data on the Croatian population to support the development of modern clothing size systems and their application in the apparel industry. Anthropometric measurements were performed in accordance with the requirements of international ISO standards for human body measurement using standard anthropometric instruments and predefined measurement protocols (ISO 8559-1–2 and HRN EN 13402-3:2017) [4-6]. The descriptive analysis and processing of anthropometric measurements were conducted using the SPSS statistical software package and relevant scientific and professional literature [7-9].

Table 1. Sizing system for girls' outerwear (ages 12–16) according to HRN standards based on primary body measurements (in cm)

Clothing size	12/146	13/152	14/158	15/162	16/166
Body height	146	152	158	162	166
Bust girth	76	80	84	88	92
Waist girth	65	66	67	68	69
Hip girth	82	86	90	94	98

The body measurements according to the HRN system used in this study are based on the standards for the designation of clothing sizes for girls' outerwear and underwear (HRN F.GO.006), as presented in Table 1 [10-12].

3. Results and Discussion

The primary measurement used for sizing children's clothing, whether intended for infants, young children, boys, adolescent boys, girls, or adolescent girls, is body height, rather than chronological age. This approach is based on the fact that children of the same age may exhibit considerable differences in height throughout growth and development [1, 13]. In addition to height, the key anthropometric measurements used in the development of clothing size systems are chest, waist, and hip girths. These measurements were therefore selected for

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presenting the results and comparing different clothing sizing systems.

The graph (Figure 1) shows the average body height of subjects aged 12 to 16 in the two observed groups (HRI and HRN). In both groups, there is a trend of increasing average body height with age, with different growth dynamics.

When the groups are compared, it is clear that subjects in the HRI group have a higher average height between the ages of 12 and 15. The difference between the groups gradually decreases from 9 cm at age 12 (155 cm versus 146 cm) to 3 cm at age 15 (165 cm versus 162 cm). At age 16, the HRN group records a higher average body height than the HRI group for the first time (166 cm versus 165 cm).

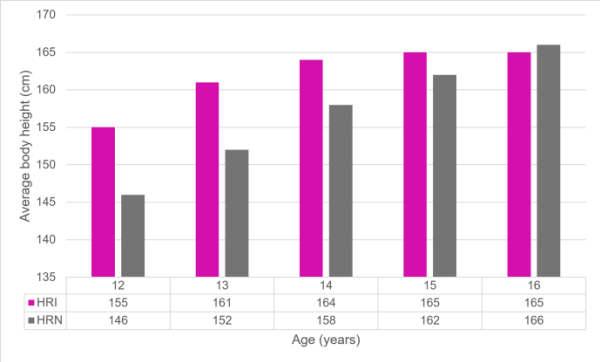


Figure 1. Average body height values of girls by age according to HRI and HRN [7, 10-12]

Figure 2 shows the average bust girth of girls aged 12–16 years according to the HRI and HRN clothing size systems. In both systems, the average bust girth increases with age; however, the pattern of growth differs slightly between them.

In the HRI system, the average bust girth increases from 76 cm at 12 years to 88 cm at 16 years, representing an overall increase of 12 cm. In the HRN system, the corresponding values increase from 76 cm to 92 cm, resulting in a total increase of 16 cm over the same age period. At 12 years of age, both systems report the same average bust girth (76 cm). At ages 13 and 14, the HRI values are slightly higher than those of the HRN system by 1 cm (81 vs 80 cm and 85 vs 84 cm, respectively). At ages 15 and 16, the HRN system reports larger average bust girths than the HRI system, with differences of 1 cm (88 vs 87 cm) and 4 cm (92 vs 88 cm), respectively.

Overall, the results indicate that the HRI system records slightly larger average bust girths during early adolescence, whereas the HRN system shows a more pronounced increase in later adolescence, resulting in higher average values at 16 years of age.

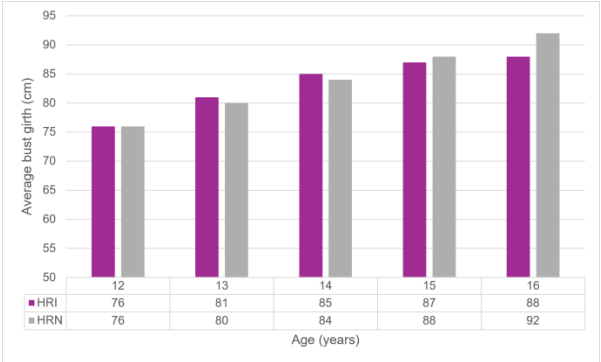


Figure 2. Average bust girth values of girls by age according to HRI and HRN [7, 10-12]

Figure 3 presents the average waist girth of girls aged 12–16 years according to the HRI and HRN clothing size systems. In both systems, the average waist girth generally increases with age, although the magnitude of the increase differs between the two datasets. In the HRI system, the average waist girth rises from 66 cm at age 12 to a maximum of 72 cm at 15, followed by a slight decrease to 71 cm at 16. Overall, the increase from 12 to 16 years is 5 cm. In the HRN system, the average waist girth increases steadily from 65 cm at age 12 to 69 cm at 16, representing a total increase of 4 cm. Across all age groups, the HRI system reports higher average waist girth values than the HRN system. The differences are 1 cm at ages 12 and 13, 2 cm at age 14, and 4 cm at ages 15 and 16. The largest discrepancy is therefore observed in the older age groups.

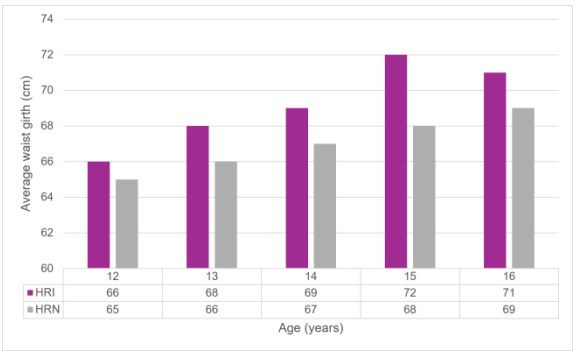


Figure 3. Average waist girth values of girls by age according to HRI and HRN [7, 10-12]

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Finally, the results indicate that girls included in the HRI clothing size system have consistently larger average waist girths than those represented in the HRN system, with the differences becoming more pronounced during late adolescence.
Figure 4 presents the average hip girth of girls aged 12–16 years according to the HRI and HRN clothing size systems. In both systems, the average hip girth increases with age; however, slight differences are observed between them.

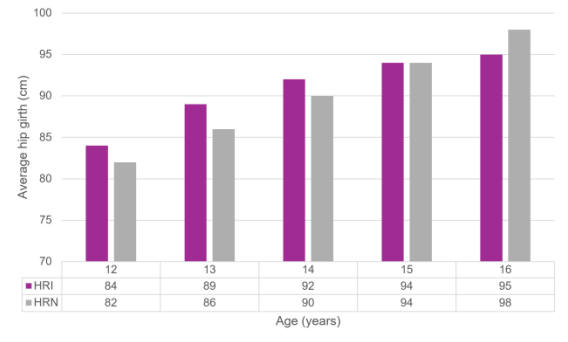


Figure 4. Average hip girth values of girls by age according to HRI and HRN [7, 10-12]

In the HRI system, the average hip girth increases from 84 cm at the age of 12 years to 95 cm at 16 years, representing an overall increase of 11 cm. In the HRN system, the average hip girth increases from 82 cm to 98 cm over the same age range, corresponding to a total increase of 16 cm.

The HRI system reports higher average hip girth values than the HRN system at ages 12–14, with differences of 2 cm at age 12 (84 vs. 82 cm), 3 cm at age 13 (89 vs. 86 cm), and 2 cm at age 14 (92 vs. 90 cm). At the age of 15 years, both systems report the same average hip girth (94 cm). By the age of 16 years, the HRN system exceeds the HRI value by 3 cm (98 vs. 95 cm).

These results indicate that girls represented in the HRI clothing size system have slightly larger average hip girths during early adolescence, whereas the HRN system shows a greater increase in hip girth with age, resulting in higher average values at 16 years of age.

4. Conclusions

Comparison of selected anthropometric measurements of girls aged 12–16 years between the former HRN clothing size system and the current HRI clothing size system revealed changes in several body dimensions over time. The results confirm the presence of secular changes in anthropometric characteristics, which should be taken into account when developing and updating clothing size systems.

Compared with the HRN system, girls included in the HRI survey showed greater average body height, waist girth, and hip girth in the younger age groups, while differences in bust girth were less pronounced. In the older age groups, a different trend was observed: body height, bust girth, and hip girth values in the HRN system reached or exceeded those recorded in the HRI system, whereas waist girth remained consistently higher in the HRI system across the entire age range.

These findings indicate changes in the growth patterns and body proportions of girls compared with data collected in the early 1960s. Such changes show that clothing size systems based on outdated anthropometric data may no longer accurately represent the current body characteristics of the population. Therefore, regular anthropometric surveys are essential to ensure that clothing size systems remain aligned with contemporary anthropometric characteristics, thereby improving garment fit, functionality, and wearer comfort.

The results of this study highlight the importance of continuous monitoring of anthropometric changes in the population and provide a valuable basis for further development and improvement of the national clothing size system in the Republic of Croatia.
Type your text here. Type your text here. Type your text here. Type your text here. Type your text here. References should be numbered in order of appearance and indicated by a numeral or numerals in square brackets i.e., [1] or [2, 3], or [4-6].

References

[1] Ujević D. et al.: Theoretical Aspects and Application of Croatian Anthropometric System (CAS), Zrinski, 2010

DOI: 10.34187/ko.75.2.1

[2] Hrženjak R. i sur.: Usporedba tjelesnih mjera djevojčica i dječaka prema JUS i HAS sustavu, 2. Znanstveno-stručno savjetovanje Tekstilna znanost i gospodarstvo, Bischof Vukušić, S. (ur.), Sveučilište u Zagrebu Tekstilno-tehnološki fakultet, Zagreb 2009., 179-182

[3] Anthropometric system – measuring and size designation of clothes and footwear, Croatian Technical Report, HRI 1148:2012 hr, HZN, February 2012, ICS: 01.040.61:61.020.

[4] HRN EN ISO 8559-1:2021: Size designation of clothes -- Part 1: Anthropometric definitions for body measurement (ISO 8559-1:2017; EN ISO 8559-1:2020)

[5] HRN EN ISO 8559-2:2025: Size designation of clothes -- Part 2: Primary and secondary dimension indicators (ISO 8559-2:2025; EN ISO 8559-2:2025)

[6] HRN EN 13402-3:2017: Size designation of clothes -- Part 3 Size labelling based on body measurements and intervals (EN 13402-3:2017)

[7] Hrženjak R.: Influence of body proportions of children and youth as the basis for clothing construction, PhD Thesis, University of Zagreb Faculty of Textile Technology, Zagreb, 2012

[8] Pallant J.: SPSS survival manual: A step-by-step guide to data analysis using SPSS, Belgrade: Mikro Knjiga, 2011

[9] Horvat J.: Statistics by SPSS/PC+. Osijek: Faculty of Economics, J. J. Strossmayer University, 1995

[10] HRN F.GO.006 – Girls children outerwear, Croatian Standards Institute, Zagreb, Croatia

[11] Hrženjak R et al.: Development of sizing system for girls aged 6 to 12 years in Croatia. Coll Antropol 37 (2013) 4, 1095-1103

[12] Hrženjak R et al.: Sizing system for girls aged 13–20 years based on body types, Textile Research Journal 85 (2015) 12, 1293-1304 doi:10.1177/0040517514559579

[13] Hrženjak R. et al.: Anthropometric Investigations of Children in the Republic of Croatia, 4th International Textile, Clothing & Design Conference – Magic World of Textiles, Dragčević, Z. (Ed.), Faculty of Textile Technology University of Zagreb, Dubrovnik, Croatia 2008, 599-604

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