Nikolić, D., Stošić, K., Stanković, M., Đorđević, J., Stamenković, S., Mitić, D., & Đorđević, S. (2026). Prevalence of overweight and obesity in preschool children in Bujanovac according to the WHO and CDC recommendations, *Sport media and business*, 12(2), 86-96

Original scientific paper
Received: 20.5.2026
Accepted: 19.6.2026

UDK: 613.95:796
613.25-053.4
DOI: https://doi.org/10.58984/smb2602096n

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PREVALENCE OF OVERWEIGHT AND OBESITY IN PRESCHOOL CHILDREN IN BUJANOVAC ACCORDING TO THE WHO AND CDC RECOMMENDATIONS

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Abstract: *The rising incidence of childhood obesity among preschoolers presents a substantial global public health challenge, with rates climbing to epidemic levels. This study aims to evaluate the occurrence of overweight and obesity among young children in Bujanovac utilizing benchmarks from the World Health Organization (WHO) and the Centers for Disease Control and Prevention (CDC). The analyzed cohort comprised attendees of the "Naša radost" kindergarten in Bujanovac. A group of 106 individuals took part, consisting of 50 boys (47%) and 56 girls (53%), aged between 3 and 6 years (44–77 months). Anthropometric metrics including body mass and height were documented for each subject to determine their Body Mass Index (BMI). These BMI calculations were subsequently benchmarked against WHO and CDC reference frameworks. Under the WHO standard, 11.3% of the subjects were identified as overweight and 14.2% as obese. Concurrently, the CDC guidelines identified 13.2% as overweight and 12.3% as obese. Both evaluation metrics yielded an identical aggregated overweight and obesity rate of 25.5%. These outcomes indicate that excess body mass among preschoolers in Bujanovac aligns with trends seen in Western Europe while surpassing figures documented across Middle Eastern and African regions. Furthermore, no statistically meaningful variation appeared between the WHO and CDC interpretive models for defining weight categories within this sample (p=0.716). The notable presence of excess weight documented here highlights an urgent necessity for targeted preventive initiatives and public health frameworks designed to lower these metrics and mitigate the long-term health risks linked to early childhood obesity.*

Keywords: obesity, preschool children, overweight, BMI index, southern Serbia.

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Introduction

The expansion of early childhood obesity is escalating (Gebremedhin, 2015) and poses a significant challenge to international public health frameworks, as international figures reach crisis levels (Wang et al., 2022). Existing data indicates that the most pronounced concentration of excess weight and obesity in early childhood is situated within North America, though European metrics demonstrate similarly concerning trends. Conversely, specific analyses from Asian and African territories suggest that regional cohorts have not yet reached the high levels of weight escalation observed among their North American and European counterparts (Nikolić, Gadžić & Stamenković, 2022). The volume of childhood weight elevation throughout Europe remains substantial. For children under the age of five, regional overweight and obesity numbers fluctuate broadly between 1% and 28.6% (Mantzorou et al., 2023). Inquiries focused on our specific geographic zone demonstrate that young populations in Serbia closely match European averages regarding weight elevation percentages (Jovanović et al., 2010; Đurašković et al., 2012; Stupar, Popović & Vujović, 2014; Ilić, 2014; Međedović et al., 2014; Cvetković & Cvetković, 2018; Pelemiš et al., 2021). The highest probability of carrying obesity into mature adulthood is tied to having obese parents or exhibiting high weight characteristics between three and ten years of age. It is hypothesized that approximately 30% of obese adults displayed high weight parameters during their youth (Đurašković et al., 2012).

According to the WHO, overweight and obesity are defined as an excessive accumulation of fat that can endanger health (Ilić, 2014, Vuceraković & Mitrović, 2021). Among youth cohorts, obesity is characterized by an inflation of body mass exceeding standard reference distributions calibrated for specific sex, age, and standing height parameters, driven by disproportionate internal adiposity (Peco Antić, 2009). Elevated weight parameters in early childhood create a profound dilemma paired with enduring and dangerous medical sequelae (Mantzorou et al., 2023), which directly impacts the developmental trajectory of the youth (Fäldt et al., 2023). These consequences manifest as psychological and somatic health impairments, diminished quality of life vectors, insulin resistance markers, metabolic disorders, hypertension, lipid abnormalities, and distinct cardiovascular, orthopedic, and oncological issues (Liu et al., 2022; Sekhobo et al., 2010). Early weight issues regularly transition into adulthood as a persistent pathology, sparking numerous downstream crises like emotional difficulties, obstructive sleep apnea, metabolic syndromes, high blood pressure, strokes, and specific tumors (Sekhobo et al., 2010; Wang et al., 2022; Fäldt et al., 2023). Empirical observations suggest that the collective influence of overlapping habits involving dietary routines, physical conditioning, and inactive behaviors—collectively recognized as the behavioral energy balance—is intimately linked to the probability of developing elevated weight status (Miguel-Berges et al., 2023). The initial stages of childhood represent a highly sensitive developmental milestone highlighted by rapid somatic and neurological progression (Liu et al., 2022) and provide an optimal target for obesity mitigation efforts, particularly among children from marginalized social frameworks (including economically disadvantaged contexts, ethnically minoritized groups, or unstable migratory

positions) who exhibit an elevated risk profile for weight gain (Woronko et al., 2023). It is strongly advised that structural interventions target early childhood horizons, as protocols introduced during later youth or adolescence demonstrate lower success metrics. Crucial behavioral models regarding nutritional intake and motor engagement take root during these foundational seasons of growth (Miguel-Berges et al., 2023). Recognizing that childhood weight issues can be successfully mitigated underscores the necessity of achieving a complete structural grasp of this issue to prompt effective remediation.

The objective of this research is to evaluate the distribution of overweight and obesity metrics among preschool cohorts in Bujanovac by applying the diagnostic frameworks structured by the WHO (World Health Organization) and the CDC (Centers for Disease Control and Prevention). In line with this objective, the foundational premise of this inquiry is that no statistically significant variations exist between these two analytical methodologies.

Methods

Participants

The study cohort was drawn from the student body of the "Naša radost" preschool facility located in Bujanovac. The complete experimental group included 106 young children, comprising 50 male subjects (47%) and 56 female subjects (53%). The age spectrum ranged from 3 to 6 years, equating to 44 to 77 months, with a calculated mean chronological age of 4.7 years (61.8 months). To classify weight stratifications, individual body mass and height coordinates were gathered to determine Body Mass Index (BMI). Stature was registered using a GPM anthropometer (manufactured in Switzerland), with participants positioned barefoot on a flat horizontal plane, maintaining an erect posture, fully aligned spine, and touching heels. The transverse arm of the anthropometer was lowered until it contacted the vertex of the cranium. Measurements were recorded to an accuracy of 0.1 cm and subsequently converted into meters. Total body mass was assessed via a Tefal 6010 digital scale (manufactured in France) with participants wearing minimal clothing while standing motionless on the center of the platform. Mass values were collected from the digital display with a precision of 0.1 kg.

BMI was calculated according to the standard formula, i.e. BMI =kg/m^2. Even though the mathematical formula for BMI is uniform across adult and pediatric populations, the classification logic differs significantly because body fat volume undergoes major transitions across developmental ages. Additionally, adiposity configurations vary dynamically between boys and girls. The derived BMI points were contextualized using standard tables provided by the WHO (World Health Organization) and the CDC (Centers for Disease Control and Prevention). These assessment matrices account for biological sex and age, transforming raw BMI positions into percentiles to indicate an individual child's standing relative to a peer demographic of identical age and sex. Consequently, children were allocated among four separate mass groupings: underweight, normal weight, overweight, and obese (Table 1).

Data analysis

Descriptive statistics were generated using the Statistica 10 analytical package. The distribution profile of the metrics was examined via skewness and kurtosis calculations. Skewness was utilized to appraise the symmetry of data parameters relative to the sample mean, where a perfectly balanced distribution yields a value of 0. Furthermore, kurtosis was used to capture the peak or flatness of the distribution curve, centering around a baseline expectation of 2.75. A kurtosis score substantially exceeding 2.75 indicates a leptokurtic distribution characterized by a tight concentration of data points, whereas a score notably below 2.75 represents a platykurtic layout indicating dispersed data configurations (Cain, Zhang, & Yuan, 2017). Pearson's correlation coefficients were deployed to verify the associations between the structural predictors and primary outcomes. The correlation strength was categorized using standard benchmarks (Hopkins, Marshall, Batterham, & Hanin, 2009): negligible ($0<r<0.1$), small ($0.1<r<0.3$), moderate ($0.3<r<0.5$), large ($0.5<r<0.7$), very large ($0.7<r<0.9$), and nearly absolute ($0.9<r<1$). Additionally, linear regression models were calculated to explore the impact of lower extremity structure on performance metrics during race walking.

To determine the position of the BMI value, the calendar age of the children was taken from the records in the preschool institution. Tables and graphs by which children were categorized according to the level of weight are available on the WHO website (WHO, 2024) and the CDC website (CDC, 2024).

Table 1. Categories of weight.

Underweight	Less than 5th percentile	< 5th percentile
Normal weight	from the 5th to less than the 85th percentile	5-85th percentile
Overweight	From the 85th to less than the 95th percentile	85-95 percentile
Obesity	Equal to or greater than the 95th percentile	≥ 95th percentile

Statistical procedures were expanded using the SPSS 20 platform. The following techniques were utilized:

- A Chi-square (X^2) test of independence to analyze the association between individual weight classification outcomes and the choice of diagnostic paradigm (WHO vs. CDC), with statistical significance anchored at $p < 0.05$.
- Descriptive frequency distributions to capture the essential percentage allocations required for this project.

Results

Table 2. Weight level of preschool children in Bujanovac.

Weight level	WHO		CDC	
	N	%	N	%
Underweight	3	2.8%	6	5.7%
Normal weight	76	71.7%	73	68.8%
Overweight	12	11.3%	14	13.2%
Obesity	15	14.2%	13	12.3%
Children who are normally weight	76	71.7%	73	68.8%
Children who are not normally weight	30	28.3%	33	31.2%

Legend: N - number of respondents; % - percentage of respondents; WHO - results according to the recommendations of the World Health Organization; CDC - results according to the recommendations of the Center for Disease Control and Prevention.

The empirical findings produced through the WHO criteria show that out of the entire group, 2.8% present as underweight, 71.7% exhibit normal weight, 11.3% fall into the overweight category, and 14.2% present with obesity. To contextualize the scale of mass variations, we verified that while 71.7% of these preschoolers occupy a normal weight range, 28.3% display a shift away from standard weight parameters. Looking at the CDC framework, 5.7% of the total cohort are classified as underweight, 68.8% sit within the normal weight range, 13.2% are categorized as overweight, and 12.3% display obesity. In total, 68.8% of the children possess normal weight parameters, whereas 31.2% exhibit clear variations from standard weight balances.

Table 3. X^2 test of independence - association of weight level with the choice of the WHO or CDC recommendation.

Org.	Underweight	Normal weight	Over weight	Obesity	X^2	P	Cramer's V
WHO	3 (2.8%)	76 (71.7%)	12 (11.3%)	15 (14.2%)	1.35	0.716	0.080
CDC	6 (5.7%)	73 (68.9%)	14 (13.2%)	13 (12.3%)			

Legend: * Legend: Org. - organization; WHO - results according to the recommendations of the World Health Organization; CDC - results according to the recommendations of the Center for Disease Control and Prevention; X^2 - test result; p - significance level; Cramer's V - effect size.

The X^2 test of independence verified that there is no statistically meaningful relationship between recorded weight statuses and the specific diagnostic guideline chosen to classify those parameters, X^2 (n=212) = 1.357, p=0.716, Cramer's V=0.080. This confirms that the proportions of children occupying the four weight categories under the WHO system do not deviate significantly from the patterns generated by the CDC protocol. Specifically, the

distribution of underweight, normal weight, overweight, and obese configurations remains statistically uniform regardless of whether the WHO or CDC framework is applied. Underweight metrics register at 2.8% via WHO and 5.7% via CDC. Normal weight parameters are 71.7% under WHO and 68.9% under CDC. Overweight percentages are 11.3% (WHO) versus 13.2% (CDC), while obesity figures reach 14.2% (WHO) versus 12.3% (CDC).

Discussion

The data derived from this project indicate that the prevalence of elevated body mass and obesity among preschoolers in Bujanovac is high, irrespective of the analytical framework utilized for evaluation. Based on the WHO analytical track, a significant 25.5% of the sample presents with overweight or obesity. Interestingly, applying the CDC framework produces an identical cumulative value of 25.5%. These parameters highlight a clear need to establish coordinated countermeasures to manage these metrics and shield young cohorts from the physiological risks associated with high weight profiles.

Overweight and obesity according to the WHO recommendation

Our calculations indicate that the overweight rate for preschoolers in Bujanovac is 11.3%, with obesity tracking at 14.2%. While these figures are concerning, evaluating them alongside parallel studies across Serbia reveals that the metrics in Bujanovac are lower than those recorded in Pančevo, Jagodina, Ćuprija, and Niš. Specifically, Jovanović et al. (2010) identified an overweight rate of 13.5% and an obesity rate of 15% among 4- and 5-year-old subjects in Pančevo. That combined high-weight metric reached 28.5%, contrasting with our lower regional finding of 25.5% in Bujanovac. Those researchers also noted that children with high weight parameters frequently had mothers who were also overweight or obese. Even more striking configurations were reported by Ilić (2014) from a preschool sample in Jagodina and Ćuprija, where overweight hit 19.5% and obesity was 14.6%. Their total high-weight metric of 34.1% exceeds both the Pančevo data (28.5%) and our Bujanovac results (25.5%). Furthermore, Đurašković et al. (2012) found an overweight rate of 25.6% and an obesity rate of 16.5% among young children in Niš. Their total combined rate of 42.1% is dramatically higher than our data from Bujanovac (25.5%), while also outstripping the findings from Pančevo (28.5%) and the Jagodina/Ćuprija area (34.1%).

Comparative data from Chile shows that preschoolers in Bujanovac have not reached the high weight elevations recorded among youth in that Latin American country. Kain et al. (2009) documented an overweight prevalence of 25.6% and an obesity rate of 15.6%. Their total elevated weight proportion of 41.2% is considerably higher than the 25.5% registered in Bujanovac. Looking at North American data, Twells & Newhook (2011) discovered that childhood overweight in Canada stood at 26%, more than double our observed rate of 11.3%, while their obesity level (11.3%) was slightly below our Bujanovac figure (14.2%). However, looking at the cumulative high-weight picture, Canada's total metric (37.3%) is notably higher than the 25.5% seen in Bujanovac. Conversely, the patterns reported by Ma et al. (2011) for preschoolers in Northeast China closely mirror our local data, showing an overweight rate of 10.9%, an obesity rate of 13.8%, and a cumulative high-weight metric of 24.7%.

Academic investigations out of Spain, Poland, and the Kingdom of Bahrain show overlapping patterns for overweight relative to Bujanovac, but show obesity metrics that are nearly 50% lower. Ortiz-Marrón et al. (2018) reported a 16.5% overweight rate and a 5.5% obesity rate among preschoolers in Madrid (totaling 22%). Kułaga et al. (2016) noted an 11.1% overweight rate and a 4.1% obesity rate among young cohorts in Poland (totaling 15.2%). Similarly, Al Alawi et al. (2013) found an 12.1% overweight rate and a 2.6% obesity rate in the Kingdom of Bahrain (totaling 14.7%). In comparison, the combined high-weight level in Bujanovac (25.5%) remains elevated relative to the cohorts in Spain (22%), Poland (15.2%), and Bahrain (14.7%).

Overweight and obesity according to the CDC recommendations

Focusing on the CDC methodology, our study reveals an overweight prevalence of 13.2% alongside an obesity prevalence of 12.3% in Bujanovac. Dermanović, Miletić & Pavlović (2015) recorded a slightly higher layout in Republika Srpska, noting an overweight frequency of 16.7% and an obesity level of 13.3%, yielding a combined metric of 30% compared to our local 25.5%. Conversely, Stupar, Popović & Vujović (2014) identified lower weight trends in Novi Sad, with overweight standing at 12% and obesity at 9% (totaling 21%). Pelemiš et al. (2021) documented even lower profiles from a Belgrade preschool sample, noting an overweight prevalence of 9.6% and an obesity frequency of 7.5%, resulting in a combined high-weight metric of 17.1% that sits well below our Bujanovac configurations.

According to historical data from Manios et al. (2007), young cohorts in Greece more than a decade ago presented with higher obesity patterns than those currently observed in Bujanovac. Those authors recorded an overweight rate of 16.3% and an obesity level of 15.7%, culminating in a total elevated body weight prevalence of 32%.

Data tracking from Iran and Iraq shows that childhood weight inflation in the Middle East falls below the benchmarks observed in Bujanovac. Gaeini et al. (2011) identified an overweight rate of 10.1% and an obesity rate of 4.6% in Tehran, establishing a combined metric of 14.7%. Overlapping figures were published by Fatemeh et al. (2012), who found an overweight rate of 10.6% and an obesity rate of 7.6% among preschoolers in Birjand, totaling 18.2%. Hassanzadeh-Rostami, Kavosi & Nasihatkon (2016) reported even lower metrics, with an overweight frequency of 5.7% and an obesity rate of 5.2% (totaling 10.9%). Finally, Ali Musa & Hassan (2010) found an overweight level of 10.5% and an obesity level of 3.3% among young cohorts in Iraq, resulting in a combined elevated weight frequency of 13.8%.

Differences in weight level depending on the use of the CDC and WHO recommendations

The analytical output of our inquiry confirmed the absence of a statistically significant relationship between classified weight profiles and the specific assessment guidelines utilized. This indicates that the percentage allocations for overweight and obese children produced via the WHO criteria do not vary significantly from the allocations generated using the CDC protocols.

The literature surrounding this topic shows that studies using both WHO and CDC frameworks on identical pediatric samples often produce contrasting results. For instance, in the study by Kułaga et al. (2016), weight elevation metrics were higher when applying the CDC criteria compared to the WHO tracks. Specifically, overweight registered at 18.2% via CDC versus

11.1% via WHO, while obesity registered at 8.3% via CDC versus 4.1% via WHO, culminating in an overall high-weight metric of 26.5% (CDC) versus 15.2% (WHO). In contrast, investigations by Twells & Newhook (2011) and Al Alawi et al. (2013) found that overweight frequencies were higher under the WHO system, whereas obesity parameters were more pronounced when using the CDC framework. Twells & Newhook (2011) documented overweight at 26% (WHO) versus 19.1% (CDC), paired with obesity at 11.3% (WHO) versus 16.6% (CDC). Al Alawi et al. (2013) noted an overweight prevalence of 12.1% (WHO) versus 9.8% (CDC), alongside an obesity prevalence of 2.6% (WHO) versus 5.2% (CDC). Different configurations were presented by Ma et al. (2011), who determined that overweight was higher under the CDC protocol (11.3% vs. 10.9%), while obesity was more prevalent under the WHO guidelines (13.8% vs. 11.7%).

Reflecting on these collective outcomes, it is clear that the use of advanced equipment to evaluate nutritional components remains highly valuable, alongside the deployment of precise physical scales to capture granular somatic shifts.

In addition to these structural strengths, a clear limitation should be noted regarding the total sample size, which limits our ability to more exhaustively evaluate the foundational research hypothesis.

Conclusion

The empirical findings of this research show that the prevalence of overweight and obesity among young children in Bujanovac is high, regardless of whether the WHO or CDC interpretive framework is selected. This preschool cohort mirrors the weight inflation trends recorded among peers in Western Europe, while demonstrating higher obesity metrics than those documented in African and Middle Eastern territories. Furthermore, direct comparisons between the WHO and CDC diagnostic frameworks revealed no statistically significant deviations in the proportion of children classified with elevated body weight. These findings highlight that the notable presence of excess weight among preschoolers in Bujanovac underscores an immediate need for structured preventive strategies and timely public health campaigns designed to curb these rates, thereby reducing the long-term medical risks associated with early childhood obesity.

Author Contributions: Conceptualization, D.N.; methodology, S.Đ.; software, S.S.; validation, S.Đ., D.N. and S.S.; formal analysis, S.S., S.Đ., and M.S.; investigation, D.N., S.Đ., and M.S.; resources, D.M. and D.N.; data curation, D.N., J.Đ., and K.S.; writing—original draft preparation, D.N. and S.Đ.; writing—review and editing, D.N., M.S., S.S., D.M., and S.Đ.; visualization, D.N., M.S., and S.Đ.; supervision, D.N. and S.Đ.; project administration, S.Đ., K.S. and S.S. All authors have read and agreed to the published version of the manuscript.

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