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# A CLASSIFICATION OF THE PHYSICAL FITNESS BY CHILDREN IN THE FIRST EDUCATIONAL PERIOD, ACCORDING TO THE FIT-BACK CRITERIA REFERENCE STANDARDS

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*(Original scientific paper)*

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***Abstract***

*This study has an aim of classification the physical fitness by children from the age of 6 to 8 , in accordance with the latest health standards criteria on the FitBack platform and to make an examination of the gender differences in basic components of fitness. The study takes into inclusion 519 students from primary schools in the Skopje region, who performed standardized anthropo-metric measures and fitness tests: body mass index, waist circumference, grip strength, standing long jump and 20 m shuttle run test.T he classification has been based on the criteria zones which have the indication of whether the child holds the recommended health threshold. The results have showed that only 54% of the children have a health-acceptable level of cardio-respiratory endurance, as a while large proportion demonstrate insufficient development of the muscle strength. As a range of 58% do not reach the criterioa standards for the explosive strength, and 67% for static hand strength. Gender differences are statistically significant for BMI, waist circumference, cardio- respiratory endurance and strength of the hand-grip, as of girls being classified in zones that indicate the necessity for improvement. These findings make a suggestion of early emergence for health fitness disparities and highlight the need for targeted and appropriate interventions for development in the school environment. In conclusion, the research makes a confirmation of the applicability of criterion-referenced fitness assessment by the young students and provides important insights for improvement of the educational practice and public health strategies. Early detection of weaknesses in fitness components may contribute to better health outcomes later in life.*

***Keywords:*** *physical fitness, children, FitBack, cardiorespiratory endurance, muscle strength, criterion-referenced assessmen*

## Introduction

By the context of the contemporary trends of lowered physical activity and increased sedentary behavior in children, physical fitness is increasingly emerging as a key indicator of current and future health. Physical fitness does not make a limitation of the ability of performance the sports activities, but it is a complex indicator that encompasses functional, motor, cardio-respiratory and health components, and makes a reflection of the general physical condition that is directly in relation to the health and quality of life. The research is a confirmation of a higher level of cardio-respiratory endurance, muscle strength and appropriate body composition is associated with better cardio-metabolic health parameters, better mental health, higher cognitive abilities and general well-being in children and adolescents (Brazo - Sayavera et al., 2024).

In conditions as such , a continuous monitoring, precise assessment and time planned interventions are essential tools for an early identification of the weaknesses,by suppor of the educational process and for steb-by-step build of the healthy and sustainable lifestyle habits. FitBack is an European project and platform design of monitoring the physical fitness in children and young people. According to peer-review of publications, FitBack makes an ability of the establishment of age- and gender-specified reference values and health criteria,as based on the extension and harmonized European databases. Thus, the platform makes a provision of the precise and scientifically validated interpretation of fitness test results, applicable both in

the context of the public health and within the framework of educational interventions and school practice (Ortega et al., 2023; Sorić et al., 2025).

In addition, FitBack offers an automation of the individual and group reporting with visual feedbacks, as well as tools of educational methodology for teachers, trainers and pedagogues, in order of encouragement the physical literacy and promote systematic monitoring and improvement of children's health.

The school is a natural inhabitat where the development of students is being monitored in continuum, thus physical and health education classes provide a structured insight into the level of physical fitness. Therefore, the integration of FitBack into the educational process is being imposed as a choice of nature and appropriation for process improvement of the formative assessment of student fitness. This approach has a strong action character not only in terms of assessment and diagnostics, but also in terms of active influence over the educational process, through plan and implementation of th activities that are aimed at improving the health fitness of students. Put in other words,the systematic assessment followed by feedback allows the teachers and students to make an immediate identificatin of the weaknesses and take measures to overcome them within the framework of educational practice.

Ideally, all of the children in the first year of primary education could maintain a level of physical fitness that meets the health-based standards for their own age, ensuring their optimal growth and development. Such an ideal scenario would make an involvement of the regular assessment and feedback, through which any deviation would be detection in the manner of time, and students would take a participation in the sufficient physical activity in order of their full fitness development. However, reality deviates a signification of the ideal situation. Many children have the exhibition of fitness levels below the standards that are recommended, as a result of modern lifestyles that include reduced movement, increased screen time and inappropriate eating habits. Thus, within the MAKFIT study, age- and gender- specific have been established percentile norms for physical fitness among children and adolescents in N. Macedonia (Gontarev et al., 2018). Such efforts make a provision of the valuable reference points, but there have not been fully addression of the problem, as they have largely being focused on the comparison of the levels of fitness (normative standards) without definition of the clear criteria for health adequacy or guidelines for intervention.

In addition, many of these assessments have been remained in isolaion within scientific research, and have not been consistently monitored in schools or widely adaptation in educational policies. As a result, gaps still exist in the early detection and addressing of the inadequate physical fitness. The lack of criteria of referenced assessment, takes the meaning of that children who are below the health- promotion of the fitness level may go unnoticed if their results are interpreted only through the prism of percentiles or peer comparisons. The latter consequences that are direct of inadequate fitness in childhood include increased risk factors for health problems such as poor cardio-respiratory fitness or muscle weakness, which might manifest as fatigue, reduced physical performance, and early onset of some metabolic disorders.

Indirectly, this problem affects the students' self-esteem and academical performance, as well as their long-term health trajectory, increasing the likelihood of chronic diseases in adulthood and the burden on the health system (Brazo-Sayavera et al., 2024). Opportunities that are also being missed to instill healthy habits and improvement of general well-being during a critical period of growth and development.

Therefore, there is an obvious gap in the knowledge and practice: how to effectively make a classification and interpretation of the level of physical fitness by children of the earliest school age in the accordance to objective health criteria, and to use the knowledge of acquired for targeted interventions.

Although the FitBack project is an establishment of pan-European standards, so far this criteria has rarely been applied on the field level to determine the status of students in the first educational period. Without such application, teachers and decision-makers do not have a clear image of which proportion of the youngest students have to meet as a recommended fitness norm and where the largest deviations are. This research is design in fulfillment of this gap, through a systematic assessment and classification of the physical fitness in children in the first educational period in accordance with the FitBack criteria values. By taking this as an approach, the study makes an offer of intense need of insight into the level of physical fitness in early childhood, which goes beyond the simple percentage in comparis and emphasize of whether current fitness levels are sufficient from a health perspective.

This work both builds and innovates the key of previous research. It takes advantage of the new establishment of the European reference values for fitness by children (Ortega et al., 2023) and health-oriented cut-off values (Sorić et al., 2025), that moves from the theoretical frameworks to practical application in the school environment. Unlike previous studies that have mainly described the level of fitness or its association with some certain factors, our focus is on the criteria-based classification of what directly identifies children with potential risk over the health or need for intervention. The conceptual model that guides the study derives from the paradigm of health-relation of fitness and the principles of formative assessment, starting from the premise that clearly is being defined with health-related criteria for physical fitness, accompanied by appropriate feedback, can encourage improvements in children's physical development.

In this context, the FitBack feedback model and the broader concept of the physical literacy provides the basis on which we interpret the results and gives a recommendation of the next steps. The aim of this research is to assess and make a classification of the level of physical fitness by children which are aged from 6 to 8 years , according to the FitBack criterion reference values, and to examine the distribution of fitness profiles by gender, in order to make a determination of the prevalence of a health-acceptable level of physical fitness in the primary education.

*Research Methods Sample of respondents*

The research includes 519 students from primary schools in the Skopje region, with an average age of 7.15 ± 0.79 years. The students were a random selection, and the distribution by gender is almost equal (260 boys and 259 girls). The analysis makes the inclusion only for those students for whom the legal representatives gave a written consent, who are psycho- physically healthy, have regularly attended physical education and health education classes and have performed all measurements planned. Anonymous voluntarism was ensured for all respondents, and the research was conducted in accordance with the principles of ethical conduct established in the Declaration of Helsinki.

*Measures and tests*

Seven key variables were applied in the research: four anthropo-metric measurements and three motor tests. Anthropo-metric measures which include height, body weight, waist circumference and body mass index (BMI). Fitness components are assessed through tests that measure muscle strength (static hand-grip force dynamo-metry), explosive power (long jump from a standing position) and cardio-respiratory endurance (20 m running test with progressive speed increase - shuttle run).

*Measurement procedures*

The measurements were carried out in accordance with the protocols aligned with the FitBack methodology, a European system that uses validated and standardized tests for assessing health fitness in children. This is a reason why these tests are suitable for a school environment and allows the reliable and comparable assessment of the results.

Height has been determined with an altimeter, with an accuracy of 0.1 cm, when the subject stands barefoot, in an upright position, with the Frankfurt plane. Body weight was measured on a medical scale, on a stable horizontal surface, with an accuracy of 0.5 kg. Waist circumference was measured with an inelastic tape measure, twice in a row, with the analysis which uses the mean value with an accuracy of 0.1 cm.Body mass index (BMI) was calculated according to the classical formula: body mass (kg) divided by the square of height ($m^2$).

Fitness tests has been carried out in accordance to the standardi protocol. In the "standing long jump" test, the student performs a two-legged jump in order to achieve the greatest possible distance. Two attempts are performed, and the best achieved jump (in centimeters) is taken as the result. A calibrated hand dynamo-meter was used for the "hand grip dynamo- metry" test. The students performed two maximum grips for each hand, and the average value of the two best results, from the right and left hands (in kilograms) is being taken as an indicator of the muscle strength.

For the "shuttle run (20 m)" test, students ran between two lines 20 meters apart, following the pace set by the sound signals whose speed progressively increases. The test ends when the student fails to reach the

line twice in a row at the moment of the sound signal, and the final score represents the number of levels and sections successfully passed. This approach allows for a multidimensional assessment of health fitness in children, covering morphological, strength and cardiorespiratory components.

*Data processing*

The data was in process and analysis with the statistical package SPSS 26. After the automatic classification in the FitBack platform, the frequent distributions and the percentage of students in the green, yellow and red zones were calculated with descriptive statistics. To assess gender differences in the distribution of the zones, a $\chi^2$ test of independence was applied, with statistical significance determined at the $p < 0.05$ level. The analysis also take into inclusion the expected frequencies, which allowed for a more precise interpretation of the associations between gender and health-related fitness categories.

This analytical approach allowed for a valid assessment of structural differences in physical fitness and identification of critical components among students.

**Results**

The data that was collected in this action research has been processed through the FitBack platform, which categorizes the results into three health zones: a green zone indicats a health-appropriate level of physical fitness, a yellow zone indicates the need for a moderate improvement, and a red zone signals an increased health risk and the need for significant improvements. The results are presented separately for the overall sample and by gender.

Table 1. Differences in the distribution of students by BMI zones depending on gender.

| Gender | Fit zone n (%) | Improvement Recommended n (%) | Improvement Strongly Recommended n (%) |
|---|---|---|---|
| Boys | 179 (69,4%) | 45 (17,4%) | 34 (13,2%) |
| Girls | 151 (58,3%) | 74 (28,6%) | 34 (13,1%) |
| Total | 330 (63,8%) | 119 (23,0%) | 68 (13,2%) |
| $\chi^2(2) = 9{,}441$, p = ,009 | | | |

The results of Table 1 show clearly pronounce the differences in the distribution of students by BMI zones that depends on the gender. Among boys, 69.4% are in the “fit zone”, 17.4% in the “improvement recommended” category, and 13.2% in the “improvement strongly recommended”. Among girls, however, the proportion of “fit zone” is lower (58.3%), while a higher percentage falls into the “improvement recommended” zone (28.6%), and 13.1% of girls are in the “improvement strongly recommended” zone. These differences make the indication as it follows that girls are more often being classified than boys in the group for which improvement of body composition and health-related fitness is recommended. Statistical analysis with the $\chi^2$-test confirms the difference as statistically significant ($\chi^2(2) = 9.441$; p = .009), which means that gender is a significant factor in the distribution of students in the different BMI zones. Being said in other words, the probability of t the observed difference is the result of chance is low, indicating the existence of systematic gender differences in body mass status and the health risks associated with it in the earliest school age.

Table 2. Differences in the distribution of students according to waist circumference zones depending on gender

| Gender | Fit zone n (%) | Improvement Recommended n (%) | Improvement Strongly Recommended n (%) |
|---|---|---|---|
| Boys | 243 (94,2%) | 8 (3,1%) | 7 (2,7%) |
| Girls | 212 (81,9%) | 26 (10,0%) | 21 (8,1%) |
| Total | 455 (88,0%) | 34 (6,6%) | 28 (5,4%) |
| $\chi^2(2) = 18{,}640$, p < ,001 | | | |

The results of Table 2 indicate pronounced gender differences in the distribution of students according to the waist circumference zones. Among boys, as many as 94.2% are classified in the “fit zone”, while only 3.1% fall into the “improvement recommended” category and 2.7% in “improvement strongly recommended”. Among girls, however, the share of those in the “fit zone” is lower (81.9%), and a

significantly higher percentage is in the "improvement recommended" zone (10.0%) and especially in "improvement strongly recommended" (8.1%). These differences show that girls more often than boys have an increased waist circumference, which indicates a higher prevalence of abdominal adiposity and potentially greater cardiometabolic risk in them.

The application of the $\chi^2$-test makes a confirmation that these differences are as statistically significant ($\chi^2(2) = 18.640$; $p < .001$), which clearly makes an indication that actually gender is a significant factor in the distribution of children in the different waist circumference zones. The probability that such distribution structure is the result of chance is extremely low, which is a sign of the existence of a systematic gender difference in central obesity already in the first educational period. These findings point out the need for an early and gender-sensitive monitoring of indicators of abdominal adipose and for targeted prevention and intervention programs, especially aimed at girls, in order to reduce future health risks.

Table 3. Differences in the distribution of students according to cardiorespiratory endurance zones (20 m shuttle run) depending on gender

| Gender | Fit zone n (%) | Improvement Recommended n (%) | Improvement Strongly Recommended n (%) |
|---|---|---|---|
| Boys | 139 (53,9%) | 79 (30,6%) | 40 (15,5%) |
| Girls | 139 (53,7%) | 116 (44,8%) | 4 (1,5%) |
| Total | 278 (53,8%) | 195 (37,7%) | 44 (8,5%) |
| $\chi^2(2) = 36,473$, p < ,001 | | | |

The results of Table 3 make the indication of pronounced gender differences in the distribution of students according to the zones of cardiorespiratory endurance (20 m shuttle run). Among the boys, 53.9% are being classified in the "fit zone", 30.6% in the "improvement recommended" zone and 15.5% in "improvement strongly recommended". Among the girls, a similar percentage is in the "fit zone" (53.7%), but a significant larger share is in the "improvement recommended" category (44.8%), while only 1.5% fall into the "improvement strongly recommended" category. This sums up the fact that, although the proportion of children with a health-acceptable level of cardio-respiratory endurance is almost identical in both genders, the structure of unsatisfactory results is different: moderately reduced endurance dominates among girls, while a markedly low level of cardiorespiratory fitness is more often registered among boys.

Statistical analysis with the $\chi^2$-test confirms that this distribution is as statistically significant ($\chi^2(2) = 36.473$; $p < .001$), which means that gender is a crucial factor in the classification of children into the different cardio-respiratory endurance zones. The probability that the differences being observed are due to chance is extremely low, which points out the systematic gender specificities in cardio-respiratory fitness already in the first educational period. These findings make a suggestion that the need for a differentiated approach in planning endurance is improvement of the programs with a focus on the girls in the broadening the general level of cardio-respiratory fitness, and by boys on preventing and reducing cases with markedly low values, through continuous and dosed aerobic activities.

Table 4. Differences in the distribution of students according to explosive force zones depending on gender

| Gender | Fit zone n (%) | Improvement Recommended n (%) | Improvement Strongly Recommended n (%) |
|---|---|---|---|
| Boys | 121 (46,9%) | 88 (34,1%) | 49 (19,0%) |
| Girls | 96 (37,1%) | 111 (42,9%) | 52 (20,1%) |
| Total | 217 (42,0%) | 199 (38,5%) | 101 (19,5%) |
| $\chi^2(2) = 5,626$, p = ,060 | | | |

The results of Table 4 make the indication of some gender differences in the distribution of students according to the zones of explosive power, assessed by the long jump from a standing position. Among the boys, 46.9% are being in the classification of the "fit zone", 34.1% in the "improvement recommended" zone and 19.0% in the "improvement strongly recommended".

Among girls, the share of the "fit zone" is lower (37.1%), while a higher percentage is in the "improvement recommended" category (42.9%) and a similar percentage in "improvement strongly recommended" (20.1%). These values at a descriptive level make a suggestion of tendency for boys to

achieve the criterion values for explosive power more often, while girls are somewhat more often classified in the zones for which improvement is recommended.

However, the application of the $\chi^2$-test did not show statistically significant differences in the distribution of students by fitness zones between boys and girls ($\chi^2(2) = 5.626$; $p = .060$). Although there are visible percentage differences, their size is not sufficient to confirm that gender is a systematic and stable factor in the classification of explosive strength in this age period. In other words, according to the criterion reference values for the standing long jump, boys and girls generally show a similar distribution pattern, and the observed differences may be due to random variations. This indicates that during this period of development, explosive strength is relatively equal between the sexes, and that intervention programs for its improvement can be planned in a similar way for boys and girls.

Table 5. Differences in the distribution of students according to the zones of muscle strength of the palm depending on gender

| Gender | Fit zone n (%) | Improvement Recommended n (%) | Improvement Strongly Recommended n (%) |
|---|---|---|---|
| Boys | 87 (33,7%) | 104 (40,3%) | 67 (26,0%) |
| Girls | 86 (33,2%) | 79 (30,5%) | 94 (36,3%) |
| Total | 173 (33,5%) | 183 (35,4%) | 161 (31,1%) |
| $\chi^2(2) = 7,947$, p = ,019 | | | |

The results of Table 5 indicate a clearly differentiated distribution of students according to the zones of hand muscle strength depending on gender. Among boys, 33.7% are classified in the “fit zone”, 40.3% in the “improvement recommended” zone and 26.0% in the “improvement strongly recommended”. Among girls, a similar percentage is in the “fit zone” (33.2%), but a smaller share is in the “improvement recommended” zone (30.5%), while a significantly higher percentage is classified in the “improvement strongly recommended” zone (36.3%). This pattern indicates that, although the proportion of children with a health- acceptable level of static hand strength is almost identical in both sexes, girls are more often grouped in the category with the lowest values, which suggests a more pronounced deficit in muscle strength in relation to health criteria.

Statistical analysis with the $\chi^2$-test confirms this difference as statistically significant ($\chi^2(2) = 7.947$; $p = .019$), which means that gender is a significant factor in the distribution of students in the different zones of handgrip strength. The probability that the obtained distribution pattern is the result of chance is low, which indicates a stable and systematic gender-based pattern of variation in muscle strength in the early school period. These findings point out and emphasize the need of targeted intervention programs, especially for girls, that would take into inclusion the activities to strengthen the upper body and push up the muscle strength, in order to reduce the share of children in the "improvement strongly recommended" zone and to bring their results closer to health-optimal standards.

**Discussion**

As an aim of this study is the value of the physical fitness in children from the age six to eight years old by the usage of the based criteria health standards defined on the FitBack platform. Unlike traditional normative assessments based on percentile distributions, the criterion- based model allows for a direct link between fitness scores and health risks. This approach makes an improvement of the interpretative value of the testing, as it allows for an assessment of whether a child meets the minimum health thresholds, which is essential during the period when the foundation of the health behaviour and physical development is being laid.

Cardio-respiratory endurance stands out as one of the most critical components in the physical fitness profile. Only 54% of students tested meet the health criteria, which indicates an insufficiently developed aerobic level even at early school age. These values are lower compared to the European data, where over 60% of children in the HELENA study and up to 80% to 90% in Spain and Sweden meet the criterion standards (Ortega et al., 2008; Ortega et al., 2011).

Although some of the differences may be due to different $VO_2max$ calculations or variations in the cut-off values that have been applied, the results make the suggestion of a regional trend in lower cardio-respiratory fitness by the children from Southeastern Europe.

This is a significant public health challenge, given that aerobic fitness is a strong predictor of future cardio-metabolic health, lower probability of hypertension and metabolic syndrome, better cognitive function, higher academic performance, and better psychological well-being. The analysis of gender differences shows that, although the percentage of children in the "fit zone" is similar for boys and girls, the distribution pattern in the categories with lower fitness differs significantly. Girls are significantly more often classified in the "improvement recommended" zone, which indicates moderately reduced endurance, while boys are being registered with a higher percentage in the part of the "improvement strongly recommended" zone, which is a clear indication of a more drastically reduced aerobic level. This distribution is in line with data from international studies which shows that girls, in general, have lower aerobic endurance and a lower total volume of physical activity, which is partly explained by the biological, psycho-social and cultural factors (Ruiz et al., 2009; Ekelund et al., 2011). Such gender specificities point out the importance of a moderate approach in programs for improvement of the aerobic fitness. Regarding muscular fitness, the results sum up even more pronounced challenges. In the lower limb explosive strength test, a significant proportion of students do not reach the health threshold, and the situation is even more alarming in the upper body strength test, where two-thirds of students do not meet the criterion standards. This finding coincides with the global trend of decreasing muscle strength in young people (Smith et al., 2014).

Furthermore, the gender analysis shows that girls are more likely to be classified as "improvement strongly recommended" for hand strength, an indication of a greater deficit in the upper extremity muscle fitness. Boys, on the other hand, are somewhat more likely to be in the "fit zone" on this test, which is consistent with biological differences in muscle mass development that are present even before puberty (Beunen & Malina, 2008).

These results are a suggestion of the need for a greater emphasis on purpose-built muscle strength programs, especially for girls. The application of referenced criteria standards through FitBack has proven to be a significant pedagogical and diagnostic benefit. The system provides formative assessment, visual representation, and individualized guidance that supports physical literacy processes. Research suggests that when students receive clear and meaningful feedback about their fitness profile, their motivation and engagement increase (Brazo-Sayavera et al., 2024). For teachers, however, these reports represent a practical tool for quickly adapting teaching activities according to the real needs of students.

At a systemic level, the results confirm the importance of establishing a national monitoring of physical fitness. European examples from Slovenia, Finland and Portugal show that such systems lead to better health prevention, more effective interventions and higher quality of teaching practice (Jurak et al., 2020; Jurak et al., 2022). Our results are a demonstration of what FitBack can be as successful application in a home context, which is an important step towards development of an integrated system for monitoring the physical fitness.

The study, however, has several but certain limitations. The sample covers only one region and age, which limits in general. Indirect tests in young children may be under the influence by motivation or understanding of the instructions. The study does not include a controled group and does not have a long-term follow-up, which does not allow for the assessment of lasting effects.

Future researches should include larger national samples, longer-term measurements, and combined methodological approaches, which would allow for a deeper understanding of children's fitness profiles and further refinement of criterion standards. Such an approach would contribute to the development of more effective educational and health policies aimed at promoting active and healthy lifestyles from an early age.

**Conclusion**

The results make an image that a significant proportion of students do not reach the health-recommended levels of cardio-respiratory endurance and muscular strength, besides the fact that most anthropo-metric indicators are within the acceptable limits. These findings are an emphasize of the importance of early, systematic monitoring of physical fitness using criteria based standards such as FitBack, which allows for timely identification of weaknesses and planning targeted interventions.

The practical implications are clear: schools gain a basis for better planning of teaching, and health services for more effective prevention. Early improvement of aerobic capacity and muscular strength can contribute for a better physical, mental and general health in the latter and futter development of children.

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