**Title**: Comparison of physical fitness levels and body mass index in students from 5th to 9th grade in Physical Education classes depending on urban or rural residence place.

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The authors agree that submitted paper cannot be printed or submitted to publish in another journal.

**Title**: Comparison of physical fitness levels and body mass index in students from 5th to 9th grade in Physical Education classes depending on urban or rural residence place.


**Abstract**

**Introduction**: The main purpose of this study was to have a comparison of the physical fitness levels and body mass index of students with urban and rural residence from an elementary school in Portugal. **Methods**: The sample covered 270 students, 142 male and 128 female, aged between 9 and 16, from the 5th to the 9th grade. The Fitnessgram test battery (NES, 2002) measured the physical fitness, the body mass index was based on the reference values from the World Health Organization (1995) and the students' characterization was assessed through the biographical archives given by the school. **Results**: The test results only demonstrated significant differences ($p < 0.05$) amongst these students: Females in the 5th and 6th grade in the following tests, trunk extension with better results in students with rural residence and middle strenght with better results in students with urban residence; Males in the 5th and 6th grade in the following tests: the shuttle run with better results in students with rural residence; Females between 7th and 9th grade in the following tests: trunk extension with better results in students with urban residence. **Conclusions**: Significant differences were not observed between the levels of physical fitness and BMI related to the place of residence (rural and urban).



**Keywords:** Physical fitness, BMI, Children, Adolescents, Physical Education, Rural, Urban.

## Introduction

In recent decades we have witnessed profound changes in the daily lives of children and adolescents. This seems to be associated with an increasing urbanization, sedentary lifestyles and consequently the problems related to health and well-being, including the increase in obesity (Ewing, 1982 cited by Rodrigues Bezerra & Scott, 2005) and the decline in physical fitness levels of children and young people (Kuntzleman, 1992). According to Ezzati et al. (2005, cited in Machado-Rodrigues et al., 2012), urbanization refers to the concentration of people in towns and cities, linked to the economic transformation, migration and behavioural changes.

In Portugal about 45% of the population lives in metropolitan areas such as Porto and Lisbon (Baker, 2000). At the same time it is one of the European countries with the highest prevalence of overweight and obesity in children (Campos et al, s / d; Queiroz (2006).

Regarding these statistics, as stated Barreto (2000), social inequalities between rural communities have also become increasingly evident, specifically regarding health resources and education. According to Muula (2007), the interest in health issues in rural areas has increased in recent years, especially when compared to urban communities. Thus, urbanization is a determinant and influential factor for physical activity, sedentary behaviours, overweight and cardio-respiratory capacity. Intuitively it is assumed that young people living in urban centres are less active than their counterparts, which consequently gives lower levels of cardio-respiratory fitness, such as overweight and obesity levels (Springer et al, 2006; Liu et al. (2008).

However, Rodrigues Bezerra and Scott (2005) analysed the patterns of physical fitness of boys (7 to 10 years) from urban and rural areas and found that, regardless of environment, similar improvements occurred over

the years. However it differs according to the environment and the type of physical fitness indicator, such as the boys from rural areas were higher in the shuttle run test and the boys from urban areas were higher in the test of horizontal jump.

Seeking to establish a relationship between the periods of physical activity and inactivity and the environment (rural or urban) in which young people live, the study of Bathrellou, Lazarou, Panagiotakos and Sidossis (2007), which included a sample of 1,140 children from rural and urban areas in Cyprus, found that children from rural areas are slightly more active after school and busy with outdoor tasks compared to the children from the urban environment. However, children from urban areas are more related to the practice of weekly sport in relation to their peers from rural areas. These data suggest that the distribution of children in relation to physical activity and inactivity is similar between urban and rural areas, the researchers found no significant differences in physical activity habits and sedentary behaviour among children in rural and urban areas of Cyprus.

Still reviewing the periods of physical activity and inactivity, as well as the cardio-respiratory fitness of young people from urban and rural areas, the study of Coelho and Silva et al. (2012) found that urban adolescents, of both sexes, spend less time in sedentary activities than rural adolescents. Thus, the study found that the area of residence was related to fitness, time spent in sedentary behaviours and cardio-respiratory fitness among young people, and that interventions seeking to improve health and active lifestyles in youth should consider the socio-geographic impact factor.

As we found in our studies, investigations about this issue have not been completely concordant (Cicagnami, 2008). This it appears from the outset because there is no consensus on the definitions of urban and rural areas, as well as the impact this uncertainty has on the sample (students

residing in rural and urban areas) and the consequent creation of groups to study, meaning that when counting the students in certain groups, which really should not belong, we may incur in a sample selection error and as such affect the internal validity of our study. In this situation, the results could not be generalized, so our study would lose the possibility of having a coherent and credible external validity.

Regarding the replication of the results obtained in existing studies to different geographical areas, we can assume that this will be limited to the characteristics of the studied context, affecting their representativeness, i.e., its external validity.

In this study, our purpose is to analyse the levels of physical fitness and obesity in students of a school in the Interior North of Portugal, whose geographical location generally allows the coexistence of students from different areas of residence within the district in which it operates. Indeed, in this study we intend to compare the levels of physical fitness and obesity at different ages and for both genders, as well as their variability depending on area of residence (urban and rural).

## Methods

### Sample

The participants were children and adolescents attending an elementary school in Guarda district. Initially an authorization to carry out the data collection was requested, in person and in writing to the School Director through the Pedagogical Council, as well as informing on the objectives for the study. According to this, the school board approved the research. The sample was studied according to gender, grade, and the place of residence of the subjects. Inclusion criteria were the attendance of the 2nd and 3rd cycle of education (from 5$^{th}$ to 9$^{th}$ grade) of an elementary school.

We assume as sample exclusion criteria physical disability for physical activity and identification of special educational needs, so that there are no misrepresentations of the data collected by the objective of this study. The total number of participants was 270 students, representing 86% of the total school population that was 314 students. These students are aged between 9 and 16 years of age, and in the 3rd cycle of education 83 are male (45 in urban residence and 38 with rural residence) and 80 were female (51 in urban residence and 29 with rural residence). Regarding students from 5$^{th}$ to 6$^{th}$grade 59 students are male (41 in urban residence and 18 in rural residence) and 48 were female (28 in urban residence and 20 in rural residence). These data were collected directly from the constant biographical record of the class.

Table I - Frequency and percentage of students according to grade, gender and residence context.

| Grade | Gender | Residence | Frequency | Students % |
|---|---|---|---|---|
| 5th and 6th grade | Male | Urban | 41 | 15.2% |
| | | Rural | 18 | 6.7% |
| | Female | Urban | 28 | 10.4% |
| | | Rural | 20 | 7.4% |
| 7th to 9th grade | Male | Urban | 45 | 16.7% |
| | | Rural | 38 | 14.1% |
| | Female | Urban | 51 | 18.9% |
| | | Rural | 29 | 10.7% |
| Total sample | | | 270 | 100% |

This is a non-probabilistic and intentional sample, because there is a deliberate choice of subjects belonging to the sample and certain characteristics that they possess has been considered.

## Instruments

The data collected for the analysis of physical fitness were the values produced by the application of the battery Fitnessgram tests (NES, 2002), since obey familiarity criteria, possibility of use in several age levels and ease of management, measurement and evaluation of these components of physical fitness with little or no equipment at all. The contemplated tests in this test battery are: the shuttle-run evaluating the endurance, abdominal and extension arms to evaluate the middle and upper force, sits-and-reach and trunk extension to assess the flexibility, as well as body mass index (BMI) and percentage of body fat (% BF) assessing body composition, calculated by the formula: BMI = weight/height$^2$ (meters).

As for the biographical data of the sample participants, these were provided by the elementary school upon appropriate written request to the School Director and accessed the appropriate direction dossier of each class. Before the collection of data concerning the research, students were informed about the objectives of this study and that their participation was voluntary and optional.

## Procedures

Before any procedures made, an informed consent has been delivered to children's parents accepting the participation in this study.

The Shuttle-run test is a test for progressive exertion levels, namely a low intensity begins to become increasingly intense. The purpose of this is to achieve the maximum distance possible in stages of 20 meters distances increasing speed successively in one minute. In this regard, a route of 20 meters was initially set with a cone mark and a line at each end. The study investigators were always the same throughout the study, being prepared with record sheets and pens. These marked the number corresponding to the

sequence that the individual completed, and when the sequence was failed they circled the number corresponding to that exercise.

The test protocol was based on instructing students to complete as many laps as possible, touching the bottom line when they heard a beep. At this point, they should reverse their direction of the race to the other end. Where students reached the line before the beep, they should wait for it before running in the opposite direction. The pace of running is stipulated by a set of acoustic signal intervals between them, produced by a stereo system. The running speed was 8, 5 km / h at the start of the test and it was increased by 0.5 km / h every minute. A beep indicating the end time of each route and a triple beep after each minute indicated the end of each level of effort. This last sign was intended to alert students that the race pace would increase, forcing them to accelerate the race to cover the 20 meters in less time. In situations that students did not reach the line at the buzzer they should immediately reverse the direction of the race. Then the student was given another opportunity to try to keep pace with the race. The students repeated this procedure until they were no longer able to reach the lines at the sound of the beep. At the end of testing, students continued walking to return to rest. On the test of middle strength, the goal was achieving the largest number of abdominal push-ups to a maximum of 75, making use of a specific cadence. To achieve some test material was needed, gym mattress, measuring tape, CD with cadence and a stereo system.

For the test run in the class two students were necessary so that one executed and the other helped. The first assumed the supine position, with knees bent, feet flat on the mattress, legs slightly apart and arms extended and in contact with the proximal end of the measuring tape. The second, kneeling, supported the head of colleague and was responsible for counting and error checking. To complete an abdominal push-up it was necessary to

determine if there was a slip of the finger from the proximal end to the distal end of the measurement range. The test was interrupted whenever the performer: (i) Reached the maximum number of repetitions; (ii) Rested between two executions; or (iii) Stopped the movement and / or performed a second repetition incorrectly, i.e. after the first error or failure in carrying out the movement test would be completed. In the upper strength test, the student had to hold the largest number of arms extensions to the sound of a particular cadence. They had to perform arm flexion and extension with no support from any part of the body, so as not to be eliminated. The dynamic test developed in pairs, each pair for an element observes and corrects the position of the other during execution. Then, the student assumes a prone position on the mattress, placing their hands under their shoulders, fingers extended, legs extended, parallel and slightly apart, leaning on tiptoe. The performer should rise from the mattress with the force of their arms to put them in extension, keeping their back and legs aligned (board). The body should form a straight line from head to toe throughout the test. Then, the performer must flex the arms to the elbows to form a 90 ° angle and the arms are parallel to the ground. To complete an arm extension it was necessary to determine if the student was bending the arms at a 90 ° angle and keeping the plank position. The test was stopped when the thrower (i) reached the maximum number of repetitions; (ii) resting between two executions; or (iii) stopping the movement and / or performed a second repetition incorrectly, i.e. after the first error or failure in performing the movement the test is terminated. On the trunk extension test, the performer positioned in the prone position, held a maximum length of the trunk, where the distance between their chin and the ground was measured, with the neutral position of the head. The trunk extension test was performed with the performer positioned in the prone position, with legs extended, hands

placed under the thighs and the head fixed on an imaginary point. On the evaluator's signal, he performed a maximum length of the trunk, with measurements of the distance between the chin of the performer and the ground (neutral position of the head). The elevated position of the trunk should be maintained for several seconds to provide the reading of the result. They were allowed two attempts and the best result was registered. This test required the use of a slit 50 cm long, a mattress and a record for recording the results. Body mass index was measured by recording the height and weight of students. The height in cm was determined with a SECA 220 stadiometer in a standing position with feet together and barefoot, arms extended along the trunk, with eyes directed forward, with the ear on the shoulder alignment and the back of the body in contact with the ruler. As for the weight, students were also barefoot and with light clothing, and with the measurement being taken from the scales as mentioned above. These measurements had to be carefully considered, to choose a time when students had not just finished lunch or ingested large amounts of water before (Fragoso and Vieira, 2000). The BMI of overweight and obesity were based on the reference values of International Obesity Task Force (IOTF, Pediatric Obesity, 2012), by gender and age.

**Statistical analysis**

Data analysis was performed using SPSS (Statistical Package for the Social Sciences, version 21.0 for Windows) aided a database of values collected in Microsoft Office Excel. Initially we characterized our sample using frequency tables according to grade, gender and residence context. Later we found the data normality using the Kolmogorov-Smirnov or the Shapiro-Wilk test when the sample was higher or lower than 30 subjects respectively. The tests that followed a normal distribution were submitted to

inferential analysis to identify differences on the average values, using parametric and nonparametric techniques in accordance with the prior confirmation of normal distribution of data - T-test for independent samples and the Mann-Whitney test, respectively. We considered significant differences exist when the $p < .05$.

Table II - Presentation of the mean values, standard deviation and P value of physical fitness tests depending on the residence for females between 5th and 9th grade.

| Test | Education Grade | Urban mean | Rural mean | P Value | Standard deviation Urban / Standard deviation Rural |
|---|---|---|---|---|---|
| BMI | 5th and 6th grade | 19:20 | 17.74 | .900 | 4.12 / 2.73 |
| | 7th to 9th grade | 19.95 | 21:55 | .148 | 2.84 / 4:00 |
| Upper strength | 5th and 6th grade | 10:50 | 8:00 | .167 | 6.71 / 05.06 |
| | 7th to 9th grade | 22:35 | 24.41 | .182 | 24.12 / 23:40 |
| Middle strength | 5th and 6th grade | 24.96 | 18.70 | **.045** | 12:41 / 17:00 |
| | 7th to 9th grade | 27.25 | 28.41 | .870 | 25.10 / 26.52 |
| Trunk extension | 5th and 6th grade | 21.96 | 24.75 | **.030** | 4:29 / 4:18 |
| | 7th to 9th grade | 29.80 | 27.31 | **.012** | 4.88 / 5.86 |
| Sit and reach left. | 5th and 6th grade | 24.36 | 24:20 | .932 | 6:38 / 6:07 |
| | 7th to 9th grade | 26.63 | 25.24 | .273 | 5.92 / 8.17 |
| Sit and reach right. | 5th and 6th grade | 24.21 | 25.15 | .506 | 6.95 / 5.86 |
| | 7th to 9th grade | 25.43 | 25.38 | .850 | 6:01 / 7.74 |
| Shuttle-run | 5th and 6th grade | 24.93 | 22.85 | .555 | 12.92 / 10:39 |
| | 7th to 9th grade | 32.75 | 36.21 | .885 | 9.63 / 17.70 |

**Results**

The collected data were studied and grouped according to the grade and gender of the sample participants, depending on their residence (urban or rural environment) and the values obtained in the shuttle-run tests, upper strength, middle strength, sit and reach, trunk extension and body mass index.

Presented in Table II are the average values of physical fitness and BMI tests depending on the residence of female gender from 5$^{th}$ to 9$^{th}$ grade.

With regards to students of 5$^{th}$ and 6$^{th}$ grade we found that in the results of physical fitness tests, there were no significant differences between students with urban and rural residence, except for trunk extension test with a P value = .030 and middle strength with a value of P = .045. Trunk extension test in students with rural residence obtained better results, namely 24.75, compared to 21.96 recorded by students with urban residence. As for the mean strength test, the students with urban residence had an average of 24.96 higher than the average of the students with rural residence was 18.70. In the group of students from 7$^{th}$ to 9$^{th}$ grade, in general, there are no significant differences in the results of the physical fitness tests analysed, except for the trunk extension test that shows us a value of P = .012. The students with urban residence had an average of 29.80 which is higher than the average of 27.31 of students with rural residence.

Table III. Presentation of mean values, standard deviation and P value of physical fitness tests depending on the residence for male gender.

| Test | Education Grade | Urban mean | Rural mean | P Value | Standard deviation Urban / Standard deviation Rural |
|---|---|---|---|---|---|
| BMI | 5th and 6th | 21:27 | 17.84 | .075 | 5.84 / 2.95 |

| | | | | | |
|---|---|---|---|---|---|
| | grade | | | | |
| | 7th to 9th grade | 20:55 | 20:03 | .996 | 4.23 / 3.57 |
| Upper strength | 5th and 6th grade | 11:32 | 9:50 | .442 | 5.29 / 7.82 |
| | 7th to 9th grade | 31.07 | 31.82 | .635 | 23:27 / 20.85 |
| Middle strength | 5th and 6th grade | 25.49 | 28.50 | .114 | 17:39 / 15.75 |
| | 7th to 9th grade | 41.33 | 44.26 | 10:00 am | 30.10 / 32.94 |
| Trunk extension | 5th and 6th grade | 23:34 | 23:17 | .373 | 4:49 / 6:17 |
| | 7th to 9th grade | 28.73 | 28.47 | .812 | 5.81 / 6:00 |
| Sit and reach left. | 5th and 6th grade | 21:34 | 21.94 | .636 | 7:05 / 7:47 |
| | 7th to 9th grade | 21:44 | 21:37 | .751 | 8.82 / 7.66 |
| Sit and reach right. | 5th and 6th grade | 21.61 | 22:22 | .665 | 8:02 / 6.90 |
| | 7th to 9th grade | 21:44 | 21:42 | .754 | 9.21 / 7.60 |
| Shuttle-run | 5th and 6th grade | 26.83 | 36.39 | **.039** | 12:46 / 17:39 |
| | 7th to 9th grade | 48.18 | 53.53 | .286 | 06.19 / 26.43 |

Presented in Table III are the mean values of physical fitness and BMI tests depending on the residence of male subjects.

Regarding the 5th and 6th grade we have found no significant differences in physical fitness tests, except for the shuttle-run test that obtained a value of P = .039. In this test students with rural residence registered an average of 36.39 which was higher than the results of students in urban context, being 26.83.

Between 7th and 9th grade we didn´t found no significant differences in all results of physical fitness tests collected.

## Discussion

The objective of this investigation was to compare physical fitness

levels and BMI of urban and rural students in a school in North Interior of Portugal. Essentially this study suggests that children residing in urban and rural areas enjoy the same activity times and physical inactivity, since they show results with not significant differences between them in most of the tests, considering these same results a consequence of active or sedentary lifestyles. In fact, the absence of significant differences in the levels of physical fitness and BMI in most tests among students residing in rural and urban areas seems to agree with the generality of the revised bibliography. The study of Machado-Rodrigues et al. (2012) seek a connection between physical activity, physical inactivity and sedentary behaviors in relation to cardio-respiratory fitness of 362 adolescents (165 males and 197 females), aged between 13 and 16 living in rural and urban areas of central Portugal. The findings of this study point to the trend of urban students of both genders expending less time in sedentary activities than rural students, showing that urban male youth are more active than rural ones during weekends. However, in female gender, urban girls are less active than rural girls during the weekdays. Also, according to the researchers, the rural students of both genders have higher levels of cardio-respiratory fitness than urban. In fact, the time spent by young people in physical or sports activity can be decisive for the results obtained in the physical fitness tests. As mentioned, the research performed by us does not corroborate with the analysis that there is a prevalence of the best results of physical fitness by residents in rural or urban areas, because, in most tests, no significant differences were identified between the two groups. The only differences relate to the prevalence of better results of urban youth in two tests (middle strength in the female of $5^{th}$ and $6^{th}$ grade, and trunk extension in female by $7^{th}$ to $9^{th}$ grade) and better results in rural youth in two other tests (shuttle-run in male of $5^{th}$ and $6^{th}$ grade and trunk extension in female of $5^{th}$ and $6^{th}$

grade), so even in the recorded differences, urban and rural groups are balance (2 test each).

Our results are also divergent from Rodrigues, Bezerra and Scott (2005) study, held in the North coast of Portugal, comparing the physical fitness standards of 1,832 urban and rural boys aged between 7 and 10 years. Data from this study showed that urban and rural youth show a significantly different level of fitness and over age. The only point in common in relation to our study is the existence of differences in specific tests of physical fitness, specifically the shuttle-run test, middle strength and trunk extension. The divergence does not end in the studies mentioned, since the study by Martins and Honório (2013), which consisted of the analysis of the levels of physical fitness and the degree of association in relation to rural and urban areas of children of 1$^{st}$ to 4$^{th}$ grade in the Fundão district, with a sample of 161 students, results point to the existence of significant differences both in terms of BMI, or the results of physical fitness tests with higher values for urban children. However, the study Bathrellou, Lazarou, Panagiotakos and Sidossis (2007), which assessed periods of physical activity and inactivity of 1,140 children in urban and rural areas of Cyprus identify compliance with the data we obtained in the sample of urban and rural students in the Interior North of Portugal. Just as there were no differences between periods of physical activity and inactivity among Cypriot youth from urban and rural areas, our study similarly does not point to the same differences as the results of physical fitness tests because of periods of physical activity and they do not reflect significant differences. It is important to note that our results should not be generalized to the rest of the Portuguese territory, so they should be examined with due reservation. In future researching this theme suggests the inclusion of a socio-economic variable that was not taken into consideration in this study

and that can induce some variability to the data collected. It is important also that the sample was not filtered as the hypothetical differences in physical activity level or as little as the practice of extra-curricular sports activity. Future studies should consider the influence of these parameters because of how they may have influenced the existence of significant differences in the investigations of Martins and Honório (2013), as well as Rodrigues Bezerra and Scott (2005), may also have influenced the lack of significant differences in our study since they were not controlled.

## Conclusions

The registered results allow us to conclude that, significant differences were not observed between the levels of physical fitness and BMI related to the place of residence (rural and urban).

From a practical perspective this study can serve as a document to support this school, as it assists in defining the sports to offer in extracurricular activities at school (schedules, types of activities, etc.), identifying the students who lack these kinds of activities, assessing them in relation to their residence (urban or rural). It is also useful as a tool for promoting political analysis of physical and sports activity in the district of Guarda, as it relates subjects residing in urban and rural areas.

This is a contribution that can be added to the existing literature, which allows in some way to help the researcher analysing the differences in the levels of physical fitness and BMI in children and adolescents in the North Interior of Portugal, according to their homes, urban or rural.

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